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NEWSLETTER

OF THE

NEW ZEALAND MATHEMATICAL SOCIETY

Contents

PUBLISHER'S NOTICE

This newsletter is the official organ of the New Zealand Mathematical Society Inc. This issue was edited by Miguel A Moyers González and Phillip L Wilson. Editorial enquiries and items for submission to this journal should be submitted as plain text or LaTeX files with "NZMS newsletter" in the title of the email to phillip.wilson@canterbury.ac.nz. LaTeX templates are available upon request from the editors.

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

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EDITORIAL

Welcome to the final issue of 2018, and the final issue of our tenure as editors! The issue is very full, with Vivien Kirk's 2018 President's Report on p.6, lots of reports on events and travel starting on p.30, draft minutes of the recent AGM on p.38, and plenty of local news beginning on p.20.

We also have an interesting range of articles and columns beginning on p.9. The first of these articles is a revealing headcount of women in mathematics and statistics performed by Astrid an Huef and Vivien Kirk. It shows how far we still have to go to achieve equal numbers of women and men in our field. We thoroughly support their call for an annual survey of gender distribution in mathematics and statistics in NZ in order to track our progress towards this goal.

Because of how important this goal is for all of us, it is disappointing when pseudo-scientific attempts to "explain away" the observed gender disparity in mathematical sciences are still commissioned and accepted for publication by journals. In his Cybermath column on p.14, Mark Wilson draws our attention to a recent example. It seems clear to us that it was wrong of some of the editors involved to seek controversy with this article — that is not their job, nor is it responsible to thousands of women working hard (not to mention uphill) around the world. Moreover, the argument that greater male variability (a larger standard deviation in standardised test marks for men compared to women) explains why there are more men than women in the mathematical sciences has been roundly and repeatedly refuted. For example, a recent meta-analysis of over 1.6 million grades shows that while there is indeed greater male variability across most subjects, it is much *lower* in the mathematical sciences than in other subjects — including those more traditionally dominated by women. You can read more about this analysis at theconversation.com/study-of-1-6-million-grades-shows-little-gender-difference-in-maths-and-science-at-school-101242.

It seems to us that in addition to dodgy science, the recent controversy which Mark mentions involves both questionable politics and problematic editorial practices. The public evidence does not support the claim that the paper in question was rejected for purely political reasons. Our reading of the situation is that the anticipated controversy over the paper led to greater scrutiny of its scientific content and validity, and a recognition of poor oversight and refereeing practices, all contributing to the decision not to publish.

We can be proud of our Society's efforts to promote equality in mathematics in Aotearoa New Zealand. There is a long way to go, so we welcome the recent Council statement on Women in Mathematics, reproduced on p.37.

Finally, thank you to everyone who has helped us in our tenure as Editors. All of the Newsletter contributors — correspondents and columnists and everyone else — have been wonderful to work with, and the Newsletter would not exist without you. Our thanks also go to John Shanks for uploading the Newsletter and emailing members about it. Astrid an Huef and Vivien Kirk have given us so much support and advice — thank you. Lastly, we thank you the reader for reading the Newsletter when there are so many demands on your time. We're confident that you will continue to do so as the Newsletter grows and improves in the very safe hands of Fabien Montiel and Melissa Tacy.

Miguel Moyers and Phil Wilson

PRESIDENT'S COLUMN

What follows is my President's Report for 2018. This year was another busy one for the NZMS, with the Council and individual members being involved in a full range of activities, and with some spectacular successes for individuals in our community.

Membership

The current membership is 265, up from last year's 260. We have 64 student members. Please encourage new colleagues and students to join our Society. The first year of membership is free.

Lecture Tours

The 2018 Forder Lecturer was Valerie Isham from University College London. Her public lectures and more specialized presentations on stochastic modelling, particularly the modelling of epidemics, were very well received, and members around NZ were appreciative of the opportunity to engage with Valerie. I am grateful to Mick Roberts for coordinating Valerie's tour.

Bakh Khoussainov of the University of Auckland will be the 2019 Aitken Lecturer and will visit the UK in June and July 2019. In addition to giving lectures at various universities around the UK, Bakh will deliver the Aitken Lecture at the General Meeting of the London Mathematical Society in June. The London Mathematical Society has reported that the Aitken Lectureships to date have been very well received in the UK and has indicated that it wishes to continue with both the Forder and Aitken Lectureships in the future.

NZMS Colloquia

This year's New Zealand Mathematics Colloquium was hosted by the University of Otago. I thank the organisers, especially Florian Beyer, for all their work. The 2019 Colloquium will be hosted by Massey University in Palmerston North and the 2020 Colloquium will be at AUT University in Auckland. The venues for the 2021 and 2022 Colloquia are not yet settled, but the 2023 Colloquium will be held in Auckland as part of a joint meeting with the American Mathematical Society and the Australian Mathematical Society.

Student Travel Grants and Other Funding, December 2017 to December 2018

The NZMS awarded student travel grants to Mohamed Al-Sultani, Hahmed Amirinezhad, Fareeda Begum, Emma Greenbank, Saima Gul, Peter Huxford, Jo Knox, Ireesha Ratnayake, Steven Turnbull, Demi Vasques, Giorgia Vattiato and Faheem Zaidi.

The NZMS supported several conferences this year: MINZ 2018, NZMASP 2018, and the Mirzakhani Hui: Women in Mathematical Sciences Conference (see p.31). We put aside funding to support student participation in the 2018 Character Varieties and Topological Quantum Field Theory conference and the 2019 Fluids in NZ conference. We also supported Maths Craft New Zealand.

Nominating Committee

2018 was the first year of operation of the Nominating Committee, which is tasked with identifying candidates for positions, awards and fellowships associated with the NZMS (e.g. NZMS prizes and awards, Fellowship of the NZMS and RSNZ, positions on Council, lectureships, etc). The Nominating Committee does not nominate anyone, but suggests to others that a person might be nominated or encouraged to apply; individuals are also free to nominate themselves or someone else, separately from the activities of the Nominating Committee. The Nominating Committee has been very active this year, ensuring a broad pool of nominations for all the appropriate positions and awards. I would like to thank the committee for their sustained work throughout 2018.

NZMS Research Awards and Prizes

I thank the members of the judging panels for their work in assessing the applications and nominations received for the 2018 Awards and Prizes and for judging the student entries for the Aitken prize.

The Early-Career Research Award went to Fabien Montiel (University of Otago) "for outstanding contributions to the development of mathematical and computational methods in wave scattering theory and his innovative approach to modelling the propagation of ocean waves in ice-covered seas".

The Research Award was given jointly this year. Alex James (University of Canterbury) received the award "for her contributions in mathematical modelling ranging from the theoretical, such as Lévy walks and complex ecological systems, to the very applied, such as masting and snail dynamics". Carlo Laing (Massey University) received the award "for his sustained contributions to the field of mathematical neuroscience, and pioneering work in the study of coupled oscillator networks".

The Kalman Prize for Best Paper is for an outstanding and innovative piece of research in the mathematical sciences published by a member or members of the NZMS. The prize, of value $5000, is generously funded by the Margaret and John Kalman Charitable Trust in recognition of the significant contributions to mathematics in New Zealand made by Professor John Kalman. The 2018 Kalman Prize was awarded to Andre Nies, Dan Turetsky and Noam Greenberg for the journal article Coherent randomness tests and computing the K-trivial sets, by Laurent Bienvenu, Noam Greenberg, Antonin Kucera, Andre Nies, and Dan Turetsky (J.European Math. Society 18 (2016), 773–812).

The Aitken Prize is for the best contributed talk by a student at the Colloquium. The winner was Pascal Eun Sig Cheon (University of Auckland) for his presentation *Domain truncation in pipeline monitoring problems*. An honourable mention was given to Martin Bachraty (University of Auckland) for his presentation *Approaching the Moore bound for diameter 3 with Cayley graphs*.

NZMS Fellowships

I thank the members of the Accreditation Committee for their work in assessing applications and nominations for Fellowship of the NZMS. Fellowships are awarded to members of the NZMS in recognition of their contributions to mathematics and their professional standing in the NZ Mathematics community. There is an outstanding group of new Fellows this year: Peter Donelan (Victoria University of Wellington), Noam Greenberg (Victoria University of Wellington), Sina Greenwood (University of Auckland), Stephen Marsland (Victoria University of Wellington), Clemency Montelle (University of Canterbury), Warren Moors (University of Auckland), Rua Murray (University of Canterbury), John Shanks (University of Otago), Mike Steel (University of Canterbury), and Caroline Yoon (University of Auckland).

Other Prizes

Mathematicians did spectacularly well in the 2018 Royal Society Te Apārangi 2018 Research Honours. Marston Conder (University of Auckland) was awarded the Jones Medal for his lifetime achievement and leadership in mathematics. Rod Downey (Victoria University of Welington) was awarded the Rutherford Medal for his revolutionary research into mathematical logic and computer science. Matt Visser (Victoria University of Wellington) was awarded the Hector Medal for his research into both classical and quantum gravity. Jurij Volčič, now at Texas A&M University and formerly at the University of Auckland, received the Hatherton Award for his paper Matrix coefficient realization theory of noncommutative rational functions published in the Journal of Algebra in 2018. In addition, David Bryant was elected to Fellowship of the Royal Society Te Apārangi. Congratulations to all five!

Diversity in the NZ Mathematics Community

The Council has this year been investigating ways in which it can support diversity in our Society and the wider community. The focus has mostly been on gender diversity. In the last 12 months, the Council has developed a statement on Women in Mathematics, participated in the Australian Mathematical Society working party on gender equity, collected data on the participation rates of women in Mathematics and Statistics in NZ universities, and continued to promote the participation of women in mathematics through its own practice when making funding and policy decisions. Work for the near future will be to develop activities to promote other types of diversity in mathematics.

