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Gazette

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- Classroom notes on presenting mathematics in an elegant way
- Items relevant to mathematics education
- Letters on relevant topical issues
- Information on conferences, particularly those held in Australasia and the region
- Information on recent major mathematical achievements
- Reports on the business and activities of the Society
- Staff changes and visitors in mathematics departments
- News of members of the Australian Mathematical Society

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Deadlines for the *Gazette* are 15 February for No. 1 (March), 15 April for No. 2 (May), 15 June for No. 3 (July), 15 August for No. 4 (September), and 15 October for No. 5 (November).

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Editorial

Sid and I welcome you to another issue of the Gazette.

The International Congress of Mathematicians, normally one of the world's largest gatherings of mathematicians, has recently concluded. The congress is organised every four years by the International Mathematical Union, and is preceded by the IMU General Assembly. The ICM usually opens with the presentations of the Fields Medals and the Abacus Medal (a continuation of the Rolf Nevanlinna Prize). This year the Congress had to be held online, but in case you missed it, all lectures are now available at https://opade.digital/.

However the General Assembly, the Medal awards ceremony, and subsequent lectures by the medallists, took place in person in Helsinki early in July. The Society's president Ole Warnaar was present at these events and reports in detail in his column. Three of the four Fields Medallists received their awards for proving famous conjectures and one for making important steps towards such a proof. Ole invites you to think whether you would like to see famous conjectures proved, or whether a counterexample would be more interesting. Sometimes a counterexample turns out not to be an isolated oddity, but the door to a whole new topic. He mentions the Australian connections of Fields Medallist Hugo Duminil-Copin. Not only was he a joint winner of the Society's Gavin Brown Prize in 2018, but a significant part of his work concerns the q-state Potts model, introduced by Ren Potts, who was Professor of Applied Mathematics at the University of Adelaide for many years. Ole also remarks on the lack of diversity in the IMU's Executive Committee, with the current EC having only one woman among its members, our own Nalini Joshi, who will at least be joined by three others on the 2023-2026 EC. However no candidates from China or India were elected to the new EC, although there was one representative from each in the outgoing committee.

Catherine Greenhill in the column from WIMSIG reports on several events which took place on International Women in Mathematics Day, 12 May. She also reports on the Australian team's success at the 2022 European Girls Mathematical Olympiad, finishing third out of 57 countries participating. This is in stark contrast with the mathematics situation in Australian schools, where participation rates in year 12 mathematics subjects continue to decline. This is exposed in more detail by Maaike Wienk and Tim Marchant in the column from AMSI. Their report makes sobering reading.

We congratulate Warren Ewens on becoming an Officer of the Order of Australia in the recent Queen's Birthday Honours.

We have obituaries of three Australian mathematicians who have recently passed away, John Coates, Roger Hosking and Barry Thornton.

Just as this issue was going to press, we received the sad news of the passing of Lynn Batten of Deakin University.

Katherine A. Seaton brings our attention to the special session *Visualisation and Mathematical Art*, which will also include an exhibition, at the AustMS meeting

to held at UNSW in Sydney in December. Let us also draw your attention to the *CARMA/MATRIX Mathematical Art Competition*, whose winners will be announced at AustMS2022; further details are in the News Section.

The News contains as usual information about other conferences, PhD completions, awards of various sorts and staff changes. With the borders now open again, we are finally able reinstate the Visitors list.

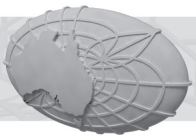
Deborah Jackson in the AustMS News encourages applications for Lift-off Fellowships and Walter and Lyn Bloom Travelling Fellowships, and announces the creation of the Rodney Baxter Prize.

A new development for the Gazette is the listing of the tables of contents from the Society's research journals, the Bulletin of the AustMS, the Journal of the AustMS and the ANZIAM Journal. The listings begin with this issue, and will be a regular feature.

This issue also contains the second of our new column Fun With Numbers by Geoffrey Campbell, and the longstanding Puzzles by Peter Higgins.

David Yost, Centre for Informatics and Applied Optimisation, Federation University Australia, Ballarat, VIC 3353. Email: d.yost@federation.edu.au

David Yost has lived in eight countries and ten cities. This has included working full-time at La Trobe University, the Australian National University, the Free University of Berlin, the University of Extremadura, King Saud University, and the University of Ballarat/Federation University. He has been the recipient of a Queen Elizabeth II Fellowship, a Humboldt Fellowship and the Lester R Ford Award. His leadership roles included Deputy Head of School for three years, Acting Director of the Centre for Informatics and Applied Optimization at FedUni for two years, and one time Director of the AustMS Annual Meeting. Most of his research has been in Banach spaces, but in recent years he has focussed on combinatorial geometry. He has also dabbled in C*-algebras, approximation theory, finite dimensional convexity, and optimisation.



President's Column

Ole Warnaar*

I have just finished reading Ian McEwan's *Machines Like Me*, set in an alternative version of the UK in the 1980s, in which Alan Turing (who is still alive and has become Sir Alan Turing) has resolved P versus NP in the affirmative, with far-reaching implications, including for machine learning and artificial intelligence. After meeting Turing, the main protagonist, Charlie, tries to understand P versus NP (now P = NP) with rather limited success. He does however share with the reader the amusing although undoubtedly incorrect conclusion that "if the equation was shown not to be true, that would be extremely useful, for then everyone could stop thinking about it". I was thinking about this, and more generally our attitudes towards the disproving of famous conjectures or the answering open problems in the negative, while attending the Fields Medal award ceremony in Helsinki on the 5th of July. All four Fields Medalists have done spectacular work by either proving famous conjectures (such as June Huh's proof of the Heron–Rota–Welsh conjecture for matroids, the proof by Maryna Viazovska that the E_8 root lattice achieves the optimal sphere packing density in $\mathbb{R}_8$, or Hugo Duminil-Copin's rigorous confirmation of the long-held belief that the Ising model in three dimensions exhibits a continuous phase transition) or by making important steps towards the proof of famous conjectures (such as James Maynard's work towards a proof of the twin prime conjecture). Would the IMU's Fields Medal Committee and the mathematics community more broadly have been equally excited if these four famous open problems had all been disproved? Apart from P versus NP — the majority of experts expect that P $\neq$ NP, although the only real consensus seems to be that Alan Turing will not be the one to settle the problem — all other six Millennium Problems are phrased in such a way that it is clear the Clay Mathematics Institute is hoping (if not explicitly asking) for positive solutions. This is of course exactly what they got in the case of the Poincaré conjecture. Are we as mathematicians perhaps too conservative, preferring to have our mathematical world-view and beliefs confirmed rather than upended? Do we perhaps need more Cantors, Gödels and Brouwers? Some thirty years ago, while still a PhD student, I read Imre Lakatos' *Proofs and Refutations; The Logic of Mathematical Discovery*. I still rate this the most impressive and eye-opening book on the philosophy of mathematics I have ever read. At the time it convinced me that flawed reasoning, false conjectures or incomplete proofs, and especially the exposure thereof, could be as valuable and insightful as watertight arguments, valid conjectures or rigorous proofs. But looking back on my own past thirty years in mathematics and my attitudes towards it, I must admit that I too prefer to see conjectures confirmed, and I probably would be disappointed if tomorrow someone (other than perhaps me) would produce a counterexample to the Riemann Hypothesis. Why exactly is this?

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I certainly was not disappointed by the awarding of the Fields Medals to Duminil-Copin, Huh, Maynard and Viazovska. They all are very deserving, and in the case of Hugo Duminil-Copin, there are strong Australian connections in the awarded work. In 2018 Duminil-Copin was joint winner of the Gavin Brown Prize of the AustMS. Moreover, as beautifully described by Martin Hairer in the Laudatio, see https://www.mathunion.org/imu-awards/fields-medal/fields-medals-2022, among Duminil-Copin's breakthroughs is his work on the q-state Potts model, based on earlier conjectures as well as results by Rodney Baxter. I already mentioned Rodney's many influential contributions to statistical mechanics and mathematical physics in my previous Gazette column. Perhaps fewer Gazette readers will be aware of the work of Renfrey (Ren) Potts, who held the position of Chair of Applied Mathematics at the University of Adelaide between 1959 and 1990, and was awarded the 1995 ANZIAM Medal. The q-state Potts model, introduced by Potts in his 1951 PhD thesis, is a model generalising the above-mentioned Ising model which corresponding to $q = 2$. Like the Ising model, the Potts model has become one of the most important and well-studied models in statistical mechanics, worthy of a 2022 Fields Medal. I encourage you all to read all four Laudatios as well as the excellent "popular scientific expositions" of the works of the Fields Medalists by Andrei Okounkov. The IMU has also produced four short video presentations of the Fields Medalists, which were shown during the award ceremony. All four videos are extremely interesting and surprisingly personal. Please do watch them, they are highly inspirational.

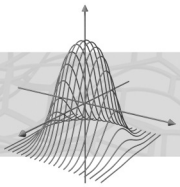
In the two days prior the awards ceremony, Amnon Neeman (ANU), Jacqui Rammage (Durham University), Regina Burachik (UniSA) and I were part of the Australian delegation attending the 19th General Assembly (GA) of the IMU. Some of the most important decisions made at the GA were the election of a new IMU Executive Committee (EC), the awarding of a US bid to hold the 2026 ICM in Philadelphia, and the establishment of an emergency fund to support the IMU membership of countries that find themselves unable to pay their dues due to temporary, extreme conditions.

The IMU's EC consists of 10 elected members, the President, the Secretary General, two Vice-Presidents and 6 Members-at-Large. This is complemented by the Ex-Officio Past President and an EC-appointed Treasurer. The 2019–2022 EC has only one(!) woman among its members, our own Nalini Joshi, who is one of the current Vice-Presidents. This embarrassing situation — there were female candidates in 2018 other than Nalini — led the EC to the extraordinary step of inviting female observers to their meetings in the past four years. Fortunately, this time round the outcome of the election was much more balanced, at least on the gender front. Four women were elected, which includes the re-election of Nalini Joshi, who will serve an additional four years as an EC member-at-large. Incidentally, Nalini received the highest number of votes among the candidates, a clear acknowledgement of her excellent work for the IMU to date. Congratulations Nalini. No candidates from China and India were successful in the elections, including for positions on the Commission for Developing Countries and the Joint International Commission on the History of Mathematics. The lack of representation from the two most populous nations on earth is once again concerning.

The GA was also asked to vote in favour of the US bid to have the 2026 ICM held in Philadelphia. Given there were no alternative candidates, the decision was a relatively simple one despite concerns about possible visa issues (eight countries are currently blacklisted for travel to the US), a multi-million dollar hole in the proposed budget despite very generous support from the Simons Foundation, and the non-negotiable of holding the next General Assembly at Times Square in New York instead of a much cheaper location in Philadelphia. The IMU will probably have to rethink the way the ICM is run and financed in the coming years, or it will risk running out of prospective host countries.
On the second day of the GA, a delegate from Ukraine requested the waiving of Ukraine's membership fees for the coming year. In a great show of solidarity, a number of mathematical societies immediately offered to pay Ukraine's dues, but after a fair amount of discussion, the IMU instead proposed the creation of an emergency fund to assist adhering organisations experiencing extreme but temporary hardship, whether it be through war, natural disasters or otherwise. The GA unanimously supported a resolution to this affect and also decided that Ukraine's dues would be covered through this fund. I am pleased to let you know that the Council of the AustMS has just voted in favour of a resolution to make a donation into this fund.