Education Group

The Education Group within the NZMS has had a focus this year on secondary school mathematics and first year tertiary mathematics. Amongst other activities, the Education Group made a submission on behalf of the NZMS, in response to the Ministry of Education's consultation on NCEA, and has also held meetings with members of the Ministry of Education and the NZ Qualifications Authority. More information about the work of the Education Group and opportunities to contribute can be found on the Education Group page of the NZMS website.

Acknowledgements

Many people contribute to the running of the NZMS, and I am grateful to them all. I thank Boris Baeumer for his service as webmaster, John Shanks for his service as Membership Secretary and work on the website, and Shaun Cooper for his service as Editor of the NZ Journal of Mathematics.

Miguel Moyers-Gonzalez and Phil Wilson have served as editors of the Newsletter for three years, and will step down at the end of 2018. The Newsletter provides an important link between members in different parts of the country, and Phil and Miguel have done an excellent job of sustaining these connections through their choice of material. I thank Phil and Miguel for all their efforts. Fabien Montiel will take over as Newsletter editor in 2019.

I am grateful to all the members of the Council for their ongoing service to the NZMS. Rua Murray (Secretary) and Stephen Marsland (Treasurer) have put in particularly long hours to enable the the work of the NZMS to run smoothly. Mark McGuinness has completed two consecutive terms (six years) on the Council and steps down this year. I am grateful to Mark for the patience, common sense and good humour he has brought to this role. Astrid an Huef also leaves the Council this year after seven years of service, including the last four as President and Vice-President. Astrid has provided outstanding leadership during her time on Council, contributing wisdom and a great deal of time and energy to ensuring that the Society aspires to the highest standards in its engagement with its members and the wider community. I thank Astrid for all her efforts over the years.

Vivien Kirk

INVITED ARTICLE

Headcount of women staff in Mathematics and Statistics in NZ universities

Summary
Below we present data on the gender distribution of academic staff in Mathematics and Statistics in universities in NZ. Compared with data reported on in the NZMS Newsletters #70 (August 1997) and #58 (August 1993), we have found that the participation of women in Mathematics and Statistics has improved but that the distribution is very unequal across the country and across academic levels. Overall, the number of women in senior levels is low, and some institutions have no or very low numbers of women at any level. Statistics has a more even gender distribution than Mathematics but has few women at senior levels. A large proportion of women are employed in teaching-only positions.

Motivation
The NZMS is concerned about under-representation of women in the mathematical sciences. The Society has recently:

1. committed to gather and monitor data about gender in its membership, its committees and prize winners;
2. instituted a Nominating Committee to ensure that a wider range of people might be considered for prizes, lectureships, Council vacancies etc

— see also p.37. Consistent with the commitment to gather data, we propose to conduct an annual survey of the gender distribution of academic staff in Mathematics and Statistics in tertiary institutions in NZ. We and the Society are often asked by other mathematical societies to provide such data. Below is our 2018 data.

Table 1: Overall participation rates by gender and academic level

2018 data	Maths Female	Maths Male	Stats Female	Stats Male
Postdocs and research fellows	2 (22%)	7 (78%)	4 (33%)	8 (67%)
Tutors and teaching fellows	15 (52%)	14 (48%)	14 (61%)	9 (39%)
Lecturers, including fixed term	7 (33%)	14 (67%)	7 (39%)	11 (61%)
Senior Lecturers	7 (19%)	29 (81%)	9 (24%)	28 (76%)
Associate Professors, Readers	6 (27%)	16 (73%)	8 (47%)	9 (53%)
Professors	2 (6%)	34 (94%)	3 (25%)	9 (75%)
Total	**39 (25%)**	**114 (75%)**	**45 (38%)**	**74 (62%)**

Methodology
We collected data by looking at university calendars and webpages, then asking an appropriate person in each Department or School (usually the head of the academic unit) to check the data we had obtained. We used a census date of March 1st, 2018. Our method of gathering data imposed some restrictions on the type of data we could collect. Specifically: our numbers represent a head count rather than taking into account FTE of each staff member; we have included fixed-term as well as permanent employees; we did not include emeritus staff or those with honorary contracts; and we used binary gender assignments. We collected data from the following universities: Massey, Auckland, AUT, Waikato, VUW, Canterbury and Otago. We could not find information about Mathematics and Statistics at Lincoln University.

We have chosen to separate Mathematics and Statistics numbers. In doing so, we acknowledge that the division is not always clear in those universities where both disciplines are within one academic unit. However, it is apparent from the data that something quite different is happening in the two disciplines, and separation of the disciplines is therefore helpful.

Data

Table 1 shows the number of women and men employed in each of the main academic levels, aggregated across NZ. The numbers in brackets are the corresponding percentages of the total (male plus female) employed at that level.

Figure 1 shows the distributions of women and men across the academic grades, for both Mathematics and Statistics. Women are significantly under-represented in the senior positions that require research, and are over-represented in the teaching-only positions. This pattern is similar for both Mathematics and Statistics, although less marked for Statistics where the percentage of both women and men in senior research-required positions is low.

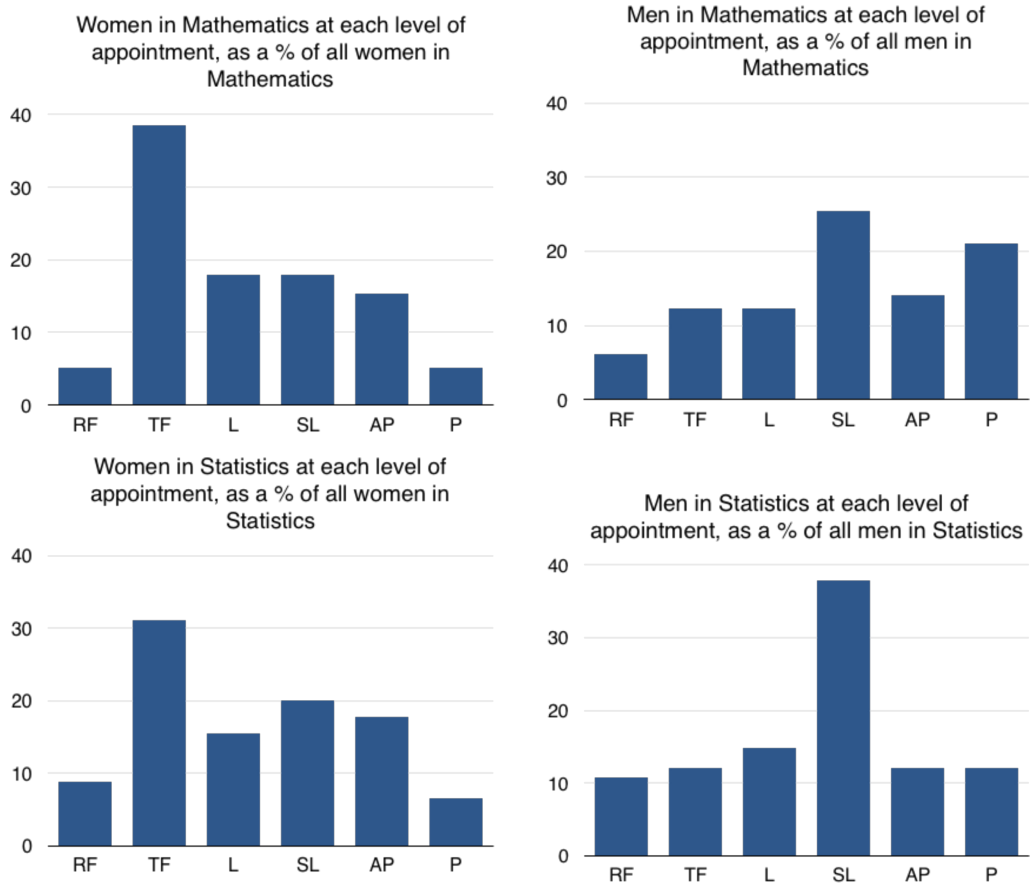


Figure 1: Distribution of women and men across the academic grades. RF=Postdocs, Research Fellows and Senior Research Fellows, TF=Tutors and Teaching Fellows, L=Lecturers (including fixed term), SL=Senior Lecturers, AP=Associate Professors and Readers, P=Professors.

Table 2 shows the number of men and women employed in positions that require research and positions that do not require research. The numbers in brackets show the corresponding percentages of the total (male plus female) employed in that type of position.

Table 2: Participation by type of position

2018 data	Maths Female	Maths Male	Stats Female	Stats Male
Research required	24 (19%)	100 (81%)	31 (32%)	65 (68%)
Research not required	15 (52%)	14 (48%)	14 (61%)	9 (39%)

The participation of women varies significantly across the institutions we surveyed, with the University of Auckland having by far the largest number of women staff of any of the universities. Table 3 shows the number

of women employed at the University of Auckland compared with the rest of NZ. Auckland has almost twice of the number of women in Mathematics and 2.5 times the number of women in Statistics compared with the next largest departments. Some universities have no or few women. In terms of percentage participation, Auckland, Canterbury and AUT have broadly similar, relatively high participation rates for women in Mathematics (33–39%), and Auckland, AUT and VUW have broadly similar relatively high rates for Statistics (44–50%).

Table 3: Number of women at the University of Auckland compared with the rest of NZ.

2018 data	Maths Female	Maths Male	Stats Female	Stats Male
Auckland	15	30	20	25
Rest of NZ	24	84	25	49
Auckland as a % of NZ total	38%	26%	44%	34%

A limited amount of data is available for 1997 and 1993, from the Newsletter articles cited above. While it is difficult to make a direct comparison with earlier data, to the best of our understanding the situation in Mathematics in 1997 was as in Table 4.

No data was given in the 1997 article about the participation of women in Statistics, although the data did include staff working in Operations Research in Mathematics departments; some of these staff might well be counted as Statistics staff today. Comparison of the data for 1997 and 2018 shows there has been a significant increase in the participation of women in Mathematics and Statistics in the last 21 years, with roughly double the number and percentage participation rates in 2018 compared with 1997.