To conclude my column, many of us will have once again been asked by the ARC to act as assessor for ARC Discovery Projects. It is timely to remind you all that when acting as assessor of proposals or as referee of papers to be critical but fair, to be mindful of ROPE, and to always strike a respectful tone when writing reports.

Ole Warnaar is Chair and Professor of Pure Mathematics at the University of Queensland. His research interests include algebraic combinatorics, number theory and the theory of special functions. He currently serves on the MATRIX advisory board, AMSI scientific board and is the chair of the organising committee of the Simon Marais Mathematics Competition. Ole is a Fellow of the Australian Academy of Sciences, Fellow of the Australian Mathematical Society, and joint recipient of the 2020 George Szekeres Medal. In his spare time he coaches judo and enjoys rock climbing, running, hiking, reading and art house movies.



Puzzle Corner

Peter M. Higgins*

Welcome to Puzzle Corner 73 of the Gazette of the Australian Mathematical Society. In this first section I shall introduce the "Chances of Singularity". After that Alex Bishop and I present a solution to Puzzle Corner 72 "Snow and the Golden Ratio". I would be happy to receive your solution to Puzzle Corner 73 not later than August 31, 2022. The email address for solutions is austmspuzzles@gmail.com. Any particularly interesting solutions received before the deadline will be mentioned in the next Puzzle Corner or, if size warrants, included in the section "Addendum to Puzzle Corner" which is edited by Alex Bishop and me.

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Chances of Singularity

This problem pair arises from considering an $n \times n$ binary matrix, A over the field of two elements (so that $1 + 1 = 0$). As with any square matrix over a field, A may or may not be singular. However, in contrast to matrices over the standard infinite fields of $\mathbb{R}$ or $\mathbb{C}$, there are only finitely many matrices to worry about, so the exact proportion of singular matrices can be determined. So let's do that.

Problem 1. What is the probability p_n that a randomly chosen $n \times n$ matrix A over the field $\mathbb{F}_2$ is singular?

And of course we are then obliged to ask how this number behaves for large n.

Problem 2. Show that the limit as $n \to \infty$ of p_n exists and is a positive number strictly less than 1.

Solution to Snow and the Golden Ratio

Prepared by Alex Bishop and Peter Higgins

Problem. Steady snowfall began during the morning. At noon, the snow plough set out, clearing two miles of road in the first hour, and one mile in the second. When did it start snowing?

There may look to be insufficient information to answer but there is, provided we accept one implicit assumption: the speed of the plough is inversely proportional to the depth of snow on the highway.

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In response to this problem, we received correct solutions from Hyunbin Yoo from South Korea, and Graham R. Baird. Although their solutions use the same techniques, their approaches to this problem are slightly different. In particular, Yoo writes that the snow starts at time $t = 0$, and computes the time $t_1 > 0$ which corresponds to noon; while Baird instead writes that time $t = 0$ corresponds to noon and reduces the problem to finding the vertical asymptote of a particular hyperbolic curve. We provide an edited version of their solutions as follows.

In order to combine these two responses, we write t_0 for the time the snow started, and t_1 for the time corresponding to noon. For Yoo's solution, we have $t_0 = 0$; and, for Baird's solution, we have $t_1 = 0$. In the following, we measure time in hours. We write $v(t)$ and $h(t)$ for the speed of the plough in miles per hour, and the depth of the snow in front of the plough, respectively, at time t.

Baird and Yoo both began by noting that since the snowfall is steady, then the depth of the snow in front of the plough at time t is given by $h(t) = a(t - t_0)$ for some constant $a > 0$. Moreover, since the speed of the plough is inversely proportional to the depth of the snow, we see that $v(t) = b/h(t)$ for some constant $b > 0$. That is, $v(t) = c/(t - t_0)$ for some constant $c > 0$.

Recall that the plough cleared 2 miles of snow in the first hour, and 1 mile of snow in the second hour. From this, Yoo and Baird noted that

$$\int_{t_1}^{t_1+1} v(t)\,dt = 2 \qquad \text{and} \qquad \int_{t_1+1}^{t_1+2} v(t)\,dt = 1$$

and thus

$$\int_{t_1}^{t_1+1} \frac{c}{t-t_0}\,dt = 2\int_{t_1+1}^{t_1+2} \frac{c}{t-t_0}\,dt. \tag{1}$$

We describe the remaining parts of Yoo and Baird's methods separately as follows.

Yoo solved the problem by setting $t_0 = 0$, evaluating the integrals in (1) and solving for $t_1 > 0$ which then corresponds to the number of hours before noon at which the snow started. In particular, after setting $t_0 = 0$ and evaluating (1) we obtain

$$c\ln(t_1+1) - c\ln(t_1) = 2(c\ln(t_1+2) - c\ln(t_1+1)).$$

After some simplification, we then find that

$$\ln\left(\frac{t_1+1}{t_1}\right) = \ln\left(\left(\frac{t_1+2}{t_1+1}\right)^2\right),$$

and thus, $t_1^2 + t_1 - 1 = 0$. From the quadratic equation, we then find that

$$t_1 = \frac{-1 \pm \sqrt{5}}{2}.$$

Since t_1 must be positive, we see that the snow started $(\sqrt{5}-1)/2 = 1/\varphi$ hours before noon, which is approximately at 11:23 am (to the nearest minute).

Baird instead set $t_1 = 0$ to obtain

$$\int_0^1 \frac{c}{t-t_0}\,dt = 2\int_1^2 \frac{c}{t-t_0}\,dt. \tag{2}$$

We then see that $y(t) = c/(t-t_0)$ is a hyperbola. Baird then had a more geometric view of the problem. In particular, recall that the hyperbola $y(t) = c/(t-t_0)$ has a vertical asymptote given by $t = t_0$. We may then find this asymptote by solving equation (2) for t_0. In particular, we may evaluate the integrals in (2) and perform some simplifications (similar to Yoo's method) to obtain

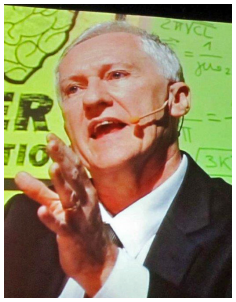
$$\ln\left(\frac{1-t_0}{-t_0}\right) = \ln\left(\left(\frac{2-t_0}{1-t_0}\right)^2\right).$$

Thus, we see that $t_0^2 - t_0 - 1 = 0$. From the quadratic formula, we find that

$$t_0 = \frac{1 \pm \sqrt{5}}{2}.$$

Since t_0 occurs before $t_1 = 0$, we have $t_0 = (1-\sqrt{5})/2$. Again, we find that the snow started $t_1 - t_0 = (\sqrt{5}-1)/2 = 1/\varphi$ hours before noon.

Alex Bishop is a research associate at the University of Sydney. Alex's research interests lie in geometric group theory and its intersection with formal language theory.



Peter Higgins is a Professor of Mathematics at the University of Essex. He is the inventor of Circular Sudoku, a puzzle type that has featured in many newspapers, magazines, books, and computer games all over the world. He has written extensively on the subject of mathematics and won the 2013 Premio Peano Prize in Turin for the best book published about mathematics in Italian in 2012. Originally from Australia, Peter has lived in Colchester, England with his wife and four children since 1990.

Consecutive 6th powers and base 6 numbers

Geoffrey B Campbell*

Abstract

We give a surprising identity for a sum of three consecutive sixth powers represented by a sum of base 6 numbers.

Long ago, number theory seemed to involve many equalities for sums of squares, or cubes or biquadrates. Less common were sums of fifth or higher powers. However, today, the higher power results can be immediately verified on websites and apps. So, here is a set of solutions for an *exponential Diophantine equation* $(a-1)^6 - a^6 + (a+1)^6 = 6^b + 6^c - 6^d + 6^e - 6^f + 2$ for positive integers a, b, c, d, e, f, that would probably not have arisen in the days of Fermat, or Euler.

$$\begin{aligned}
5^6 - 6^6 + 7^6 &= 6^6 + 6^6 - 6^5 + 6^4 - 6^3 + 2,\\
35^6 - 36^6 + 37^6 &= 6^{12} + 6^{10} - 6^9 + 6^6 - 6^5 + 2,\\
215^6 - 216^6 + 217^6 &= 6^{18} + 6^{14} - 6^{13} + 6^8 - 6^7 + 2,\\
1295^6 - 1296^6 + 1297^6 &= 6^{24} + 6^{18} - 6^{17} + 6^{10} - 6^9 + 2,\\
7775^6 - 7776^6 + 7777^6 &= 6^{30} + 6^{22} - 6^{21} + 6^{12} - 6^{11} + 2,\\
46655^6 - 46656^6 + 46657^6 &= 6^{36} + 6^{26} - 6^{25} + 6^{14} - 6^{13} + 2,\\
279935^6 - 279936^6 + 279937^6 &= 6^{42} + 6^{30} - 6^{29} + 6^{16} - 6^{15} + 2,\\
1679615^6 - 1679616^6 + 1679617^6 &= 6^{48} + 6^{34} - 6^{33} + 6^{18} - 6^{17} + 2,\\
10077695^6 - 10077696^6 + 10077697^6 &= 6^{54} + 6^{38} - 6^{37} + 6^{20} - 6^{19} + 2,\\
60466175^6 - 60466176^6 + 60466177^6 &= 6^{60} + 6^{42} - 6^{41} + 6^{22} - 6^{21} + 2,\\
362797055^6 - 362797056^6 + 362797057^6 &= 6^{66} + 6^{46} - 6^{45} + 6^{24} - 6^{23} + 2,\\
2176782335^6 - 2176782336^6 + 2176782337^6 &= 6^{72} + 6^{50} - 6^{49} + 6^{26} - 6^{25} + 2,
\end{aligned}$$

and so on. These results do not seem to be in the literature. The above equations are cases $n = 1, 2, 3, \ldots 12$ of the following identity.

$$(6^n - 1)^6 - (6^n + 0)^6 + (6^n + 1)^6 = 6^{6n} + 6^{4n+2} - 6^{4n+1} + 6^{2n+2} - 6^{2n+1} + 2.$$

We point out that the statement highlights 6th powers of three consecutive integers, but that the negative of the middle term left side is same as left most term on the right side. The number 6^{72}, featuring in the last example case above, is a number with 57 decimal digits. Nonetheless, a fun observation about numbers, with some deeper meaning not seen in current mathematical theories.

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Geoffrey Campbell completed his PhD at Australian National University in 1998 under Rodney Baxter and has enjoyed continued affiliation with the ANU Mathematics Department for 30 years. He also served as a Visitor with LaTrobe University Mathematics and Statistics Department for 8 years. His career has included various Commonwealth and State government contract roles, including at Department of Prime Minister and Cabinet; and at a Royal Commission. Geoffrey is writing a text/ monograph on Vector Partitions for Chapman and Hall Publishers, and is also a published poet in Australia.

Queen's Birthday Honours 2021

One Mathematical Scientist became an Officer (AO) in the General Division of the Order of Australia, in the Queen's Birthday Honours list last month. Our congratulations to

Emeritus Professor Warren John EWENS FRS FAA
(University of Pennsylvania)

For distinguished service to biology and data science, to research, and to tertiary education.

Warren Ewens has a long and distinguished career in computational biology and evolutionary population genetics. After tertiary education at the University of Melbourne and the Australian National University, he was Foundation Chair and Professor of Mathematics at La Trobe University, and then Chair of the Department of Mathematics and Statistics at Monash University for many years. He has also served as President of the Victorian branch of the Statistical Society of Australia. He was awarded the Statistical Society's E.J. Pitman Medal in 1996. He became a Fellow of the Australian Academy of Science in 1981 and a Fellow of the Royal Society in 1999. He has been Professor of Biology in Pennsylvania since 1997.

Visualisation and Mathematical Art at the AustMS meeting

Katherine A. Seaton*

Abstract

At the 2021 AustMS meeting, *Visualisation and Mathematical Art* joined the already extensive list of Special Sessions. This short note serves to put this initiative in context, and invites readers to consider what they might contribute to, or gain from, future such sessions. In particular, an exhibition of mathematical art is envisaged for the 2022 meeting; this will require both practical and artistic labour if it is to be a success.

Introduction

The 2021 AustMS Meeting hosted by the University of Newcastle included a new Special Session *Visualisation and Mathematical Art*, organised by Matt Skerritt (RMIT, UoN CARMA alumnus) and Katherine Seaton (La Trobe) with support from Judy-anne Osborn (UoN).

Conversations among Australians interested in a mathematical art event, motivated by what we could see happening internationally, had been going on informally for a number of years. Some of us had participated in Bridges, an international conference for mathematics and art. Others had published in the Journal of Mathematics and the Arts. An exhibition of mathematical art is a feature of the Joint Mathematics Meetings in the US. In 2020, a satellite (online) symposium to the meeting of the German Mathematical Society was held: *Mathematik und Kunst*.

Thus the 2021 Special Session was both a culmination to these conversations, and a first step. Perhaps this extract from the email sent to announce this venture says it best:

> We'd like to draw your attention to this new Special Session ... and encourage you to contribute. We know there are lots of people creating mathematical art and using visualisation in their mathematical work in Australia ... In the longer term we are hoping to create a forum to share such work and to build a base from which future ventures could grow, such as a regular art exhibition at the AustMS meeting (as happens in the US), or a dedicated conference or workshop down the track, and we will set aside some time in the session to discuss these possibilities.

The Session description used in the conference call for talks was:

> Visualisations of mathematical ideas can be both instructive and attractive. In this session, speakers are invited to explain how a picture

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> or physical object of their own original construction assists the viewer to visualise a mathematical concept and/or to describe aesthetic decisions they made as creator. This session will potentially traverse many areas of mathematics, and we invite a range of visualisations (e.g. digital, painting, sculpture, fibre arts).

What is meant by 'mathematical art'?

To comprehensively define what mathematical art might be is beyond the scope of a short note. Is it using mathematics to create artwork, or making artwork to explain mathematics?[2] It is both, and many things in between. It has a long history, and it's fresh and evolving; it could be the analysis of ancient cultural works using modern mathematics, or long-standing mathematical ideas interpreted in new media. It might be created with the tools of mathematician – a compass and straight edge, or computer software (see Figure 1). Or it could be sculpted from metal or clay, painted on or printed on or drawn on or folded from paper, or woven or knitted or knotted.

The reader who would like to investigate this question further may find the Opinion Piece of Frank Farris [4], the various accounts of recent Bridges conferences [5, 6, 7], or the *Journal of Mathematics and the Arts* to be good starting places. From the German symposia comes this piece [3], which suggests and illustrates a variety of ways in which mathematics and art may interact creatively. To view images of some wonderful works of mathematical art, the galleries of the Bridges conferences and the JMM meetings can be found at the same website [1].

The 2021 Session

The Session comprised one keynote address and eight contributed talks. Many more than nine people, however, attended talks in the Session.

The keynote was given by Daniel Mansfield, on identifying geometry on archaeological clay tablets from Ancient Mesopotamia, work that had been featured in the media. The contributed talks included three on mathematical fibre or textile arts, one by a PhD student on glorious visualisations arising in her work using Newton's Method, and one on mathematical origami design. Karen Amanda Harris (a UK-based mathematical artist) joined us very late in the evening her time to tell us about her non-digital mathematical art; she also had a lot of wisdom to share about writing artist statements that tell the story of what the work is about. The remaining two talks took the theme of visualisation: visualisation in proofs and visualisation (of bijections) in mathematical outreach. The session speakers and abstracts for the talks can be found in the Conference Booklet (https://carmamaths.org/florianbreuer/AustMS21-booklet.pdf).

Because the conference was being hosted by UoN, it seemed like a great chance to experience some art pieces that had been submitted to the second CARMA Maths Art/Poster competition over morning tea on the final day of the conference. You can view them, too, at the CARMA Maths Art/Poster gallery (https://

Figure 1. *Singular wave* by Peter van der Kamp. Artist's statement: "Depicted are three curves of an infinite family of cubic curves all going through the same three points. The singular wave is special because it visits one of those points twice. In *Singular wave* something catastrophic is about to happen; a violet blob launches itself into an orange sky."

carmamaths.org/art/gallery/competition/). Judy-anne Osborn gave beautiful commentary on each piece before announcing the virtual awards.

The final time-slot was used for an open discussion to gauge enthusiasm for future sessions along these lines, and for exhibition.

Going forward

Participants were definitely in favour of having a similar Special Session at the 2022 AustMS meeting. Some who had just listened at this meeting were keen to speak in future.

Moreover, there was enthusiasm for an exhibition of 2D and 3D mathematical art in conjunction with the next meeting. (Poetry, music, dance and performance art might have to wait a year or so!) This is seen both as contributing to the conference

itself for attendees, but also as a possible outreach event, to raise the profile and broaden understanding of what maths is.

Organising a Special Session of talks on mathematical art is, as we found in 2021, very similar to organising any other Special Session. To hold an exhibition, on the other hand, requires more work and longer planning.

Potential exhibitors need time to create their works. For this reason, advance announcements were made in Twitter a short while ago, and now by way of this article. N.B. The logistics of getting artwork to and from the exhibition venue is something to consider, as this may constrain size or materials used.

We (Katherine Seaton, Matt Skerritt and Julia Collins) are hoping that there may be people willing to volunteer to help with the practical organisational aspects of holding such an exhibition, whether or not you wish to create and show a piece of your own mathematical art. We fear that without a few more volunteers (preferably some on the ground in Sydney) this may not be possible.

Acknowledgements

Thanks to Peter van der Kamp for permitting reproduction of his digital work *Singular wave* to enhance this note. More of his work can be viewed at https://wiskun.de/mathematical-art. Also to Matt Skerritt and Judy-anne Osborn, partners in planning and execution of this first step, and to Julia Collins for joining us for the second.

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John Henry Coates, FRS

1945–2022

Coates, John H.
Occasion: Pro-p Extensions of Global Fields and pro-p Groups. Location: Oberwolfach.
Author: Schmid, Renate. Year: 2006. Copyright: MFO.
Photo: Archives of the Mathematisches Forschungsinstitut Oberwolfach.
https://owpdb.mfo.de/detail?photo_id=7985

In early May, the Australian mathematics community received the sad news of the passing of one of its most beloved sons, John Coates. He was a legendary figure in the study of elliptic curves, a pioneer in the field of arithmetic geometry, and a father figure to many number theorists around the globe. Despite spending the majority of his career in Europe (particularly the United Kingdom), he remained a passionate supporter of Australian mathematicians, and the departments they worked in, during some turbulent periods.

John was born on the 26th of January 1945, and grew up in outback New South Wales on the family farm at Possum Brush. His secondary school education was at Taree High School, where he developed a keen interest in the mathematical sciences. Family circumstances were tough, with his mother Beryl having died when John was aged just seven years old, and his father John Snr. suffering from periods of poor health. In order to finance his university studies, he went to work at B.H.P. in Newcastle with the hope of obtaining a scholarship from the company, although this did not work out. However he did manage to obtain a scholarship from the A.N.U. and he commenced his BSc degree, with an intention of pursuing physics as a major.

It was during his undergraduate studies that John attended a course on elementary number theory given by Kurt Mahler, who had been appointed to the faculty in Canberra in 1963. Mahler's course left a profound impression on John, who switched his focus squarely from physics to pure mathematics, and worked together with Mahler on his Honours project. It was also during this period that he met a young politics student, Julie Turner, and they later married in 1966. They were together for the next fifty-six years, and had three sons.

At the urging of his mentors at A.N.U., John was encouraged to travel to Paris and start his doctorate at l'École Normale Supérieure. Coates' studies at the E.N.S. were firmly influenced by the school of Grothendieck and his contemporaries, with an emphasis on total abstraction that was perhaps not to John's own personal tastes. Growing gradually less enamoured with this approach, John switched his PhD program to work with (future) Fields Medallist Alan Baker at Trinity College in Cambridge. During these three years, Coates produced a brilliant thesis concerning p-adic analogues of Baker's method for linear forms in logarithms (itself a generalisation of the Gelfond-Schneider theorem).

In 1969 John moved to the United States to take up firstly an assistant professorship at Harvard University, followed three years later by an associate professorship at Stanford. During this time, and following ideas of John Tate, he collaborated with Sinnott and Lichtenbaum to undertake a detailed study of the special values of zeta-functions, relating them to annihilators of K-groups (for the rings of integers of number fields). He also became fascinated by Kenkichi Iwasawa's recent theory of $\mathbb{Z}_p$-extensions: this is a technique used to study the arithmetic of number fields by focussing on a particular prime number p, and then considering towers of these fields which are 'dominated' by p (in a suitable sense) but no other primes. One then establishes some general statement holds true atop this infinite tower, and then descending the tower carefully, as if by magic one obtains a theorem over the original number field.

Returning to Cambridge in 1975 as a lecturer in pure mathematics and a fellow of Emmanuel College, John embarked upon the work for which he is arguably best known. Together with his new research student, Andrew Wiles, they applied ideas from Iwasawa's theory to study the arithmetic of elliptic curves. In particular, by utilising the deep arithmetic properties of elliptic units, they proved the first concrete theorems in the direction of the Birch and Swinnerton-Dyer Conjecture (one of the seven Millennium Prize problems): they showed that for a special class of elliptic curves (called CM curves), if the zeta-function of the curve does not vanish at its central point then the elliptic curve can have only finitely many rational points. Following John's work with Wiles, Iwasawa theory has become one of the most powerful tools in attacking the BSD conjecture, and is nowdays a large and flourishing area of number theory.

The late 1970s and 1980s saw Coates move universities quite a bit, including being appointed full professor at the A.N.U., followed by a period in France where he was professor at Orsay (Paris XI) for seven years, and then an appointment as director of mathematics at l'École Normale Supérieure. He returned to Cambridge in 1987 where he became Sadleirian Chair of Mathematics until his retirement in 2012, a position occupied previously by only seven mathematicians: Cayley, Forsyth, Hobson, Hardy, Mordell, Philip Hall and Cassels. He was elected a Fellow of the Royal Society in 1985, and served as President of the London Mathematical Society from 1988–1990. He was also Head of Department in the nineties, initiating the move from the creaky old printworks in Mill Lane to the shiny new location up Wilberforce Road.