Table 4: Participation data from 1997

1997 data	Maths Female	Maths Male
Research required	11 (9%)	105 (91%)
Research not required	9 (75%)	3 (25%)

Conclusions

There is still work to be done towards gender equality in Mathematics and Statistics in NZ universities. A long-term goal would be equal participation by women and men, but a shorter-term goal would be to aim for participation rates similar to those for undergraduates in NZ; we are not there yet, at least in Mathematics. Disappointingly, even though relatively high numbers of women PhD students were reported in 1993 and 1997 (e.g., 31% and 34% of PhD enrolments in Mathematics in 1993 and 1997, respectively) this has not flowed through to comparable participation rates for staff a generation later.

It is clear that some institutions and some disciplines are much more successful at recruiting and retaining women than others. A challenge for the NZ Mathematics and Statistics communities is to determine what activities or mechanisms are supporting gender equity in the departments that have significant numbers of women staff, and to encourage the departments experiencing less success to adopt these strategies where possible.

Astrid an Huef and Vivien Kirk

EDUCATION

High-school competitions at Victoria University of Wellington

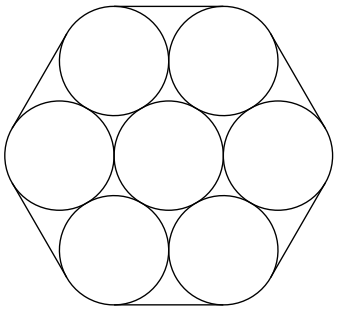
The School of Mathematics and Statistics at Victoria University of Wellington runs an annual competition in mathematics and statistics for high-school students from across the Wellington region, in collaboration with the Wellington Mathematics Association. The fifth such competition took place earlier this year, so this is an appropriate time to share some of our experiences.

Schools are invited to send a team, or teams, to compete, and the typical team size is eight. We encourage 'vertically integrated' teams, with representatives from different year-levels. Of course, this makes things more challenging for the organisers (as well as for the competitors), since the challenges must be accessible to students with diverse levels of experience. We do our best to ensure that teams are recognised not only for mathematical prowess, but also for creativity in other areas, such as best team-name.

Running the competition has become a full-department effort. Academics from both our mathematics and statistics groups write questions, and then help to mark solutions. This last job has to be done under a considerable amount of time pressure. Our graduate students also play a role. During several of the five competitions, we have been able to allocate a graduate 'coach' to each of the teams. A team's coach will work alongside them, providing some mathematical maturity, but perhaps more importantly, chat to the students and give them an idea of what it might be like to study mathematics at university. The administrative staff in the school, especially Ginny Whatarau and Kelsey Firmin, take on the logistical burden of keeping more than a hundred secondary students entertained, organised, and fed throughout the competition days. In the last competition, Kelsey also ran an exercise involving the traditional Māori pebble game, *mu torere* (see cyningstan.com/game/267/mu-torere). I think the mathematics of this game are genuinely interesting. Some analysis has appeared in the literature (jstor.org/stable/2690304), but I think there is the potential for a great deal more, especially on the complexity of a generalised form of the game.

The size of the competition has grown over time, albeit not monotonically. In 2014 we started with nine teams from seven schools, and by 2018 this had increased to seventeen teams from ten schools. We have discovered that persistent outreach to schools is very important. Kelsey has been especially pro-active in contacting single-sex girls' schools; and as a result, in 2017 and 2018, teams from such schools outnumbered those from boys' schools. Having said that, the single-sex Wellington College has achieved All Blacks-style dominance: taking home the gold medal in *every single one* of the competitions so far. The school that eventually topples them from first place will be rightfully proud.

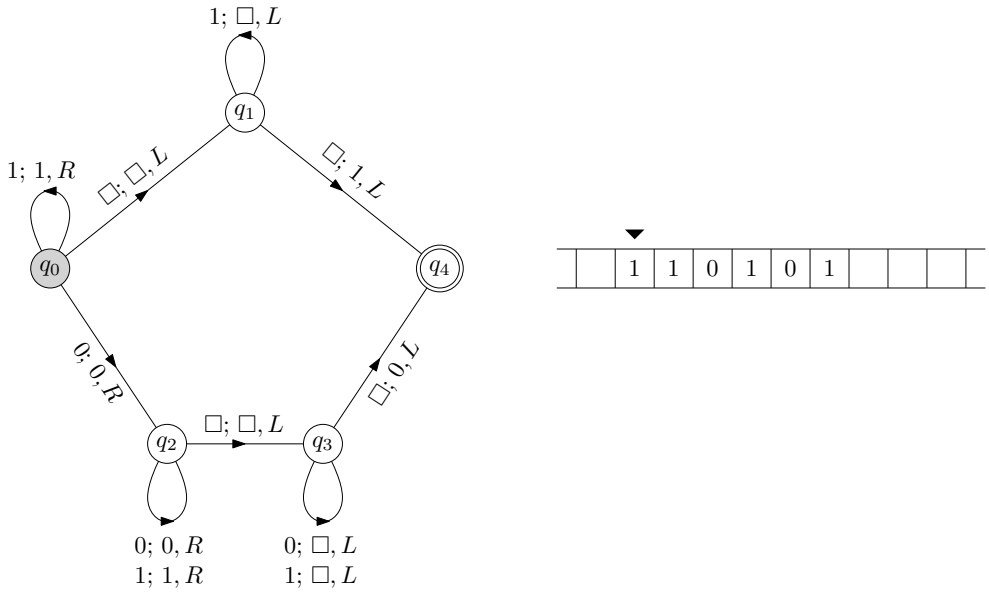
For the mathematics side of the competition, we have consistently relied on 'Olympiad-type' questions. In fact, we owe a debt to the Olympiad teams of Mexico, Ireland, Estonia, the United Kingdom, and various other nations. These countries have all worked hard to prepare their national teams, and several of their study booklets have been inherited by our school and have provided much inspiration for the question-writers. The schedule that we have developed involves setting Olympiad-style mathematics questions in the morning session. The second half of the day is usually dedicated to longer-form questions, in which the students are asked to provide a deeper analysis of a more open research-type question. These challenges have focused on a diverse array of topics including operations research, Student's t-distribution, and models of computing machines.



I am going to mention a couple of my favourite problems from the last five years of competitions. Solutions are available from me upon request!

The first question is simple but pleasing, and is inspired by the Olympiad team of Mexico (which is where I am writing this column, coincidentally). The above diagram shows seven coins, each with unit radius, tightly wrapped by a length of string. What is that length?

My second question comes from one of our longer-form investigations, in this case, an exploration of Turing machines. We define such a machine to be a labelled directed graph, as shown in the diagram below. We call the nodes of the graph *states*. One node is shaded grey, and this is our *starting state*. Any node marked with a double circle is a *halting state*. The accompanying tape is divided into an infinite number of *cells*, where each cell can contain one of three symbols: 0, 1, or the blank symbol, □. The black triangle shows the current location of the *read/write head*. Each arc of the directed graph tells us what steps to take at a stage of the computation. The first character on an arc-label tells us to follow that arc (transitioning to the state at the head of the arrow) if we are currently reading that character on the tape. In the example below, we start at the state q_0, and the character we are currently reading is 1. Therefore we follow the self-directed loop, meaning that we stay in the state q_0. The second character in the arc-label tells us to write 1 in the current cell of the tape, and the third character tells us to move the read/write head one cell to the right. All other arc-labels work in an analogous way. We continue the computation until we reach a halting state.



With a bit of work, we can see that this example machine will move the head to the right until it encounters a blank cell, and then start moving left, overwriting every cell with a blank symbol as it goes. When it encounters its next blank cell, it will overwrite it with a 1 or a 0, depending on whether it has encountered a 1 or not on its trip, and then halt. Thus this toy example can test whether a contiguous string of non-blank symbols contains a 1 or not. The Church-Turing thesis says that any computable function can be simulated by a machine such as this.

Now multiple challenges present themselves. For a simple one, we could ask students to construct a machine which will test a contiguous string of characters, and halt with a single 1 on the tape if and only if the input string is a palindrome. For a much more difficult challenge, we can ask the students to construct a machine which will write as many 1s as possible onto the tape, *before halting* (this constraint is important), given an initial tape filled with blank characters, and given that we only allow them three states, including one halting state. This challenge is known as the *busy beaver* problem, and is an active area of research. This illustrates exactly why I like exercises such as this one so much: students are very quickly taken to the boundary of the known mathematical universe. Challenges that introduce students to profound mathematical ideas in an accessible way are the most satisfying to me (and are not at all easy to construct). Anecdotal (and some qualitative) evidence suggests that students can enthusiastically embrace advanced challenges like this one.

I know that other mathematics departments around the country are involved in similar competitions, and I would be very interested to hear about their experiences. Equally, if anyone is thinking of starting a competition of their own, and would like to discuss our programme, I am always happy to chat!

Dillon Mayhew

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MATHEMATICAL MINIATURE

MM46: Stanley Gill 1926–1975

In the early development of computers, a crucial step forward was giving these new machines the ability to make decisions. This was accomplished in the stored-program computer, the EDSAC, by calculating the address of a **goto** statement before obeying it. Thus, **if** A **then** P **else** Q **fi** becomes a sequence of statements which carries out the steps:

1. Calculate an address n based on the formula for A. The value of n will be n_1 if A is true and n_2 if A is false
2. Place n in the address field of the following statement
3. Obey the statement **goto** n
4. A series of statements beginning with the label n_1 which carry out the work of P
5. **goto** m
6. A series of statements beginning with the label n_2 which carry out the work of Q
7. **goto** m
8. The rest of the program beginning with the label m

A closed subroutine on this type of computer is a sequence of statements ending with **goto** n where n is set to the address to return to when the work of the subroutine has been completed. Stanley Gill was a member of the team, led by Maurice Wilkes, which developed these pioneering accomplishments in the late 1940s. He is sometimes accredited personally with the invention of the closed subroutine. Gill became an essential member of the team that built the program library for the ILLIAC at the University of Illinois. In the late 1950s, half a world away, I was using this library on the University of Sydney SILLIAC, which had the same architecture. I had had no training in numerical analysis but I learnt the basics, and more than the basics, by understanding and using many of the fine subroutines in the ILLIAC library. Early computers used fixed-point arithmetic so that floating-point was only possible using a subroutine to do the detailed calculations. Amongst the applications of this technique, was a subroutine for carrying out a single step of a fourth-order Runge–Kutta. method. This subroutine was authored by S. Gill.