At the turn of that decade, Coates mentioned to Wiles about the work of his current PhD student, Matthias Flach, on bounding the Selmer group of the symmetric square of an elliptic curve. This built on earlier joint work of John and Claus-Günther Schmidt. In 1993 Coates was one of the organisers of a workshop at the Isaac Newton Institute, where the mathematical world was rocked by a series of three lectures given by Wiles, announcing a proof of Fermat's Last Theorem. Whilst the original proof turned out to have a serious gap, this was subsequently patched by Wiles and his former student Richard Taylor in 1995. Certainly the ideas of Coates, and in particular Flach, were among the crucial ingredients in Wiles' proof of modularity for semistable elliptic curves. Coates was awarded the prestigious Senior Whitehead Prize by the London Mathematical Society in 1997.

The new millennium saw John focus his efforts on further extending his theorems to include various non-commutative situations. He collaborated with many number theorists during the 2000s, notably the gifted Japanese mathematician Kazuya Kato, and the Indian mathematician Sujatha Ramdorai. Indeed their work (joint with Fukaya and Venjakob) led to the formulation of a non-commutative Iwasawa Main Conjecture, which has since inspired much further exciting mathematics. He also had a passionate interest in Japanese culture, and was a keen collector of pottery and antiques from the country. After his retirement in 2012, he travelled to Korea and China a great deal, and was instrumental in fostering the development of algebraic number theory in the far east.

On a personal level, John was a warm and generous human being. He was also a well cultured and highly educated person, with many interests outside of just mathematics. He was deeply loved and respected by his PhD students, of which there have been over thirty-five in number over the years. John was extremely generous with his knowledge and he shared what he knew so freely; this was part of his success as a supervisor and mentor for so many number theorists. At a conference in Cambridge in 2005 to celebrate John's 60th birthday, a couple of his former students had constructed a 'mathematical family tree', details of which can be found at the URL https://www.math.uni-bielefeld.de/documenta/vol-coates/vol-coates-all.pdf and which indicate the wide-reaching support he gave to other people's math careers. John Coates was undoubtedly one of Australia's greatest mathematicians, and his beautiful results (of which there were many) are rightly lauded. Yet somehow his contribution to mathematics transcended mere theorems, and it is his selfless championing of the discipline he adored, throughout the world, which is perhaps his greatest legacy.

The last time I saw John was at a conference in France in 2019, and it was clear that time was gradually catching up with him. He still had that old twinkle in his eye, however, and his mind was as sharp as ever. The last couple of years saw John bravely battling cancer, and apparently he was still attending seminars until right before the end. John Coates passed away peacefully on the 9th of May surrounded by his close family, and it is to them that our thoughts go out at this time.

Daniel Delbourgo
Email: daniel.delbourgo@waikato.ac.nz

Roger John Hosking

Roger John Hosking was born in Port Pirie, South Australia in 1940. At school he was a keen Aussie Rules footballer and cricketer as well as being academically gifted. Following his final school year at Adelaide Boys School, Roger enrolled as an undergraduate student at the University of Adelaide. Roger had intended to take science or engineering as training for a career with BHP, but instead found a passion for mathematics and finished with an honours thesis in plasma physics. On leaving university, and after a short stint at what would become Defence Science and Technology Group, he decided to pursue a PhD overseas and chose a project with John Blackwell at the University of Western Ontario, London, Canada, where his future wife, Jacoba, was offered a teaching position. Roger arrived in Canada in 1961, and married there a year later becoming a father for the first time, a year before submitting his PhD thesis, in 1965.

A postdoctoral position at the Max Planck Institute in Munich, during which the highlights were furthering his interests in plasma physics and meeting the former Director Werner Heisenberg, was cut short when Roger was offered a lectureship in Adelaide at what became Flinders University. Roger adopted the (then) North American style of inviting questions during his mathematics lectures to medical and engineering students. He was an active member of AustMS and a founding member of ANZIAM. He coordinated the first interstate Applied Mathematics Conference (later to be known as the ANZIAM conference) at Halls Gap in 1968 with Bruce Morton of Monash University, and later served the ANZIAM community as the Chairman of the Applied Mathematics Division of AustMS.

Roger's interest in plasma physics led to a collaboration with Bruce Liley and a special research leave arrangement with him at the Australian National University. He then followed Bruce to the University of Waikato, New Zealand, where Roger was appointed as Professor of Mathematics in 1971. He stayed until 1988, during which time he fostered a very talented applied mathematics group, served as the Head of the Mathematics Department and as a member of the Asian Institute of Technology in 1980–81, and conducted study leave at the University of Cambridge

in 1975 and 1984, hosted by John Doherty and George Bachelor. In the later stages of his time at Waikato, he produced trail blazing theoretical research into aircraft landing on floating sea ice. This work resulted in a series of articles in the *Journal of Fluid Mechanics*, and a collaboration with Vernon Squire that started in Cambridge and continued when Squire moved to New Zealand. The culmination of Roger's work in this field is his classic research monograph *Moving Loads on Ice Plates*. This was one of four books Roger wrote during his career, for which all the profits went to charity.

In 1988, Roger moved to James Cook University, Townsville, to develop the research capability of the Department of Mathematics. He enjoyed a successful first decade at JCU, and served as Deputy Chairman and then Chairman of the Academic Board. Sadly, his life was turned upside down in 1998 when his wife, for 36 years, died. In the same year, administrative reorganisation at JCU reduced the academic staff number and activity to mainly service teaching. Roger undertook a research attachment at the University of Hokkaido, sponsored by the Japanese Society for the Promotion of Science and the Australian Academy of Science, and then joined the exodus of professors from JCU by transferring to Universiti Brunei Darussalam as Professor of Mathematics. He served at UBD for eleven years, during which time he re-married, and helped found the *East Asian Journal of Applied Mathematics*, which he edited until 2017.

Roger moved back to Adelaide in 2010 with his family at his parents' former home in Mitcham near to Scotch College where his four sons completed their secondary schooling. He took the position of Adjunct Professor in the School of Mathematical Science "to keep his brain young", where he collaborated with Luke Bennetts and Andrew Metcalfe, and maintained collaborations with Bob Dewar at ANU, with whom he published a fourth book *Fundamentals of Fluid Mechanics and Magnetohydrodynamics* in 2016, and Fausto Milinazzo at Victoria, Canada, with whom he published his final article in the *Journal of Fluid Mechanics* only months before he passed away.

Roger was diagnosed with leukaemia (AML) shortly after returning from a research programme at the Isaac Newton Institute of Mathematical Sciences, Cambridge, in 2018. Given only months to live, Roger showed his courage and determination by surviving for four years during which he continued with research. We remember a valued and generous friend and colleague. Roger is survived by his wife, Juk, and sons, Tony, Derek, James and Mark. As an epitaph to his life, Roger and his family established the Muggs Hill Mathematics Scholarship for indigenous students at Scotch College.

Andrew Metcalfe and Luke Bennetts
University of Adelaide

Barry S. Thornton

1930 to 2021

Barry Stephen Thornton was born in Sydney on 3 May 1930. Barry's schooling at Coogee Bay Public School and Sydney Boys High School was followed by first class honours in physics at Sydney University, a PhD at University of New South Wales, an MSc at Sydney University and years later a DSc from the University of Sydney for his published work.

Barry had a long and distinguished career, beginning in the late 1950s with his long-term link to the use of computers for the benefit of society. He was one of Australia's computing pioneers working on one of the first computers installed in Australia. Uniquely, Barry was happy to work across disciplines in recognition that the solution of many problems requires a transdisciplinary approach. In recognition of his achievements, Barry was inducted into the Pearcey Hall of Fame in 2009. He was an eminent aeronautical engineer, using his diverse skills on modelling flutter in helicopter blades through to modelling the setting of yacht sails under different wind conditions (for an Australian challenge of the America's Cup.

From 1961 to 1963 Barry was the Director of Remington Rand Australia's UNIVAC Division, followed by ten years as Director of Technical Operations at Honeywell Australia. During this time he undertook research and consulting work with Boeing Seattle and the US Air Force (USAF) System Command. This comprised Barry applying his computer methods in the design of wideband radar absorbers on the USAF Stealth aircraft project. In the 1980s, principles from this work initiated Barry to designing fail-safe multifunction airborne computer control systems and jet engine compression innovations. Later, there were applications in breast cancer detection research.

For such work, Barry was awarded a prestigious silver medal by the Royal Aeronautical Society, the first awarded to an Australian.

Establishment of UTS

In 1974, Barry was the inaugural Dean of what was then the Faculty of Mathematics and Computing Sciences at the New South Wales Institute of Technology (NSWIT) which became UTS by an Act of the New South Wales

Parliament. The original Act passed in 1987 and enacted on Australia Day 1988 was a result of the work of Barry, other Deans and Heads of Schools convincing the then Australian Vice-Chancellors' Committee (AVCC) that NSWIT was conducting Teaching and Research at a level expected of a university.

Barry oversaw numerous projects through the Foundation for Australian Resources which he established in 1974 in response to scarce research funding at the time. Projects investigated by the Foundation included research into water pollution in mining, landmine mapping, solar energy planning, and breast cancer. On the latter, for example, Barry had been asked if his prior work on wave absorption could be applied to a breast screening method. A new method for dynamic infrared testing was established, but proved to be too slow for mass screening purposes. However, it sparked an interest for Barry in breast cancer research, with much research involving detecting microcalcifications in breast mammograms utilising innovative digital imaging systems. His later work in biomedical engineering related to the dielectric structure of living cells as they transform from normal to tumorous.

Additionally to the above, while working at UTS, Barry organised funding from the Foundation for Australia Resources for the first Masters Degree publicly awarded. He organised a Scholarship Scheme for Higher School Certificate students wishing to enter in Faculties of Science, Engineering or Information Technology and which operated for 5 years.

He also initiated and established research grants for post graduate work in environmental and resource sciences at UTS with prizes for best undergraduate performances plus scholarships for High School Leavers to enter University.

Barry's other awards included a Doctor of the University of Technology Sydney, Honoris Causa, awarded in 1997 for outstanding services to the University, and an Order of Australia in 1997. In 2003 Barry received the Australian Prime Minister's Centenary Medal for technology benefitting the nation and community.

Following retirement, Barry was accorded Emeritus Professor status, continuing to work across disciplines in Mathematics and Statistics, Computing Sciences and Biomedical Engineering.

Barry was a Fellow of the Royal Aeronautical Society, the Institute of Physics (London), the Australian Institute of Physics, the British Computer Society, the Australian Computer Society, the Australian Academy of Technological Sciences and Engineering, the Institute of Radio, Electronic & Electrical Engineers, the Institute of Engineers (Aust), and the New York Academy of Sciences (one of 13 Fellows elected world-wide in 1997).

In 1973 Barry married Fae Dorothy (nee Davis) whom he had met while working at Boeing. He died on 28 December 2021, just two months after Fae's death. They are survived by their only child, Dr Elysia Thornton-Benko and 3 grandchildren.

Prof Barry Stephen Thornton played a significant role in multidisciplinary science in Australia and will be sorely missed by family, friends and colleagues.

Elysia Thornton-Benko, Prof Tony Moon UTS, Prof Ian Faulkner USyd

AMSI News

Maaike Wienk* and Tim Marchant**

Declining participation rates in Year 12 mathematics subjects

Every year AMSI collects data on Year 12 mathematics enrolments across Australia, with a particular focus on participation rates in higher and intermediate mathematics. Higher mathematics corresponds to Specialist Maths subjects in most states and territories (Extension Maths in NSW) while intermediate maths corresponds to Maths Methods (Advanced Maths in NSW). These subjects include introductions to calculus and are intended to prepare high school students for university study, particularly in science, engineering, and IT.

The longitudinal data over the last decade shows that the proportion of higher and intermediate maths students has been slowly declining, to about 10% and 20% respectively. Between 2008 and 2020 the Year 12 school population has grown by 17% while student numbers in intermediate and higher maths remained static. In 2019, only a half cohort graduated Year 12 in Queensland, so the numbers dropped but the participation rate held up. However, the 2020 data indicates numbers dropping further, as well as an alarming new low participation rate, with only 9.2% of students studying higher maths in 2020, compared to 10.1% in 2019. For intermediate maths there has also been a dramatic decrease from 20.5% in 2019 to 17.6% in 2020.

In 2009 the number of Year 12 students completing higher/intermediate maths (around 63,000) comfortably exceeded the number of domestic students starting a degree in science, IT and engineering (around 42,000) in the following year. In 2020, 59,000 new domestic students started university degrees in these fields (an increase of 40%) while 61,500 Year 12 students studied higher/intermediate maths in the preceding year (a decrease of 2%). This trend indicates that the supply of qualified Year 12 students is not keeping up with the demand for degrees for which higher/intermediate maths is an essential prerequisite. To illustrate the scale of missed potential consider also this "what if" scenario: In 2011, 31.5% of Year 12 students graduated having completed higher/intermediate maths. If that participation rate had been stable for every year to 2020, an additional 22,000 students over 10 years would have graduated with higher/intermediate maths under their belt. If we had been able to maintain the participation rate of 2008 (34.9%), this would have added another 100,000 students over 12 years.

The dramatic drop in maths participation rates in 2020 (with preliminary data for 2021 looking much the same) comes at a time when demand for maths graduates is growing, with roles relating to data science and analytics, logistics and optimization in urgent demand. An illustration of this increasing demand is salary growth: the average starting salary in 2021, of $104K, for mathematical sciences postgraduate coursework graduates is now amongst the highest in Australia. Their

*AMSI Finance, Advocacy and Policy Manager

**AMSI Director

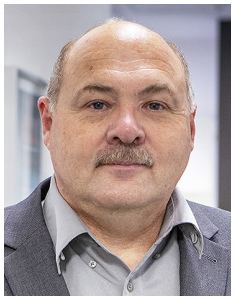
starting salaries have jumped by 21% since 2016, which is considerably more than for other disciplines.

Australia's declining mathematics participation is a complex multi-faceted problem that requires national collaboration between government and educators to reverse. Most importantly, we need to make sure that school students are incentivised to keep studying maths at the level they are capable of. To achieve this some possible actions and initiatives are:

- ensuring every student is taught maths by confident, well trained teachers from pre-school onwards;
- tackling cultural perceptions among parents and students as maths being boring, too hard or not useful;
- effective careers and subject choice advice in schools, which informs students of the broad range of careers involving mathematics;
- university admission maths requirements for entry into science, IT, engineering, and other degrees with high quantitative content;
- remedial maths training at university, which is both readily available and commonwealth funded.

The problem of declining participation in Year 12 maths is not one that can be solved by one organisation or within one sector in isolation. AMSI has employed initiatives and made contributions to the national discussion in a number of these areas for many years. To take this further, AMSI's next step will be to bring together all sectors with an interest in solving the problem: the education sector, universities, industry and government to promote a mutual understanding of the issues, find common ground and promote change with a unified voice.

Maaike holds a PhD in Law from Tilburg University (NL) and a Grad Dip in the Arts (Sociology) from the University of Melbourne. She has worked in various capacities within the mathematical sciences discipline for many years, including for the AustMS Gazette (2004–2006) and at La Trobe University (2004–2014). She has been involved with AMSI since 2012 as coordinator of the ACE network, Financial Officer and Research and Policy Officer. In her current role as Finance, Advocacy and Policy Manager, Maaike manages the AMSI finances and prepares publications and policy submissions to support AMSI's programs and the mathematical sciences discipline in Australia.



Tim Marchant is Director of the Australian Mathematical Sciences Institute (AMSI) at the University of Melbourne. Tim was previously Dean of Research at the University of Wollongong. He has undertaken senior leadership roles within the Mathematical Sciences, including President of the Australian Mathematical Society, Chair of ANZIAM and Director of the Mathematics in Industry Study Group. Tim has also had a range of external leadership roles, having twice been an executive member of the Council of Deans and Directors of Graduate Studies and a member of the Endeavour Awards and National Colombo Plan selection panels. Tim gained a PhD in Applied Mathematics from the University of Adelaide in 1988 and has published more than 100 research papers.

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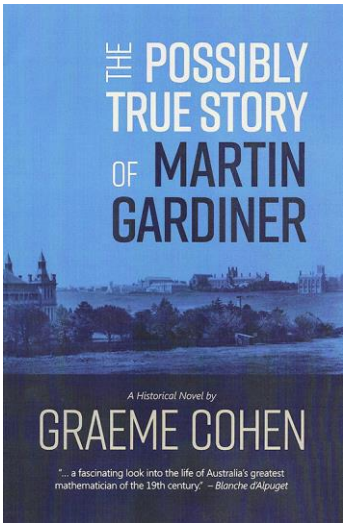

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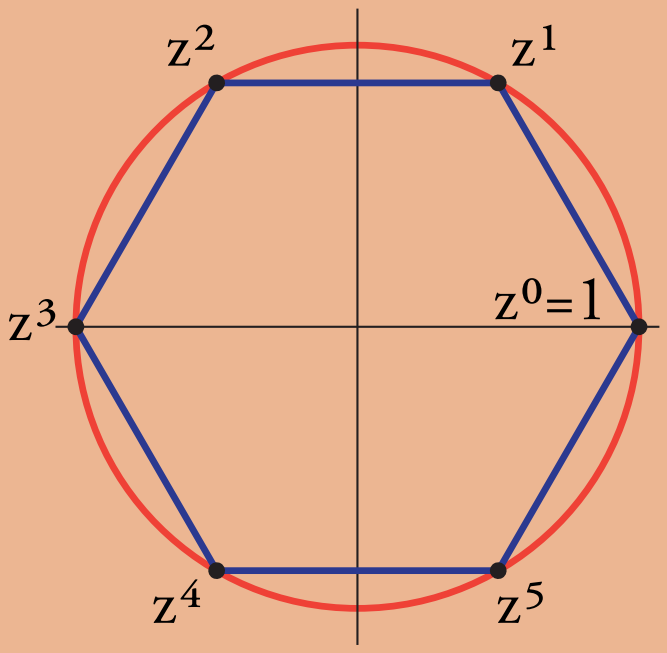

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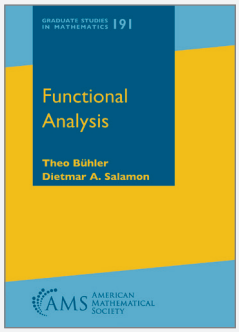


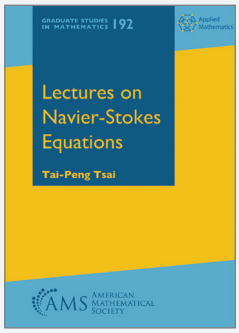
FUNCTIONAL ANALYSIS

Theo Bühler & Dietmar A. Salamon, ETH, Zurich

Functional analysis is a central subject of mathematics with applications in many areas of geometry, analysis, and physics. This book provides a comprehensive introduction to the field for graduate students and researchers. With 10 to 20 elaborate exercises at the end of each chapter, this book can be used as a text for a course on functional analysis for beginning graduate students.

Graduate Studies in Mathematics, Vol. 191

Jul 2018 472pp 9781470441906 Hardback A$111.00



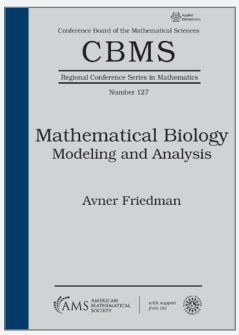
LECTURES ON NAVIER-STOKES EQUATIONS

Tai-Peng Tsai, University of British Columbia

A graduate text on the incompressible Navier-Stokes system, which is of fundamental importance in mathematical fluid mechanics as well as in engineering applications. The goal is to give a rapid exposition on the existence, uniqueness, and regularity of its solutions, with a focus on the regularity problem.

Graduate Studies in Mathematics, Vol. 192

Jul 2018 224pp 9781470430962 Hardback A$111.00



MATHEMATICAL BIOLOGY

Modeling and Analysis

Avner Friedman, Ohio State University

The fast growing field of mathematical biology addresses biological questions using mathematical models from areas such as dynamical systems, probability, statistics, and discrete mathematics. This book considers models that are described by systems of partial differential equations, and it focuses on modeling, rather than on numerical methods and simulations. The models studied are concerned with population dynamics, cancer, risk of plaque growth associated with high cholesterol, and wound healing.

A co-publication of the AMS and CBMS

CBMS Regional Conference Series in Mathematics, Vol. 127

Aug 2018 101pp 9781470447151 Paperback A$70.00

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MATRIX

Tom Keegan*

MATRIX Collaborations

MATRIX has been delighted to host program organisers and participants in-person at Creswick in January-July of this year across ten research programs, and one other research program online (https://www.matrix-inst.org.au/events-01/past-events-archive/).

Domestically MATRIX is continuing a PhD student research symposium series together with AMSI and has hosted two MATRIX-SMRI research symposia built around a distinguished researcher or publication.

Check out the various funding opportunities below through our research programs and MATRIX-Simons fellowship and travel grants.