A method like this is based on a tableau

$$\begin{array}{c|cccc} 0 & & & & \\ c_2 & a_{21} & & & \\ c_3 & a_{31} & a_{32} & & \\ c_4 & a_{41} & a_{42} & a_{43} & \\ \hline & b_1 & b_2 & b_3 & b_4 \end{array},$$

with $c_i = \sum_{j<i} a_{ij}$ and the a_{ij}, b_i coefficients satisfy 8 conditions to achieve fourth order accuracy. It is known that all solutions to these conditions satisfy $c_4 = 1$. Kutta in 1901, found the solution to these conditions for a generic choice of c_2 and c_3 and also for some special cases of which the most well-known is based on Simpson's rule:

$$\begin{array}{c|cccc} 0 & & & & \\ \frac{1}{2} & \frac{1}{2} & & & \\ \frac{1}{2} & \frac{1}{2}-\frac{1}{6b_3} & \frac{1}{6b_3} & & \\ 1 & 0 & 1-3b_3 & 3b_3 & \\ \hline & \frac{1}{6} & \frac{2}{3}-b_3 & b_3 & \frac{1}{6} \end{array}, \qquad (*)$$

The most widely used of all Runge–Kutta methods is $(*)$ with $b_3 = \frac{1}{6}$, but Gill's ILLIAC program used, instead, $b_3 = \frac{1}{3} - \frac{1}{6}\sqrt{2}$. Why? It was shown by Gill that an N dimensional problem needs $4N + C$ memory locations to take a step with an arbitrary fourth order method but this can be reduced to $3N + C$ if

$$\det\left(\begin{bmatrix} 1 & a_{31} & a_{32} \\ 1 & a_{41} & a_{42} \\ 1 & b_1 & b_2 \end{bmatrix}\right) = 0. \qquad (\dagger)$$

Using the tableau $(*)$, this gives the restriction $18b_3^2 - 12b_3 + 1 = 0$ or $b_3 = \frac{1}{3} \pm \frac{1}{6}\sqrt{2}$. An argument based on error coefficients gives a preference for $b_3 = \frac{1}{3} - \frac{1}{6}\sqrt{2}$.

In Gill's day it was not feasible, because there was no algebraic manipulation software, to explore the generic case but with the simplification provided by $c_2 = 1 - c_3$. I am now able to report that in this newly-explored case, $(\dagger)$ gives the restriction $3c_3^3 - 3c_3 + 1 = 0$, with solutions $c_3 = -\frac{2}{\sqrt{3}}\cos\left(\frac{\pi}{18}\right), c_3 = \frac{2}{\sqrt{3}}\cos\left(\frac{5\pi}{18}\right), c_3 = \frac{2}{\sqrt{3}}\cos\left(\frac{7\pi}{18}\right)$. The third of these options gives what seems to be a promising new method.

Coming back to Gill's ILLIAC subroutine, when I tried to understand this 60 years ago, I didn't appreciate the strange way the output from a single step was put together as input for the following step. I now realise this was perhaps the first use of what is now called compensated summation — a device for eliminating the worst effects of round-off error.

Stanley Gill was also a pioneer in education as the first Professor of Computing Science at Imperial College, London.

J.C. Butcher

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CYBERMATH

Having failed to make the last issue, this column is probably too late to say anything interesting about the Fields medallists for 2018. The best general description of the medallists and their work that I saw was in Quanta magazine (quantamagazine.org/tag/2018-fields-medal-and-nevanlinna-prize-winners/) — there is a wealth of interesting information there. This free online resource backed by the Simons Foundation (itself created by the world's richest mathematician) has many excellent articles written for the thinking layperson. For a completely different perspective, see Doron Zeilberger's opinion at sites.math.rutgers.edu/~zeilberg/Opinion168.html.

I have started using Twitter (but only as representative of professional organisations MathOA and Free Journal Network) and have been looking for interesting mathematical content there. Twitter is best used to advertise links to other content, and formulae are not easy to include there. It might be fun to try to present a nontrivial proof in 140 (or 280) characters! A recent tweet by Clifford Pickover presented a 1966 paper from Bulletin of the American Mathematical Society (twitter.com/pickover/status/585271919991095296) that was only two sentences long, with no abstract, which is presumably a record. If any readers have interesting links to mathematics on Twitter, please let this column(ist) know.

So, as usual, back to academic publishing. The big news since the last column is the advent of Plan S (coalition-s.org), stemming from a decision by several national European science funders to accelerate the change to open access publication that has been seen by many as inevitable since the internet became widely used in the late 1990s. After all, publication means making public, and not using modern technology to do that seems very weird. Plan S, which has already been revised once and which has a feedback deadline of 1 February 2018, has attracted support from charitable funders (such as the Gates Foundation) and non-European government funders — including several from China, which many outsiders had seen as uninterested in open access. If it is implemented as expected, within 2 years all grant-funded research will have to be published under stringent open access rules. This is a major incentive for "prestigious" journals to change their way of operating. I recently had a conversion with the Editor-in-Chief of perhaps the most highly-reputed mathematics journal, who is concerned about this issue (but apparently not yet concerned enough to make major changes in the journal's antiquated processes!)

As usual when the status quo is threatened, there has been resistance. An open letter by researchers mainly in the field of chemistry (sites.google.com/view/plansopenletter/home) has circulated. And support: a letter supporting funder mandates of the Plan S type (michaeleisen.org/petition/) has circulated more recently. Each has 1000–2000 signatories, a tiny fraction of researchers worldwide (I have signed the second but not the first). The main concerns of the former letter are academic freedom (which I consider to be barely relevant here) and the impact on scholarly societies, which often subsidise their operations via journal subscriptions.

The NZ Journal of Mathematics (nzjm.math.auckland.ac.nz/index.php/New_Zealand_Journal_of_Mathematics), supported by the NZ Mathematical Society and the University of Auckland Maths Department, is freely available online with no authors charges, which is excellent. However it has been allowed to stagnate in some ways, and is not up to the standard of similar journals. I am not discussing the editorial and refereeing standards, but the website, licence information, ethics statement, and other things expected from a serious publisher (see the criteria for membership of the Free Journal Network, satisfied by the Australasian Journal of Combinatorics and Electronic Journal of Combinatorics, for example). I hope that some much-needed modernisation can occur and this journal can take its rightful place in the journal ecosystem.

It is not hard to imagine a much better system than the current one. Universal open access, with publication costs paid for by libraries and research funders without authors having to consider payment, would save perhaps 80% of current costs worldwide (now paid mostly by libraries via subscriptions). To keep costs even lower, a widespread use of the arXiv overlay model used by, for example Tim Gowers's recently established Discrete Analysis and Advances in Combinatorics would be a substantial improvement. One of the features of the current system that every researcher knows about but is rarely mentioned in policy discussions is that (at least in fields like mathematics) commercial publishers very often subtract value from an arXiv version by making typesetting and proofreading errors. In fact, the published version has not really been peer reviewed, because changes can be made by the author after acceptance and usually only non-researcher publisher staff see them.

Conversion to a better system has been much slower than everyone expected. My opinion is that there is plenty of blame to go around and that big commercial publishers must share some of it, but universities, learned societies and researchers have had the ability to fix the situation and have largely abdicated their responsibility. I urge all readers to at least support those of us who are working hard to bring about a better system, even if you can't

spare any effort to help. A simple discussion with colleagues and administrators at your own institution can often be surprisingly fruitful. And make your voice heard by signing relevant petitions, or explicitly state that you are apathetic and I can have your proxy vote! And those happy few readers who are in a position to influence policy, please do it, or ask me how. For example, the RSNZ/Marsden Fund could sign up to Plan S right away if they chose.

For those interested in control by researchers of scholarly publishing (which is the first principle of Fair Open Access and without which, in my view, no good sustainable alternative system can function), there will be an online event on 7 February 2019 with which Free Journals Network is involved, among several other organisations. Check out Academic-Led Publishing Day at academicledpublishingday.com.

Some other big news since the last column concerns the Ted Hill affair. This is an enormously controversial issue, and I will give some selected links for those who have not already followed it. Briefly, a paper studying a model of evolution that some might argue could support a view that differences in participation in research mathematics by men and women may not be due solely to deficient social organization was accepted by Mathematical Intelligencer, then rejected for essentially political reasons. It was then accepted in New York Journal of Mathematics and swiftly removed after complaints by its editorial board. The Editor-in-Chief died very soon after and the accepting editor is no longer an editor there. My opinion is that very few people came out of this looking better than when they went in, and it shows the need for high ethical standards in all aspects of research. When the basic standards of liberal democracy are under heavy assault by authoritarian leaders and their helpers worldwide, we must hold the line and not allow science to be polluted. And we should strive to improve our standards — several years of being interested in academic publishing have shown me that there are many dodgy practices still out there!

Some links:

- quillette.com/2018/09/07/academic-activists-send-a-published-paper-down-the-memory-hole/
- reddit.com/r/skeptic/comments/9f6gs6/the_other_side_to_the_story_about_ted_hills/
- gowers.wordpress.com/2018/09/13/additional-thoughts-on-the-ted-hill-paper/

Editors' note: here are some additional links to complement those above:

- liorpachter.wordpress.com/2018/09/17/mathematics-matters/
- gowers.wordpress.com/2018/09/09/has-an-uncomfortable-truth-been-suppressed/

Mark C. Wilson

The opinions expressed in this article are the author's own and do not necessarily represent the official policy or position of the NZMS.

MATHEMATICAL MISEPONYMY

Bell Numbers

There are quite a few possible definitions of these numbers but here is one. The Bell numbers form a sequence $\langle b_n \rangle$ of positive integers such that for each n, b_n is the number of partitions of a set of n elements. A partition of a set is a collection of mutually disjoint subsets whose union is the set. So, for example, $b_3 = 5$ because the set $\{x,y,z\}$ has the five partitions: $\{\{x\},\{y\},\{z\}\}$, $\{\{x\},\{y,z\}\}$, $\{\{y\},\{x,z\}\}$, $\{\{z\},\{x,y\}\}$ and $\{\{x,y,z\}\}$. The sequence starts at $b_0 = 1$ and continues $1,2,5,15,52,203,877$, growing quite quickly as one might imagine, so $b_{20} = 51724158235372$.

Two ready sources concerning the Bell numbers are [7][1] and [8]. These sources describe many other equivalent ways to define the Bell numbers, including the number of rhyme schemes for an n-line poem: a typical limerick has rhyme scheme *aabba*, meaning that there are five lines with the last syllables of the first, second and fifth rhyming as for the third and fourth. A 3-line poem could have five rhyme schemes: *abc, abb, aba, aab* and *aaa*; I have listed them in that order to emphasise the natural enough bijection with the example given after the definition.

It seems that the Bell sequence was so named because Bell discussed it in a paper [2, p 540] appearing in 1938. However, the sequence was discussed many times before Bell, with Bell himself referring to the expression $\frac{1}{e}\sum_{m=0}^{\infty}\frac{m^n}{m!}$, which is equal to b_n as long as you allow $0^0 = 1$, appearing in [3] in 1877 and noting that it 'has been ascribed to Euler, but without a specific reference'. In 1880, Charles Peirce, see [6, p 48], discusses the classification of relatives and the table on p 48 containing the Bell numbers is a variant of the Pascal triangle, later used by the New Zealander Alexander Aitken in [1], again before [2]. Each of the two edges of the Peirce(-Aitken?) triangle list the sequence $\langle b_n \rangle$.

All of these sources, however, were beaten by an ancient game played in Japan and described in [5, pp 25–27]. In the game genji-ko the host would in turn burn five packets of incense and the players were asked to guess which were the same as each other and which different: a bit like wine-tasting, I suppose. It was recognised that there were $52 (= b_5)$ possibilities. One figure in [4] lists all of these possibilities diagrammatically; for example one such partition, corresponding to the limerick rhyme scheme, is represented by a figure like that below. As described in [5], this led to Takakazu Seki and his students in the early 1700s investigating the number of partitions for an n-point set, with some outcomes appearing in a book published in 1769.

Meanwhile in England, George Puttenham, a writer and literary critic, published in 1589 a book that included some possible rhyme schemes for poems with diagrams somewhat like those appearing in [4] but his list was incomplete. The connection between Bell numbers and rhyming schemes is therefore quite old.

References

[1] A C Aitken, *A problem in combinations*, Mathematical Notes **28** (1880), 18–23.

[2] E T Bell, *Exponential polynomials*, Annals of Mathematics **35** (1880), 539–557.

[3] G Dobiński, *Summirung der Reihe* $\sum \frac{n^m}{n!}$ *für* $m = 1,2,3,4,5,\ldots$, Grunert's Archiv, **61**, 333–336.

[4] http://www.japanese-incense.com/genji

[5] Donald E Knuth, *Two thousand years of combinatorics*, in *Combinatorics: Ancient and Modern*, Robin Wilson and John J Watkins (eds), Oxford University Press, 2013, pp. 7–37.

[6] C S Peirce, *On the algebra of logic*, American Journal of Mathematics **3 (1)** (1880), 15–57.

[7] N J A Sloane (ed), http://oeis.org/A000110

[8] https://en.wikipedia.org/wiki/Bell_number

David Gauld

[1] At the time of writing this source (lop off the A000110) consists of 321324 (but a week later this had grown to 321514) different integer sequences collected by Sloane, details of some still pending, and includes one contributed by me.

PROFILE

Vivien Kirk

In the nature of things, one has few colleagues that command unqualified respect and admiration. One likes one's colleagues, of course, one has to, but it's the unqualified bit that can often be a sticking point.

Not so with Vivien Kirk. She has shown herself to be invaluable in so many spheres; as a research colleague, as an administrator, as a dedicated and wonderful teacher, as an organiser, as an inspiration to so many students, as a source of strength to so many others, and, most particularly, as a rigorous and penetrating mind, accompanied by an unparalleled kindness and empathy. This combination is not so commonly found, and thus Vivien is deservedly regarded as one of the true leaders of the New Zealand applied mathematics community.

It was many years ago, maybe around 16, that I first met Vivien Kirk (that I can remember, anyway). I was giving a talk for a job interview at the University of Auckland, and I was blathering on in typical fashion about the dynamics of something or other. A hand pops up in the audience; it was Vivien. "No", she said, "you're completely wrong." (Well, I paraphrase, as Vivien would never be so directly impolite, but I have accurately conveyed the underlying message.[2]) From such humble beginnings are collaborations made and friendships built; over the years since then Vivien and I have worked together on many, many problems, and she has become undoubtedly one of my closest, most trusted, and most valued colleagues.

Vivien's early training was at the University of Auckland, in both Mathematics and Physics. I asked her why. It was from her parents, she said. Her father was a maths teacher, and, showing an early penchant for questionable

[2]If you ask Vivien about this directly she will deny ever having said anything of the sort, and she will accuse me of making up falsehoods. Don't believe her. Trust me. It really happened.

behaviour, she'd bribe him into giving her short math problems (if a watermelon costs $5.17 and 27 people need to eat it, etc). So doing Maths and Physics at Auckland was a natural extension; much like childhood, really, but without (one hopes) the bribery.

Once she'd finished her BSc in Maths and Physics Vivien had worked out that she didn't want to continue in Maths (the people were too strange), so did her MSc in Physics, with Paul Barker[3]. On some topic that I forgot to ask about, but in the general area of Nuclear Physics. After that it was Cambridge, in the department of Applied Mathematics and Theoretical Physics, for her PhD with Nigel Weiss. During her PhD Vivien also worked closely with Paul Glendinning and Colin Sparrow, so when she'd finished her PhD, she went off to study with another dynamical systems luminary, in the person of Jerrold Marsden, who was then at Berkeley. When, 18 months later, Marsden moved to CalTech, Vivien went too.

Since those years Vivien has established an enduring interest and international reputation in the field of dynamical systems. Why dynamical systems, I asked her. It's an easy question to ask, but not really a fair one; can anybody really explain to somebody else why they find subject X interesting? Still, Vivien tried. It's the variety, she said. The ability to work on a diverse set of problems, from theoretical to computational to very applied. The connection to experiments, which can add another dimension. The construction of new tools for solving new problems. The qualitative nature of the work, which suits someone not interested in proving theorems.

At any rate, from CalTech it was back to New Zealand, to a job as Lecturer in the Department of Mathematics and Statistics, headed at that time by Alastair Scott. Moving to a Maths department wasn't such a huge leap from Physics, of course, particularly as the field of dynamical systems had, to a considerable extent, migrated to Maths departments by then.

Why New Zealand? I mean, we are talking about a young mathematician of the highest possible pedigree. Cambridge, Berkeley, CalTech; it simply doesn't get any better. Job offers would have been streaming in (yes, they were, says Vivien. Well, at least one.). But as with so many native New Zealanders the answer is simple but hard to explain. Vivien had family in Auckland. She loved New Zealand. She didn't want to spend the rest of her life in the U.S., and the longer you stay the harder it is to move. All small things by themselves, I suppose, and difficult to stack up against a high-performance career doing something you love at the very best places in the world. But these small things get under your skin, and before you know it, you've moved. Against, Vivien adds, the strongly-worded advice of eminent New Zealand mathematicians working overseas, who told her she was crazy.

Vivien disagreed, and home she came, to Auckland in 1992, where Margaret Morton was the only female permanent research faculty. The interest in dynamical systems has persisted, and nowadays Vivien works with a wide range of people, both in New Zealand and abroad. Her work with me concentrates on very applied questions, and links to experiments. Her work with Martin Wechselberger focuses on the construction of new tools for multiple time scale problems. With Mathieu Desroches it's theoretical questions to do with things I don't understand (which doesn't really restrict the field a great deal). Vivien has worked with Hinke Osinga and Claire Postlethwaite, with Jonathan Rubin, Alastair Rucklidge, Mary Silber, and Edgar Knobloch, a roll call of prestigious names in a variety of disciplines. Vivien has maintained this diversity throughout her entire career, and prospered with it.

The prosperity (speaking from a research point of view) is the result of multiple Marsden grants, over many years, yet another striking demonstration of the superlative quality of Vivien's research. I forgot to ask Vivien how many Marsden grants she has had as Principal Investigator. It's been a lot. At least three. Not to mention a string of other grants to fill up the spaces.

On the topic of grants, I asked Vivien if she has any advice for younger researchers about to embark on the dispiriting and intimidating treadmill of grant application writing. She passed on some advice that she originally got from Ivan Reilly. You will write applications, and you will be rejected. Some of the time you might even be successful. But either way, don't take it personally. If your application is rejected it doesn't mean it was bad. It simply means you weren't the lucky one. And the converse is true also. If you get the grant, it doesn't mean you're any better than your peers, just that you were luckier that time around. Next time is likely to be different. It's very good advice, I think.

However, right from the beginning of her career Vivien has been about a lot more than simply doing top-quality research. She has devoted a large part of her time to administration, to organising the best possible teaching, to the construction and running of the Applied Mathematics Unit at the University of Auckland, and, most recently, as Associate Dean of Science (more on this later).

[3] As an objective interviewer I absolutely should not point out out that some people — who wish to remain strictly anonymous —- would describe this as out of the frying pan into the fire.