Upcoming Research Programs

MATRIX looks forward to the following six research programs planned for the remainder of 2022:
https://www.matrix-inst.org.au/events-01/programs/

- Theory and Applications of Stable Polynomials
    - Program Organisers: James Saunderson (The University of Melbourne), Ngoc Mai Tran (The University of Texas)
- MATRIX-RIMS Tandem Workshop 2022 – Integrable probability, combinatorics and representation theory
    - Program Organisers: Sasha Garbali (The University of Melbourne), Chihiro Matsui (University of Tokyo), Masato Okado (Osaka Metropolitan University), Tomohiro Sasamoto (Tokyo Institute of Technology), Michael Wheeler (The University of Melbourne)
- Mathematics of Risk – 2022
    - Program Organisers: Alex Novikov (University of Technology, Sydney), Kostya Borokov (The University of Melbourne), Kais Hamza (Monash University), Yulia Mishras (Taras Shevchenko National University of Kyiv), Nino Kordzakhia (Macquarie University), Kazutoshi Yamazaki (Kansai University and The University of Queensland)

*MATRIX, Creswick, http://www.matrix-inst.org.au/

- Mathematics of the interactions between brain structure and brain functions
    - Program Organisers: Kerri Morgan (Deakin University), Mikail Rubinov (Vanderbilt University), Svetlana Postnova (University of Sydney), Nadezda Sukhorukova (Swinburne University), Julien Ugon (Deakin University), Geoffrey Goodhill (Washington University St Louis), Mark Holmes (The University of Melbourne), Sergiy Shelyag (Deakin University), Karen Caeyenberghs (Deakin University), Andrea Collevecchio (Monash University)
- Convexity, Geometry and Computation
    - Program Organisers: Martin Helmer (The Australian National University), Cordian Riener (The Arctic University of Norway), Vera Roschina (UNSW Sydney), Markus Schweighofer (Universitat Konstanz)
- IBS-CGP and MATRIX workshop on Symplectic Topology
    - Program Organisers: Young-Geun Oh (Institute of Basic Science, Centre for Geometry and Physics), Brett Parker (The Australian National University), River Chiang (National Cheng Kung University)

MATRIX-AMSI PhD Student Research Symposia

MATRIX and AMSI support PhD students in the mathematical sciences around Australia to design and run their own research symposia. The focus of each symposium is on exchanging ideas, collaborating and building relationships with your peers.
https://www.matrix-inst.org.au/events-01/phd-student-research-symposia/

In 2022, MATRIX and AMSI have hosted the following three symposia:

- Machine Learning and Decision Making: Theory, Algorithms and Applications
    - Symposium Organisers: Jun Ju (The University of Queensland), Yeming Lei (The University of Queensland), David Maine (The University of Queensland)
- PhD Student Symposium in Combinatorics (online)
    - Symposium Organisers: Afsane Ghafari Baghestani (Monash University), Yudhistira Bunjamin (The University of New South Wales), Jodie Lee (The University of New South Wales), Thomas Lesgourgues (The University of New South Wales), Jack Neubecker (The University of Queensland), Angus Southwell (Monash University)
- Graduate Talks in Geometry and Topology Get-Together $(GT)^3$ (MATRIX, Creswick)
    - Em Thompson (Monash University), Grace Garden (The University of Sydney), Ellena Moskovsky (Monash University), Yossi Bokor (The University of Sydney), James Morgan (The University of Sydney), Max Carter (The University of New South Wales)

We look forward to the following symposium coming up in September 2022:

- Categories and Companions Symposium (CACS 2022) (MATRIX, Creswick)
    - Jack Crawford (The Australian National University), Matthew Di Meglio (Macquarie University), Nicola Di Vittorio (Macquarie University), David Farrell (Macquarie University), Eli Hazel (Macquarie University), Yustyna Klish, James Koussas (La Trobe University)

MATRIX-AMSI PhD Student Research Collaboration Scheme

The MATRIX-AMSI PhD Student Research Collaboration scheme supports ongoing post-symposium/MATRIX research program collaboration between PhD students.

Australian based PhD students who participated in a MATRIX-AMSI sponsored PhD Student Online Research Symposium or a MATRIX Research Program/Workshop, can apply for funding through this scheme.

The scheme aims to support teams to continue their research collaboration for the purposes of exchanging ideas, building relationships with peers and working towards research outcomes.

MATRIX will provide:

- assessment on academic merit of the proposed collaboration by the MATRIX Scientific Committee guidance on your research collaboration plan
- up to $1,000 in funding per team, multiple teams possible per symposium

Applications for funding are to be submitted within 4 weeks post-symposium/ MATRIX Research Program/Workshop.

Further details at: https://www.matrix-inst.org.au/phd-student-research-collaboration-scheme-guidelines/

Call for MATRIX Research Programs

Anyone can apply to organise a MATRIX research program. Every research program should have ample unstructured time to encourage collaborative research. Longer programs can have an embedded conference or lecture series. Short workshops focusing on a special theme are also welcome. The MATRIX Family Fund provides additional support to participants with families.

The MATRIX Scientific Committee selects programs on scientific excellence as well as on the participation rate of high-profile international participants and/or business and industry partners, among other criteria.

The next deadline for research program proposals in 2022–2024 is Friday, 23 September 2022. Expressions of interest may be submitted at any time. Guidelines can be found at https://www.matrix-inst.org.au/guidelines/

Research Program Organisers are encouraged to supplement base funding from MATRIX through other schemes including the: MATRIX-Simons Collaborative Fund, MATRIX-Simons Travel Grant Scheme, International Visitor Program of the University of Sydney Mathematical Research Institute; AMSI and AustMS/ ANZIAM workshop funding scheme; and AustMS travel grants.
https://www.matrix-inst.org.au/funding-opportunities/

MATRIX-Simons Fellowship Program

The MATRIX-Simons Fellow program supports eminent international scholars in the mathematical sciences to make an extended visit to MATRIX, and to lead a research program in an emerging area or as part of a special theme year.

The Fellowship will provide a return airfare and cost for domestic travel to Australian universities (up to AUD3,850), and a stipend of AUD35,000 for housing and living expenses. For further information: https://www.matrix-inst.org.au/fellowship-program-guidelines/ Applications close: Friday, 23 September 2022

MATRIX-Simons Young Scholar Program

MATRIX-Simons Young Scholars will co-organise and participate in a MATRIX research program, and interact with MATRIX-Simons Fellows or other leading researchers from around the world. Scholars are encouraged to also make an extended visit to an Australian university on a collaborative project. The scholarship will provide a return airfare (up to AUD3,100), housing (up to AUD2,100) and a stipend of AUD1,050 for living expenses for a two-week visit to MATRIX and to support travel costs associated with a visit to an Australian university. For further information: https://www.matrix-inst.org.au/young-scholar-program-guidelines/ Applications close: Friday, 23 September 2022

MATRIX-Simons CollaborativeFund

MATRIX has launched a new fund to enhance collaborations and co-funding opportunities with external partners. The fund is made available by a generous grant from the US-based Simons Foundation. Access to this resource will become available to research program organisers with significant contributions to their MATRIX Research Program from funding bodies, institutions or external partners in business, industry and government, or private donors. Funding will be available to support research programs scheduled in 2022, 2023 and 2024. For further information: https://www.matrix-inst.org.au/collaborative-fund-guidelines/

MATRIX-Simons International Family Fund

The MATRIX-Simons International Family Fund is designed to lower the barrier for participation in mathematics research by mathematicians with carer responsibilities. The Fund supports the costs of international airfares for children and partners or carers, on top of additional housing, living support and access to local child care services (where required). Funding will be allocated on a case-by-case basis according to need. The Fund provides a per diem for a family, which may include a partner or carer, to cover the costs of housing and meals. The Fund will support each family with up to 14 nights housing (up to $2,140) and living expenses (up to $780). The Fund will also support a return economy airfare subsidy of up to $4,580 per family, and cover child care costs up to $130 per child/day for up to 14 days. Australian-based researchers may access the MATRIX Family Fund that allows researchers with caring responsibilities to attend MATRIX research programs by providing additional housing and support for children as well as a partner or carer. For further information: https://www.matrix-inst.org.au/international-family-fund-guidelines/

MATRIX-Simons Travel Grant Scheme

MATRIX provides partial travel support in the form of grants of up to $1,250 to those invited to participate in research programs at Creswick in 2022, 2023 and 2024. Preference may be given to participants from developing countries especially in the Asia-Pacific region and to applicants from diverse backgrounds. This scheme is made available by a generous grant from the US-based Simons Foundation. For further information:
https://www.matrix-inst.org.au/travel-grant-scheme-guidelines/

Online Seminar Series

MATRIX hosts monthly online seminars. For information on upcoming seminars and access to recordings of past seminars, visit:
https://www.matrix-inst.org.au/events-01/online-seminars/

National Science Week – MathsCraft – Free Online Workshop for Grades 5–Year 10 Students

MATRIX invites Grades 5 through to Year10 students to join us during National Science Week 2022 to come and experience why research mathematicians love maths. Students will have the opportunity to work on some really interesting and challenging maths problems.

Teachers and parents/guardians are also invited to audit the session online.

Places are limited! Register by noon on Friday, 12 August to go into the ballot for a chance to be one of 30 active student participants.

Registration for teachers and parents/guardians closes on Monday, 15 August at 9.00 am (AEST).

For further information:
https://www.matrix-inst.org.au/matrix-national-sci-week-mathscraft-2/

Become a Friend of MATRIX

Contributions to MATRIX help grow mathematical research in Australia and the Asia-Pacific region. Support from researchers in the mathematical sciences is key to success in leveraging further support from funding agencies and donors, and will contribute to enhanced opportunities for students, early career researchers and under-represented groups.

https://www.matrix-inst.org.au/donations/

We would be delighted for you and those in your network/s to become a Friend of MATRIX and show your support with a tax-deductible gift. You will receive a Friend of MATRIX 2022 edition mug for a contribution of $150 or more, and recognition as a private donor and an invitation to a special event for $1,000 or more.

Research Investment and Expenditure into the Mathematical Sciences

Published by MATRIX and AMSI, an update to the Research Investment and Expenditure into the Mathematical Sciences report has been published that analyses investment and expenditure in Australia to support research in the mathematical sciences over the period 2008–2021/22 using current publicly available date from the Australian Bureau of Statistics (ABS), the Australian Research Council (ARC) and the National Medical and Health Research Council (NHMRC).

The report includes the latest release from the ABS of 2020 data on HERD expenditure, displaying the worrying trend that investment by higher education institutions into pure basic and strategic research continues to decrease, and in particular that investment in mathematical sciences research (pure & applied) by higher education institutions took a $32 million hit in 2020 ($45 million in real terms).

The report can be accessed at: https://www.matrix-inst.org.au/research-investment-and-expenditure-into-the-mathematical-sciences-update/

Further Information

MATRIX is a national partnership between the University of Melbourne, Monash University and the Australian National University, with the University of Queensland and the ARC Centre of Excellence for Mathematical and Statistical Frontiers (ACEMS) as Associate Members.

Comments, suggestions and requests are always welcome. Please send these, as appropriate, to:

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Peter Bouwknegt (peterb@matrix-inst.org.au)

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LinkedIn: https://www.linkedin.com/in/matrix-australia/

Tom Keegan is the Executive Officer of MATRIX. He has worked in research and graduate research management in the university sector in Victoria for the past 17 years. He provides expertise in managing high-level strategic initiatives, resources and operational planning for MATRIX. Tom is a member of the Australasian Research Management Society (ARMS) and former member of the ARMS Victoria-Tasmania Chapter Executive. https://www.linkedin.com/in/tomkeegan2/

News from the Women in Mathematics Special Interest Group

Catherine Greenhill*

As you may have seen, the Australian team finished 3rd (from 57 countries) in the 2022 European Girls Mathematical Olympiad [1]. Each team member received a gold medal, the only country to achieve this. Congratulations to Grace Chang Yuan, Cloris Xu, Eunsu Choi and Iris Xu, who ranked 6th, 12th, 15th and 20th (respectively) out of 222 contestants. The team was supported and mentored by the Australian Maths Trust, and by their team leader, Thanom Shaw. On behalf of WIMSIG, congratulations to all!

These impressive individual achievements are in stark contrast with the bigger picture of mathematics in Australian schools. According to AMSI's recent "Year 12 Mathematics Participation Report Card" [2], enrolment by high school students in mathematics subjects is declining. In recent years, an average of around 71–73% of Year 12 students took at least one mathematics subject, but this figure dropped to 66% in 2020. Participation in the higher mathematics subjects dropped to below 10% in 2020. When analysing the data by gender, the report speaks of male and female students, and notes that while 52% of the students completing Year 12 in 2020 were female, only 37.8% of students taking higher mathematics subjects were female.