Of course, it's not simply administration. For Vivien, such administrative work is indistinguishable from one of her major passions; the fight for gender equity in Science generally, but in Mathematics in particular. She was trained in a field that was, and remains, highly male dominated. Vivien rattles off some relevant statistics. In all of New Zealand there are 36 professors of mathematics, 2 of whom, at the time of writing, are female. There is a Maths department in New Zealand that has not a single female permanent research faculty member. There have been improvements over the past twenty years, no doubt, but it's sobering to realise that, although in 1997 a significant fraction of Maths PhD students were female, this proportion has not translated to permanent academic jobs. I can remember making this argument myself, 20 years ago. Time will fix the problem, we argued, we just have to wait until the current PhD cohort is old enough, and then gender representation in Maths departments will finally achieve a more equitable balance.

I need hardly point out that we were completely wrong. It hasn't happened. But why not? Well, as with anything there are surely multiple reasons. Often, like a crystal, a seed is needed around which the crystal can coalesce. Maybe for historical reasons, maybe from pure chance, maybe from the persistence of entrenched and unattractive attitudes, this crystal seed hasn't happened in all places. In Auckland I like to think we're doing reasonably well; we have 14 out of 42 female faculty members. Not an equitable balance yet by any means, but moving in the right direction. And for us in Auckland, there is absolutely no doubt that the crystal seed has been Vivien Kirk. She has been a tireless campaigner for gender balance, she has been the quiet (or not) voice of reason in a sea of bias and opinion, she has stood firm time and time again against the forces of narrow-mindedness, and has remained true to her principles even when poorly supported by her administrative superiors. By the way, those are my words, not Vivien's; her language is usually more temperate, at least in public.

The fight for gender equity has, for Vivien, spilled over more recently into more senior administrative duties, where she has taken up the role of Associate Dean of Science with responsibility for doctoral students. Yes, I know it's a mouthful. All PhD students are highly vulnerable. They have no idea what good PhD supervision is — after all, they've never done a PhD before, mostly — and their supervisor can promote or blight their entire future career, for good reasons or for bad.

As Vivien points out, we usually have no problem with oversight of our undergraduate teaching. We get assessments from the students and from our peers. Our exams are carefully checked by others. The students have had dozens of different lecturers and are perfectly capable of telling good from bad. If you say something you shouldn't in class (and I have, you won't be surprised to hear) there are 100 students out there who all know perfectly well you shouldn't have said it, all eager to call you out and haul you over the coals. As they should. But PhD supervision isn't like this. There can be very little oversight. The supervisor, like the student, often has very little experience. It is not always clear, either to the student or the supervisor, where the boundaries lie, and in such fluid and uncertain circumstances lies great potential for things going badly wrong. And that is the space where Vivien likes to work, protecting, as best she can, those who need it, and ensuring that the job is done properly.

Finally, one cannot in fairness talk about Vivien without talking about her dedication to teaching. She is (in my opinion, anyway) a superb teacher. Indeed, if I were being honest, I would have to admit that she's a bit scary, especially to lazy and careless people such as myself. Vivien doesn't tolerate that. She runs a tight ship. She has set up courses properly, has taught them brilliantly herself, and expects everybody else to do likewise. For years, Vivien was the heart and soul of the Applied Maths Unit at Auckland, overseeing the course structure, ensuring that everybody did their jobs properly, and pushing us all, from part-time tutors to full-time professors, to do the best job possible. Like I say, scary, but in a very impressive way.

As my last question I asked Vivien what she does outside her job. "Music", she said immediately, "although I don't play so much now." It transpires that she plays everything. Her mother was a music teacher, Vivien was the third child, and so any time another instrument was needed, Vivien had to play it. They needed an oboe; Vivien had to learn it. They had a spare double bass; Vivien had to learn it. Even now, Vivien has anxiety dreams about showing up to a concert and being made to play an instrument she's never learned. Like the tuba. She can't play the tuba, apparently. Or the bagpipes.

I find this oddly reassuring. It's good to know that there are some things Vivien can't do. Because to the rest of us mere mortals it's not so obvious that such things exist.

James Sneyd

LOCAL NEWS

AUCKLAND UNIVERSITY OF TECHNOLOGY

SCHOOL OF ENGINEERING, COMPUTER AND MATHEMATICAL SCIENCES

Events

On 22–23 November, the Mathematical Science Research Group (MSRG) hosted the 5th annual AUT Mathematical Sciences Symposium. This was a joint effort of Profs Jiling Cao and Jeffrey Hunter, with the assistance of Drs Kate Lee, Sarah Marshall, Nuttanan Wichitaksorn and Wenjun Zhang. The symposium focused mainly on some areas in Applied Mathematics and Analytics/Statistics. This main purpose of this annual event was to develop and promote opportunities for AUT academic staff working on these areas to collaborate with colleagues from other universities. Over 50 delegates attended the event, with 31 talks across all areas of the mathematical sciences, including statistical programming, statistical methodology, stochastic modelling, data science, computational and mathematical modelling, financial analytics, financial mathematics, decision analysis, and structural dynamics.

Travel and Conference Participation

Dr Murray Black attended the biennial International STEM Conference hosted by the Queensland University of Technology between 21st and 23rd November inclusive. It brought together a large range of lecturers from education and STEM disciplines throughout several universities. The main theme of the conference was using integration in the teaching of STEM subjects over a range of transdisciplinary and multidisciplinary approaches. A large range of papers were presented researching various learning, teaching and assessment approaches in the STEM subjects. Murray's talk "*Using Structured Inquiry Based Assessments in a Quality Assurance Course*" presented evidence to suggest that using assessments based on a research question and topics taught in related papers, involving the key statistical concepts being tested, led to significantly better student outcomes in our largely statistics based on the Quality Assurance paper taught at AUT in the past years.

Between 31 July and 6 August, Prof Jiling Cao attended the 2nd International Conference of Mathematical Sciences (ICMS 2018), held at Maltepe University, Istanbul, Turkey, where he presented a plenary talk, entitled with "*Core versus Equilibrium in Economies with Differential Information*". In October, Jiling visited three universities in China: Minnan Normal University, Sichuan University and Southwestern University of Finance and Economics. During his visit at Sichuan University, Jiling and three colleagues (Shuguo Zhang, Hui Kou and Dexue Zhang) from the School of Mathematical Sciences there discussed and planned the 3rd Pan-Pacific International Conference on Topology and Applications, to be held at Sichuan University in November 2019.

Fisher's notion of "sufficient statistic" has been of great importance in theoretical statistics but of limited practical importance in applications because of its strong dependence on model assumptions. In the world of 'big data', however, the concept may be coming into a new heyday as it turns out have a useful role in compressing 'chunks' of data. Dr Murray Jorgensen has been exploring some of the applications of sufficiency in the statistical analysis of data sets to large for conventional analyses. He presented a talk on this topic at the 2018 AUT Mathematical Sciences Symposium.

Dr Sarah Marshall gave a talk entitled "*Modelling a Renewing Free Repair Warranty Using an Alternating Geometric Process*" at the Joint NZSA/ORSNZ Conference held at Massey University, Palmerston North from 27–30 November 2018. There were over 100 delegates in attendance, with presentations from both academia and industry.

Drs Catherine Hassell Sweatman, Alna Van Der Merwe and Wenjun Zhang attended the New Zealand Mathematical Society Colloquium, 4–6 December 2018, held at University of Otago, Dunedin, where each of them presented talks about their recent research work.

Dr Xinfeng Ruan attended the New Zealand Finance Meeting 2018, held in Queenstown NZ from 17 to 19 December 2018. At the conference, he delivered a talk on his recent work of "*The Information Content of Short Selling and Put Option Trading: When Are They Substitutes?*".

Wenjun Zhang

UNIVERSITY OF AUCKLAND

DEPARTMENT OF ENGINEERING SCIENCE

The Department has seen some recent PhD completions. Dr Regan Baucke defended his thesis 'Risk aversion in multistage stochastic optimisation problems' and has secured a post-doctoral research position in France. Dr Corey Kok defended his thesis 'Electricity generation capacity expansion under uncertainty and risk', and Dr Brad Raos successfully defended his thesis 'Patterning human brain cells in 3D on silicon chip'. The Department would like to offer its congratulations to all three on their achievements.

In recent funding rounds, Dr John Cater has been awarded just under $1 million by MBIE to develop a

Delegates in the AUT Mathematical Sciences Symposium.

new metal foam to create a shield that allows an object to re-enter Earth's orbit without being destroyed, was also Associate Investigator on a successful $1 million Marsden grant 'Reap the Whirlwind and Produce Carbon-Neutral Power From Atmospheric Buoyancy Vortices' alongside Principal Investigator Prof. Richard Flay in Mechanical Engineering, and also an Associate Investigator on a second Marsden award 'Locking up oxygen in titanium to achieve strength-ductility synergy'.

The work of a number of our undergraduate and postgraduate students was recognised at this year's Stats NZ and Operations Research Society of NZ meeting, held in Palmerston North. These included the ORSNZ Suez Young Practitioner Prize Competition 2018: First Prize, awrded to Isaac D. Cleland, Andrew Mason, and Michael O'Sullivan for their work "Improved Staff Rostering Algorithms". The ORSNZ Suez Young Practitioner Prize Competition 2018: Second Prize, and John A G George Memorial Prize: First Equal was awarded to Haddon Smith, Thomas Graham-Murdoch, Richard Clarke, Naresh Singhal, Alys Clarke, Vinod Suresh, Andrew Mason, and Stephen Waite for their work "Determining effective placement strategies for denitrifying bioreactors in New Zealand river systems". Finally, the ORSNZ Suez Young Practitioner Prize Competition 2018: Third Prize, and John A G George Memorial Prize: First Equal, to Jesse Prendergast, Andrea Raith, and Andrew Mason for their work "Simulating First and Last Mile Transport in Auckland".

Isaac Cleland has also recently been recognised for his achievements in staff rostering problems. Staff rostering is widely recognised as a difficult combinatorial optimisation problem. In 2010, the International Nurse Rostering Competition (INRC) was held to generate new approaches to solving staff rostering problems by attracting competitors from multiple disciplines to solve a series of 45 hard nurse rostering problem instances. Since the competition has been held, over 100 papers have been published using these problem instances as benchmarks for a variety of algorithms. These algorithms include mixed integer programming, column generation, constraint programming, variable neighbourhood search and many other heuristics. Recently PhD candidate Isaac Cleland, supervised by Andrew Mason and Michael O'Sullivan, also became the first person to solve every single problem instance to proven optimality using an improved column generation algorithm and, in doing so, found 4 new solutions which have been published on the INRC website.

The Department has also enjoyed a number of recent seminars delivered by visitors. These include: Introduction to Tecnomatix Plant Simulation, Aina Goday Verdaguer (University of Twente); The Day After Optimal: Operations Research and Modern Logistics, Prof Stefan Nickel (Karlsruhe Institute of Technology); Duty Rostering for Physicians: An Optimization Model and its Implementation at a Department of Orthopedics and Trauma Surgery, Prof. Clemens Thielen (TU Kaiserslautern); Optimisation and Machine Leaning in practice at Deliveroo and Tesco, Anthony Phillips (Data Scientist based in London).

Richard Clarke

DEPARTMENT OF MATHEMATICS

New arrivals

Marie Graff (formerly Marie Kray), took up a Lectureship in the Department in September. Marie's main interests are in Numerical Analysis of Partial Differential Equations focused on Wave Propagation Phenomena and related Inverse Problems. After her PhD in Paris in 2012 on Time Reversal techniques, Marie was a postdoctoral fellow at the University of Basel in Mathematics, then at the University of British Columbia in Geophysics and Seismic Exploration.

Padraic Bartlett and Gemma Mason are the proud new parents of Robin (see picture).

Phd student James Hannam and his partner Sheng Gong have also had a baby boy.

Major news

During the week September 17–21, to celebrate Suffrage 125, the Department of Mathematics was renamed as the Kate Edger Department of Mathematics (and the Faculty of Science was renamed as the Dame Charmian O'Connor Faculty of Science).

Marston Conder was awarded the Jones Medal of the Royal Society of New Zealand for his internationally renowned research on symmetry and chirality in discrete structures, and his exemplary leadership and service in the New Zealand mathematical sciences community.

Sina Greenwood and Gabriel Verret were awarded Marsden grants.

Professor Edgar Knobloch (University of California, Berkeley) visited the department as the Michael Erceg Senior Visiting Fellow. This fellowship is made possible by generous support from the Margaret and John Kalman Charitable Trust. Professor Knobloch gave a department colloquium on "Geostrophic turbulence and the formation of large scale structures" and a public lecture on "Spatially localized structures: what are they and how do we understand them?"

Other news

Marston Conder was an invited speaker at a BIRS workshop on "Symmetry Breaking in Discrete Structures" at Oaxaca (Mexico) in September, and a plenary speaker at a conference on Topological Graph Theory at Yokohama (Japan) in late October. He spent three weeks in Wellington in November/December acting as one of the three Moderators for the 2018 PBRF Quality Evaluation. He is also helping organise this year's Australasian Conference on Combinatorial Mathematics and Combinatorial Computing, in Rotorua.

Steven Galbraith gave a plenary lecture at the conference "Open questions in number theory and cryptography" held in Irvine in celebration of Alice Silverberg's 60th birthday. He visited the UK, France and Belgium, including meeting former colleages Dimitri Leemans and Julie De Saedeleer in Brussels. He is currently hosting Victor Flynn (Oxford) for 5 months, and organised a Number Theory Workshop in Auckland that featured talks by Victor, Yan Bo Ti (Auckland), BD Kim (Victoria), Hamish Gilmore (Waikato), Felipe Voloch (Canterbury) and Brendan Creutz (Canterbury). Steven is also the editor (with Thomas Peyrin) of the proceedings of the conference ASIACRYPT 2018, published in three(!) volumes of Springer Lecture Notes in Computer Science. Steven will be taking over as head of department in February.

Sina Greenwood gave an invited talk at the Spring Topology and Dynamical Systems Conference at Auburn University, visited Dalian Minzu University (China), and was visited by Iztok Banič (University of Maribor) and Sonja Stimac (University of Zagreb). She was selected for the NZ Women in Leadership Programme in Wellington, and topped off the great year with her funded Marsden project on "Dynamical systems from set-valued functions".

Pedram Hekmati is organising a conference on "Character Varieties and Topological Quantum Field Theory" in December.

Warren Moors has mostly finished his part of the book "USCO and quasicontinuous mappings", coauthored with L. Hola and D. Holy. He is now focussing on the book "Separate and joint continuity",

co-authored with Jiling Cao. He was in Sofia (Bulgaria) for several months (July-September) working on a project on applications of topological games to Functional Analysis and Optimisation. In December he will become a Fellow of the New Zealand Mathematical Society.

Julia Novak has been the 2018 Faculty of Science CLeaR Fellow in Teaching and Learning, focussed on the theme 'He Vaka Moana: Navigating Māori & Pasifika Student Success'. During the year she presented at the Vaka Pasifiki Education Conference (Suva, July) and the International Indigenous Research Conference — Ngā Pae o te Māramatanga (Auckland, November). She also co-organised two Talanoa events for Embedding Indigenous Values, Culture & Knowledge in Teaching and Learning, and was a participant in a discussion 'De-colonising higher education: Embedding Pacific indigenous knowledges and identities'.

Hinke Osinga was a plenary speaker at Dynamics Days Latin America and the Caribbean, 2018, in Punta del Este, Uruguay.

Jeroen Schillewaert has been awarded a Robert Bartnik Visiting fellowship at Monash University. He was visited by Prof. David Conlon (who was the University of Auckland Kalman Fellow in 2018) and is organising the event Groups and Geometries 2019.

Gabriel Verret received a Marsden fast-start grant to study "Local theory for arc-transitive digraphs". He oraganised a Group Theory Workshop on Friday 30 November in Auckland, featuring lectures by Michael Giudici (UWA), Micael Toledo (Ljubljana), Gabriel Verret (UoA), Florian Lehner (Warwick), Luke Morgan (UWA), Martin Bachratý (UoA), Anton Baykalov (UoA) and Emilio Pierro (UWA).

Steven Galbraith

UNIVERSITY OF WAIKATO

DEPARTMENT OF MATHEMATICS AND STATISTICS

Retirement of Ernie Kalnins

A function was held in November to celebrate the retirement of Professor Ernie Kalnins after a very distinguished career at Waikato of 44 years. Ernie established his reputation mainly in the area of separation of variables for partial differential equations. He will be continuing at the University of Waikato with a part time contract, mainly engaged in research. His contact details are the same as before, with email e.kalnins@waikato.ac.nz.

Raziyeh Zarre

Raziyeh joined the department in September as a Senior Tutor. She was born in Iran and obtained her first degrees in pure mathematics from Ferdowsi University of Mashhad. She moved to New Zealand in 2012 with a Marsden Fund scholarship to undertake study towards the Ph.D. at Massey University, Palmerston North. Her topic was, image registration using finite dimensional Lie groups, which was completed in 2016, and has led to interests in shape analysis, computational anatomy, Lie groups and image registration. Her email is rzarre@waikato.ac.nz.

Ernie Kalnins retired after 44 years.

The passing of Ross Barnett

Ross died near the end of November. He had been a resident of Malvina Major Rest Home and suffered declining health. Ross was a research associate in the department from around 2000 until he moved to Wellington at the end of 2013. After completing a masters in physics at Victoria he took up a scholarship at Oxford. Positions at the Universities of California and Minnesota were followed by a position at the University of Manchester, at which he spent the bulk of his career. Starting as a nuclear physicist he evolved into becoming an expert on the computation of special functions, doing ground breaking work on the numerical evaluation of Bessel and gamma functions. Following his retirement he returned to NZ and joined the department, working productively on developing a better understanding of the Riemann zeta and gamma functions. He is survived by two children (both of whom have careers closely connected with computers, with one a group director at Jim Simmonds Flatiron Institute in NYC) and two grandchildren.

John Turner turns 90

In early October a function was held in Hamilton Gardens to celebrate John Turner's 90th birthday. It

Raziyeh Zarre — new Waikato staff member.

John Turner giving his birthday speech. Photo credit: Jackie Broughan.

Ross and Kevin at a Massey Colloquium.

was attended by many members and former members of staff of the University, including from Mathematics, Statistics and Computer Science. John gave a humorous and fascinating speech, showing he has his wits in abundance, and revealing his desire to educate, even in his 10th decade. To quote

> Stop Press! Disquieting News! Your death is already programmed into your DNA; your internal clocks are already ticking your days off. No point in philosophizing about it! Read all about it in a maths book META MATH by G. Chaitin, Vintage Books 2005. Chaitin was a visiting prof at the University of Auckland in 2004.

What he didn't reveal is that he is still very mathematically active, working hard on the twin primes conjecture. His email is jcturner1928@gmail.com.

Coming and going

Daniel Delbourgo will be on Study Leave during Semester A 2019 with travel plans for Canada and Europe. Jens Kleimann from Ruhr-Universitat Bochum, Germany will be visiting from late January to around Easter. He'll be collaborating with Yuri Litvinenko and Sean Oughton on space physics projects, particularly the development of a transport model for solar wind fluctuations in the inner heliosheath.

Bob Durant was an invited plenary speaker at the AUT Symposium on Mathematics with his lecture entitled "Random Projections for Dimensionality Reduction: Some Theory and Applications", which was very well received.

Tim Stokes continues with his extensive/intensive travel program. He is off to the AustMS conference in Adelaide in early December giving a talk entitled "What is a Partial Semigroup". He will then visit Marcel Jackson at La Trobe the week after. Thence to Hobart for Christmas followed by work with Larry Forbes till mid January, then to the 2019 Asia-Australia Algebra Conference at Western Sydney University giving a talk entitled "Idempotent completions and left restriction semigroups".