These numbers should be of concern to all in the mathematical community.

International Women in Mathematics Day, 12 May 2022

The birthday of the late Maryam Mirzakhani, 12 May, was named International Women in Mathematics Day in 2019. This year the day was celebrated with some in-person or hybrid events around the country, joining more than 120 events worldwide.

- At Western Sydney University, a hybrid event was held with talks from Cheryl Praeger (UWA), Susan Wei (Melbourne) and Natalie Thamwattana (Newcastle), followed by a panel discussion. The event was attended by students and staff, from Western Sydney University and beyond.
- At the University of Wollongong, participants heard a keynote talk from Katie Buchhorn (QUT), followed by a panel discussion. The panellists were students, recent graduates and an early career academic, and participants included undegraduate students and academics in other fields.
- At RMIT University, a hybrid event was held with guest speakers Asha Rao (RMIT), Katherine Seaton (LaTrobe), Joanne Hall (RMIT) and Kerri Morgan (Monash). There was also a panel discussion with the speakers.

*Chair, WIMSIG
Email: WIMSIG-chair@women.austms.org.au

The event was attended by undergraduate and postgraduate students, early career researchers and academics.

Many thanks to the organisers of these events.

Get involved in WIMSIG!

We are looking for WIMSIG Members who would like to get more involved in some of our activities. Here are some ways you could contribute to WIMSIG's goals of supporting women, trans and gender diverse people in the mathematical sciences in Australia:

- WIMSIG Treasurer (from January 2023);
- WIMSIG Newsletter Editor (from January 2023);
- two Ordinary Members of the WIMSIG Executive Committee (from January 2023);
- member of the Selection Committee, who decide outcomes for the WIMSIG Cheryl E. Praeger Travel Award, the WIMSIG Anne Penfold Street Award and the AustMS–WIMSIG Maryam Mirzakhani Award (from mid-2022 or later);
- member of the WIMSIG Mentoring Committee, who run the WIMSIG Mentoring Scheme (from January 2023).

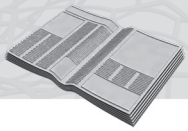
If you are interested in any of these roles, or would like more information, please email me (WIMSIG-chair@austms.org.au).

References

[1] Australian Mathematics Trust news item, "Australian Team Achieves Gold Medal Sweep, Australia Ranks Third in the 2022 European Girls' Mathematical Olympiad", 11 April 2022. https://www.amt.edu.au/news/egmo-2022-results

[2] Maaike Wienk, Year 12 Mathematics Participation Report Card: Mathematics Enrolments Reach All-time Low, Australian Mathematical Sciences Institute, April 2022. https://amsi.org.au/wp-content/uploads/2022/04/year-12-participation-2022.pdf

Catherine Greenhill is a Professor at UNSW Sydney and a Fellow of the Australian Academy of Science. She is the current Chair of the Women in Mathematics Special Interest Group (WIMSIG) of the Australian Mathematical Society. Catherine's research involves probabilistic, asymptotic and algorithmic combinatorics.



News

General News

Mathematical Art Competition

CARMA is partnering with MATRIX for the Annual CARMA-MATRIX Maths/Art Poster Competition. As previously, entries are invited in the categories: Art, Outreach and Research. Entry is available at https://carmamaths.org/art/gallery/competition/ and entries close 30 October. Winners will be announced at AustMS2022, in the "Visualisation and Mathematical Art" Special Session. This year for the first time there will also be a physical exhibition of selected invited works at MATRIX House.

Completed PhDs

Australian National University

- Dr Hooman Hezaveh Hesar Maskan, *Frequency chirping of energetic particle driven modes in tokamaks; Self-consistent modelling and simulation*, supervisors: Matthew Hole, Robert Dewar, Zhisong Qu.

University of Adelaide

- Dr Aleksandar Badza, *A quantitative evaluation of Lagrangian coherent structure detection methods based on computational and experimental limitations*, supervisors: Sanjeeva Balasuriya, Trent Mattner.

University of South Australia

- Dr Carrie Xuemei Liu, *An inexact deflected subgradient algorithm with applications to optimal control problems*, supervisors: Regina Burachik, Yalçin Kaya.

University of Southern Queensland

- Dr Abul Abrar Masrur Ahmed, *Development of deep learning hybrid models for hydrological predictions*, supervisors: Ravinesh Deo, Nawin Raj, Afshin Ghahramani. This candidate has received an Excellence In Doctoral Research Award from USQ Graduate Research School.
- Dr Ekta Sharma, *Artificial intelligence and clean air: development of novel algorithms with machine learning and deep learning*, supervisors: Ravinesh Deo, Nawin Raj, Ramendra Prasad, Jeffrey Soar, Alfio Parisi. This candidate has received an Excellence In Doctoral Research Award from USQ Graduate Research School.

UNSW Sydney

- Dr Kevin Limanta, *Super Catalan numbers and Fourier summations over finite fields*, supervisors: Norman Wildberger and Daniel Chan.
- Dr Douglas Zhang, *Complex structures on stratified Lie algebras*, supervisors: Alessandro Ottazzi, Michael Cowling.
- Dr Farah El Rafei, *Existence, uniqueness and approximation of solutions to the stochastic Landau-Lifschitz equation of the real line*, supervisors: Thanh Tran, Beniamin Goldys.

Awards and other achievements

Australian National University

- Associate Professor Barry Croke received a Cooperative Research Centres grant:
  - ONEBasin CRC
  - Partnering with local communities in regional Australia to increase resilience to flood risk (National Resilience and Recovery Agency: Disaster Risk Reduction Package)
- Adam Piggott received a National Science Week grant for The National STEM Communicators Challenge: Hidden mathematics at work. Google's search tool, credit cards, and even card games: modern lives have mathematics hidden everywhere. The Mathematical Sciences Institute at ANU are unravelling the mysteries behind the maths in our day-to-day lives, with an interactive public lecture and a short film competition exploring the "Hidden Mathematics at Work". The faculty will engage participants with surprising, accessible and compelling examples of everyday mathematics that often go unnoticed.
- Distinguished Professor Susan Scott from The Australian National University is the first Australian to be appointed as Editor-in-Chief of the international journal *Classical and Quantum Gravity*.

University of Melbourne

- Hamideh Anjomshoa was invited to be 2022 UNSW Women in Mathematics and Statistics Ambassador and gave a talk in the Girls Do The Maths event at UNSW on 23 June 2022:
  https://www.unsw.edu.au/science/our-schools/maths/engage-with-us/high-school-students-and-teachers/girls-do-the-maths

University of Southern Queensland

- Professor Ravinesh Deo and Dr Ekta Sharma were awarded an *Office of National Intelligence (ONI) Postdoctoral Community Research Grant (NIPG)*. Their Project is The Internet of Space Things – Using Commercial Grade Radios, and is valued at $349,962 over 2022–2024.

University of Western Australia

- Jesse Lansdown is the 2022 recipient of the Centre for the Mathematics of Symmetry and Computation's annual prize for the best journal paper written by an Early Career Researcher. It was awarded for the paper "Synchronising primitive groups of diagonal type exist" in the *Bulletin of the London Mathematical Society*, written jointly with John Bamberg, Michael Giudici, and Gordon Royle.

UNSW Sydney

- Gary Froyland will be a plenary speaker at the 10th International Congress on Industrial and Applied Mathematics (ICIAM 2023), to be held at Waseda University, Tokyo, Japan on 20–25 August 2023.
- Mathematics PhD student Yudhi Bunjamin has been selected to attend the 9th Heidelberg Laureate Forum to be held in Heidelberg, Germany, over five days in September 2022.

Appointments, departures and promotions

Australian National University

- Lindon Roberts, MSI Fellow, finished on 30 June.
- Cale Rankin, Postdoctoral Fellow, finished on 6 July.
- Edmund Heng, Postdoctoral Fellow, finished on 24 July.

MSI staff arrivals:

- Hongzhang Xu has commenced as a Postdoctoral Fellow, working with Rowena Ball until the end of 2022.

Murdoch University

- Dr Nayomi Attanayake has been appointed as Lecturer in Statistics.
- Dr Farzana Jahan has been appointed as Lecturer in Statistics.
- Dr Philip Schrader has been appointed as Lecturer in Mathematics.
- Dr Gerd Schröder-Turk has been promoted to Professor.

University of the Sunshine Coast

- Dr Robert McDougall is retiring from academia after many years of distinguished service.

University of Western Australia

- Carmen Amarra has been appointed as Research Assistant until September 2023.

UNSW Canberra

- Bryce Kerr joined in June on a DECRA Fellowship.
- Ben Kaehler departed in June to take up a position at Macquarie Group.

Conferences and Courses

Conferences and courses are listed in order of the first day.

Information given here is the most up to date available to us at the time of going to press. You should check the relevant webpages, or contact the organisers directly, for updates.

For a summary of upcoming MATRIX programs at Creswick, please see https://www.matrix-inst.org.au/events-01/workshops/

Workshop on Stochastic Differential Equations and their Applications

Dates: 25–30 September 2022
Venue: Monash University
Web: https://sites.google.com/monash.edu/sdes2022/home?authuser=0

The primary goal of this workshop is to bring together researchers in some of the most active and promising areas of research of stochastic differential equations, to exchange ideas and to foster future collaborations. Another important goal is to expose young researchers and postgraduate students to the most recent developments in active areas of stochastic differential equations in Australia.

Indigenizing University Mathematics 2: Indigenous Perspectives on Maths and Applications

Dates: 27–30 September 2022
Venue: Online and Newcastle
Web: https://carmamaths.org/events/

IUM2 will run online with some face-to-face components, hosted by First Nations University of Canada 26–29 September, following Canadian dates. This will be 27–30 September in Australia, mostly in the mornings, with some possible face-to-face components in Newcastle. We will build upon IUM1, information about which is available on the carmamaths.org website. Registration will soon be available at the website.

Mathematics of Sea Ice and Ice Sheets

Dates: 9–11 November 2022
Venue: University of Adelaide
Web: https://mossi-conf.github.io/MOSSI-22/index.html

The cryosphere, the part of the earth consisting of frozen water, is a critical component of the Earth's climate systems. The cryosphere has seen significant transformation in recent years in response to climate change. Sea ice and ice sheets are two key parts of the cryosphere which are distinct but related. There are numerous mathematical challenges modelling sea ice and ice sheets, some shared, which must be overcome to advance our understanding of the cryosphere and its interactions with a changing climate.

This AMSI-AustMS Workshop will bring together international researchers who are experts in the modelling of ice sheets and sea ice to discuss and address these challenges. The workshop will be comprised of invited plenary talks as well as contributed talks. The emphasis of the workshop is in person attendance but there will be some additional online options. Please visit the website for more information.

Statistics and Mathematical Modelling in Combination

Dates: 16–18 November 2022
Venue: La Trobe University (City Campus, Level 2, 360 Collins Street, Melbourne)
Web: https://www.mathematics.org.au/sys/public/home.php?conf_id=57

Deterministic modellers and statisticians have a lot to be gained by working as a team in which both types of approaches are used. The combination of statistics and classical dynamics has long been a fertile field, tracing back to statistical mechanics from the end of the 19th century and stochastic differential equations from the 1920s. The need to combine the two modelling approaches has never been greater and neither has the opportunity for affordable high-performance computation. During the COVID-19 pandemic, agreement has been found between agent-based models and differential compartment equations in modelling infection numbers. Each approach gives confidence to the other, and this suggests scope for new hybrid models.

Asia Pacific Forum on Mathematics for Industry Mathematics (theme on Public Health and Sustainability)

Dates: 21–23 November 2022
Venue: La Trobe University (City Campus, Level 2, 360 Collins Street, Melbourne)
Web: https://apcmfi.org/fmfi2022/index.html

This year's Forum will have the theme Mathematics of Public Health and Sustainability.

Bioinfo Summer 2022

Dates: 21–24 November 2022
Venue: University of Melbourne
Web: bis.amsi.org.au

IAEA Technical Meeting on Energetic Particles and Theory of Plasma Instabilities in Magnetic Confinement Fusion (EPPI2022)

Dates: 21–24 November 2022
Venue: Australian National University
Web: https://maths.anu.edu.au/news-events/events/iaea-technical-meetingenergetic-particles-and-theory-plasma-instabilities

EPPI2022 is being organized by the International Atomic Energy Agency, hosted by the Government of Australia through the Mathematical Sciences Institute of the Australian National University. For further details, see Gazette 48, no. 3, page 146, or the website.

Mahler Lecture Tour

Dates: 23 November–16 December 2022
Venue: Various
Web: rhed.amsi.org.au/mahler

The Mahler lectures are a biennial activity organised by the Australian Mathematical Society, and supported by the Australian Mathematical Sciences Institute. The tour invites a prominent international mathematician to travel to Australian universities to deliver lectures at a variety of levels, including several public lectures. In 2022, Frank Calegari (University of Chicago) will be presenting a series of Number Theory lectures around the country.

AustMS 2022 Conference

Dates: 6–9 December 2022
Venue: UNSW Sydney
Web: https://conference.unsw.edu.au/en/austms2022

The conference will include plenary lectures, special sessions, an education afternoon, and social events, including a conference dinner. There will be an associated Early Career Workshop taking place on Monday, December 5. The WIMSIG dinner will take place on the evening of Monday, December 5. Information about registration and the conference timetable will be provided in due course.

Plenary Speakers will include:

- Martin Bridson (University of Oxford)
- Frank Calegari (University of Chicago) [Mahler Lecturer]
- Serena Dipierro (University of Western Australia)
- Michael Donovan and Judy-Anne Osborn [Dr Yunupingu Lecturers]
- Nigel Higson (Penn State University)

- Mark McGuinness [ANZIAM Lecturer] (Victoria University of Wellington)
- Lewis Mitchell (The University of Adelaide)
- Lisa Piccirillo (Massachusetts Institute of Technology)
- Makiko Sasada (University of Tokyo) (to be confirmed)
- Anne Schilling [ANZAMP Lecturer] (University of California, Davis)

AMSI Summer School 2023

Dates: 9 January to 3 February 2023
Venue: University of Melbourne
Web: ss.amsi.org.au

Vale

Lynn Batten

It is with much sadness that we share with you the news of the passing of Professor Lynn Batten, who after a long illness, passed away peacefully at Mayflower Brighton Aged care on Thursday 28 July 2022.

Lynn joined Deakin in the year 2000. She was Professor of Mathematics in the School of IT, a member of the Academic Board and Professor Emerita at Deakin. She will be remembered for her strong contributions to the School and to Deakin, to the AMS and to AMSI. She was a leader in mathematics and in cyber security and a strong defender of academic standards. She played a significant part in initiating the first course in IT Security at Deakin and in connecting with the cyber security industry. Most of all she was a colleague, mentor and friend who always had our best interest at heart.

Visiting mathematicians

Future international visitors are listed here. Their details are presented in the format: name of visitor; home institution; dates of visit; principal field of interest; principal host institution; contact for enquiries.

Isaac Klapper; Temple University; 7 August to 10 September; ANU; Noa Kraitzman

Christopher Tout; University of Cambridge; 10 September to 5 November; ANU; Lilia Ferrario

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The ANZIAM Journal
The Australian & New Zealand
Industrial and Applied Mathematics Journal

Vol. 64 No. 1 (2022)

https://journal.austms.org.au/ojs/index.php/ANZIAMJ/issue/view/139

Published: 2022-06-28

Articles

Dispersal of hydrogen in the retina – a three-layer model
W.F. Mansoor, G.C. Hocking, D.E. Farrow

Hopf bifurcation analysis of a fractional order Holling-Tanner predator-prey model with time delay
C. Çelik, K. Děrli

Three-dimensional analytical solution of the advection-diffusion equation for air pollution dispersion
M. Farhane, O. Alehyane, O. Souhar

Stationary Markovian arrival processes: Results and open problems
A. Asanjarani, Y. Nazarathy

Explicit Nordsieck second derivative general linear methods for ODEs
P. Ramazani, A. Abdi, G. Hojjati, A. Moradi

Bulletin of the Australian Mathematical Society

Vol. 105 No. 3 (2022)

https://journal.austms.org.au/ojs/index.php/Bulletin/issue/view/138

Published: 2022-04-26

Articles

On quotients of values of Euler's function on factorials
A. Nath, A. Jha

On a problem about additive representation functions
M. Tang

Tight universal triangular forms
M. Kim

On the modularity of solutions to certain differential equations of hypergeometric type
H. Saber, A. Sebbar

On transcendental continued fractions in fields of formal power series over finite fields
B. Can, G. Kekeç

On the increasing partial quotients of continued fractions of points in the plane
M. Lü, Z. Zhang

A note on large values of $L(\sigma, \chi)$
X. Xiao, Q. Yang

On fine Selmer groups and signed Selmer groups of elliptic modular forms
A. Lei, M.F. Lim

On the strong metric dimension of a total graph of nonzero annihilating ideals
N. Abachi, M. Adlifard, M. Bakhtyiari

Monomial and monolithic characters of finite solvable groups
B. Çinarci

Isolated subgroups of finite p-groups
Q. Song, L. An

Second Hankel determinant of logarithmic coefficients of convex and starlike functions
B. Kowalczyk, A. Lecko

An application of Schur's algorithm to variability regions of certain analytic functions-II
M.F. Ali, V. Allu, H. Yanagihara

On the boundary behaviour of Fridman invariants
S. Yang

Centre of Banach algebra valued Beurling algebras
B. Talwar, R. Jain

A note on open book embeddings of 3-manifolds in S^5
S. Pandit, A. Selvakumar

Abstracts of PhD Theses

Intersection of conjugate solvable subgroups in finite classical groups
A.A. Baykalov

Model-based adaptive monitoring: Improving the effectiveness of reef monitoring programs
A.W.L.P. Thilan

Adversarial risk analysis for first-price sealed-bid auctions
M. Ejaz

Confidence intervals in general regression models that utilise uncertain prior information
N. Ranathunga

Spatio-temporal modelling for nonstationary point referenced data
L. Morris

Electrical impedance tomography using nonconforming mesh and posterior approximated regression
L. Lee

A dynamical study of saline plumes in desalination outfalls
S.M. Shraida

Journal of the Australian Mathematical Society

Volume 112, Issue 3, June 2022

Published online May 2022

Research article

Infinitary commutativity and Abelianization in fundamental groups
Jeremy Brazas, Patrick Gillespie, pp. 289–311,
doi: 10.1017/S1446788720000427, published online on 23 November 2020

Realizing metrics of curvature ≤ -1 on closed surfaces in Fuchsian anti-de Sitter manifolds
Hicham Labeni, pp. 312–334,
doi: 10.1017/S1446788720000506, published online on 19 February 2021

A hydrodynamical homotopy co-momentum map and a multisymplectic interpretation of higher-order linking numbers
Antonio Michele Miti, Mauro Spera, pp. 335–354,
doi: 10.1017/S1446788720000518, published online on 11 February 2021

Generators of finite fields with prescribed traces
Lucas Reis, Sávio Ribas, pp. 355–366,
doi: 10.1017/S1446788721000094, published online on 27 May 2021

Second order subexponentiality and infinite divisibility
Toshiro Watanabe, pp. 367–390,
doi: 10.1017/S1446788720000208, published online on 22 June 2020

Lie-type derivations of nest algebras on Banach spaces and related topics
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doi: 10.1017/S1446788721000148, published online on 29 September 2021

Other

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Front Cover (OFC, IFC) and matter
JAZ volume 112 issue 3 Cover and Front matter
pp. f1–f2
doi: 10.1017/S1446788721000288, published online on 10 May 2022

Lift-off Fellowships

Members are reminded of the Society's Lift-off Fellowships which provide short-term support, including living expenses and travel grants, for students who have recently submitted for examination a PhD thesis in the mathematical sciences.

The fellowship rules, application form and details of past fellowship holders can be found at https://austms.org.au/awards-grants/awards/lift-off-fellowships/lift-off-fellowships-information/

If you will soon complete a PhD, or have a student who will soon complete a PhD, please keep the scheme in mind.

Walter and Lyn Bloom Travelling Fellowships

The **Walter and Lyn Bloom Travelling Fellowships** aim to assist early career mathematicians to spend research time overseas, to present papers at National and International Conferences and to make and maintain international contacts. The Fellowships are funded annually by Walter and Lyn Bloom.

Applications for the Walter and Lyn Bloom Travelling Fellowship should be emailed directly to the committee at bloom@austms.org.au by **3rd November 2022**.

Prospective applicants should follow the application procedures given at https://austms.org.au/awards-grants/awards/walter-and-lyn-bloom-travelling-fellowships/

The Rodney Baxter Prize

Emeritus Professor Rodney Baxter (ANU) is gifting the Society a generous amount for establishing The Rodney Baxter Prize for Mathematical Physics. Rodney Baxter has been one of the world's leading figures in the field of statistical mechanics and mathematical physics. Among his many honours are the 1987 Dannie Heineman Prize for Mathematical Physics, the 2006 Lars Onsager Prize, the 2013 Royal Medal and the 2021 Henri Poincaré Prize. The prize, initially valued at $5,000, will be awarded once every three years at the ANZAMP annual

conference. Council have now approved the set of rules for the prize which are posted on AustMS website at https://austms.org.au/awards-grants/awards/the-rodney-baxter-prize-for-mathematical-physics/.

Nominations, including a nomination form, are to be sent directly to the ANZAMP Secretary via email: anzamp-secretary@austms.org.au and must be received no later than Friday 26 August 2022.

Deborah Jackson
Honorary Secretary AustMS
Email: Secretary@AustMS.org.au

Deborah Jackson (née Trueman) is a lecturer at La Trobe University. She began her academic career at Monash University and then moved to Swinburne University. After several years back at Monash, she joined La Trobe in 2010. Deborah was honorary Chair of the Victorian Algebra Group from 1996 to 2003 and its Secretary from 1994 to 1995. Deborah took over as Secretary of the Society in September 2019.

The Australian Mathematical Society

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Membership and Correspondence

Applications for membership, notices of change of address or title or position, members' subscriptions, correspondence related to accounts, correspondence about the distribution of the Society's publications, and orders for back numbers, should be sent to the Treasurer. All other correspondence should be sent to the Secretary. Membership rates and other details can be found at the Society web site: www.austms.org.au.

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The Journal of the Australian Mathematical Society

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The University of Sydney, NSW 2006, Australia

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The Australian Mathematical Society Lecture Series

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