Kevin Broughan

MASSEY UNIVERSITY

INSTITUTE OF FUNDAMENTAL SCIENCES

It has been a relatively quiet semester in the mathematics group at Massey, Palmerston North. Of note, David

Simpson was awarded a Marsden grant (with Paul Glendinning, University of Manchester) for a project titled "Organised chaos: Using geometry to explain robust chaotic dynamics in switched dynamical systems".

Richard Brown

INSTITUTE OF NATURAL AND MATHEMATICAL SCIENCES

Alona Ben-Tal has been promoted to Associate Professor, and Sasha Melnikov to Senior Lecturer Range 2.

Gaven Martin secured Marsden funding to continue his work on Modern Analysis and Geometry.

Carlo Laing received the 2018 NZMS Research Award (jointly with Alex James, University of Canterbury).

Alona Ben-Tal has been awarded a two-year Catalyst Fund Seeding grant entitled "The physiological significance of cardiorespiratory interactions: bridging between data analysis, mathematical theory and physiological models". The project will support a collaboration with Professor Aneta Stefanovska from Lancaster University, UK, who is an expert in in data analysis of living systems. Prof Stefanovska is expected to visit our Institute in March and December 2019.

Mick Roberts has been appointed as a Professorial Fellow at the School of Mathematics and Statistics, University of Melbourne.

In July Mick visited James Cook University in Townsville and gave a seminar "Is your family pet a source of antibiotic resistance?". He then attended the Society for Mathematical Biology meeting in Sydney and gave a talk "Ecological stability, epidemiological stability and reservoirs of infection" as part of the minisymposium Reproduction Numbers. In August Mick visited Utrecht University to work with Hans Heesterbeek, the AI on his Marsden project. He also gave seven lectures at the Helsinki Summer School on Mathematical Ecology and Evolution.

Annalisa Conversano and Gaven Martin were invited Fellows to the Hausdorff Institute in Bonn for the thematic programme "Logic and Algorithms in Group theory".

Carlo Laing was an invited plenary speaker at the 10th Dynamics Days Asia Pacific conference, held at Huaqiao University at Xiamen (Fujian Province, China) during November.

Graeme Wake is the keynote plenary speaker at the biennial International Conference of Mathematics and its Applications in Bangkok in mid-December, run by the Thailand Centre of Excellence. His opening invited address is entitled "50 years of Mathematics-in-Industry Study Groups (MISGs) around the World". In this public occasion he will recall memories of the beginnings of this successful model in September 1968, while he was a Postdoctoral Fellow at the University of Oxford.

Shaun Cooper

VICTORIA UNIVERSITY OF WELLINGTON

SCHOOL OF MATHEMATICS AND STATISTICS

Academics from the School were in the headlines and on radio and television following the Royal Society Te Apārangi's annual awards. Matt Visser received this year's Hector Medal for outstanding work in chemical, physical, mathematical or information sciences. Matt was cited for his internationally recognised research on black holes, cosmology, quantum physics, and analogue spacetimes. Completing the evening's celebrations at Wellington's Te Papa Tongarewa, Rod Downey received the Society's highest award, the Rutherford Medal, from patron Governor-General Dame Patsy Reddy. Rod was honoured for his revolutionary research into mathematical logic and computer science, including the co-creation of the field of parameterised complexity and fundamental work on the notion of algorithmic randomness. It is a pleasure also to acknowledge the awards of the Jones Medal to Marston Conder for his lifetime achievements in mathematics and its advancement, and the Hatherton Medal jointly to Jurij Volčič and Lettie Roach (VUW and NIWA) demonstrating the amazing depth and breadth of research in the mathematical sciences in New Zealand Aotearoa.

Postdoctoral Fellow, Dr Matthew Harrison-Trainor, was joint winner of the 2017 Sacks' Prize of the Association of Symbolic Logic for the best PhD in logic worldwide during that year. This continues an impressive sequence for the VUW logic group. Faculty members Adam Day and Martino Lupini, as well as previous postdocs Denis Hirschfeldt (University of Chicago), and Antonio Montalban (University of California, Berkeley) have also won the Sacks' Prize in past years. Matthew is currently supported by the Marsden grant of Rod Downey and Alexander Melnikov.

The finals for the Annual Senior Mathematics Competition, jointly sponsored by Victoria University and Casio, were hosted by the School in August. Overall there were 910 student entries from over 60 schools across New Zealand sitting the preliminary test back in April. The top 15 students travelled to our Kelburn Campus to sit the finals. Congratulations to all of the finalists and especially William Han (Macleans College, Auckland), Ethan Ng (Burnside High School, Christchurch) and Shine Wu (Newlands College, Wellington) who took the top three places. Thanks to Kelsey Firmin and colleagues in the School

office for coordinating this event, Hung Pham for coordinating the questions and marking, Emma Greenbank and Sebastian Schuster for helping with marking, and Sue Scott and Lauren Burr (New Zealand Association of Mathematics Teachers) who were the competition's overall organisers.

The School sponsors a special prize at the NIWA Wellington Science and Technology Fair each year for the most imaginative and effective project using mathematics or statistics. This year's Fair was hosted by the university in September, with 300 exhibits, involving 386 students from 39 schools in the Wellington region. Our PhD student, Emma Greenbank, judged the school's prize and reported that there were some amazing ideas and creativity, the winner being Luke Roeven, Wellington High School, for his exhibit "Ring Oiler". The School also hosted its annual Scholarship Workshops in October, in the Hunter Council Chamber — an awesome venue for the students to meet and work in. Each of the Calculus and Statistics workshops were attended by about 50 students who were ably helped, enlightened and encouraged by our enthusiastic academics and students.

In October, we were deeply saddened to learn of the passing of former Professor, and later Vice Chancellor at the University of Waikato, Wilf Malcolm. Wilf's association with Victoria began in 1951, when he studied concurrently at the University and at Wellington Teachers' College. In 1958, he took up a Shirtcliffe Fellowship to Cambridge University, before returning to Victoria University as a lecturer in pure mathematics. He completed his PhD in 1972 and in 1975 he was promoted to reader and then Chair of Pure Mathematics. Wilf was committed to advancing the quality of mathematics education, always keeping the student at the centre of his teaching philosophy. His academic and human qualities came to the fore as he took on senior leadership roles, always treating his colleagues with respect. He will be sadly missed by the New Zealand mathematics community.

Virginia Lisanti has commenced her PhD studies under the supervision of Stephen Marsland, working on his AviaNZ project. Meanwhile, congratulations to Matt Visser's PhD student, Sebastian Schuster, who has successfully submitted and defended his thesis *Black Hole Evaporation: Sparsity in Analogue and General Relativistic Space-Times*. Also, congratulations on their promotions in this year's round go to Dillon Mayhew and Peter Donelan (promoted to Associate Professor) and Peter Smith (to a higher step on the professorial scale).

Martino Lupini set up and was has been the major contributor to seminar series on L^p operator algebras. Martino, Dan Turetsky and Matthew Harrison-Trainor have also revitalised the long-standing but, of late, sporadic Logic Colloquium.

Your correspondent completes a second (and final) three-year term as Head of School at the end of this year. The role will be filled in the New Year by our current Deputy Head of School, Ivy Liu. As can be seen from all the above, being head of school is ultimately highly satisfying — colleagues and students alike have been immensely rewarding to work with. The School held a morning tea to recognise the trials and achievements of the past six years and generously thanked me with the gift of a beautiful matau a Māui (fishhook), produced by a local carver, commissioned by our School Manager, Ginny Whatarau.

Seminars. Associate Professor Igor Klep (Auckland): "Inclusions of matrix convex sets, Positivstellens'atze, dilations and coin tossing", Professor Aidan Sims (Wollongong): "Reconstructing graphs from C^*-algebraic data", Dr Annette Koo (Measurement Standards Laboratory): "Measurement, uncertainty and Roland".

Peter Donelan

UNIVERSITY OF CANTERBURY

SCHOOL OF MATHEMATICS AND STATISTICS

Congratulations to *Clemency Montelle* and *Mike Plank* on their promotions to Professor and to *Ngin-Tee Koh* and *Hannes Diener* on their promotions to Senior Lecturer.

Congratulations to *Varvara Vetrova* on a successful bid to the MBIE Endeavour fund. Varvara is a key researcher in the two-year project led by NIWA, called "Machine Learning approaches to downscale seasonal climate forecasts for New Zealand". The project will refine seasonal climate forecasts provided by global climate prediction models to the town and farm scale within New Zealand. Our climate is extremely variable as a result of New Zealand's maritime surroundings and its physical geography. Key economic activities — especially in the primary sector — are directly or indirectly dependent on climate. Long-term deviations from normal climate conditions have led to severe economic impacts, such as the 1997/98 and 2007/08 droughts driven by El Niño and La Niña, respectively, and the 1993/94 "Auckland Water Crisis".

Better knowledge of forthcoming climate conditions (for example average temperature and rainfall) over time-scales of one to three months resolved at relevant spatial scales (e.g. region, catchment, site) could assist in better management of risks associated with climate variability. Likewise, it would offer prospects to better capitalise on the economic opportunities climate variability presents.

The accuracy and local relevance of seasonal climate forecasts that are currently available for New

Zealand are hampered by the relatively coarse spatial resolution of present climate prediction models, which do not account for important orographic effects highly relevant to New Zealand.

This project is expected to result in significant benefits for multiple sectors of New Zealand's economy that are dependent on climate guidance. This will be achieved for the first time by leveraging recent cutting-edge advances in Machine Learning, a sub-field of artificial intelligence devoted to the development of algorithms that can learn from data and make predictions. It will provide better and more useful seasonal forecast products for Aotearoa, and will be trialled with partners in the agriculture, energy and water management sectors.

Congratulations to *Felipe Voloch*, *Geertrui Van de Voorde* and *Miguel Moyers-González* who were successful in their bids to the Marsden Fund.

Felipe's project "Hearing algebraic curves and factoring polynomials" asks whether one can tell the shape of a drum from the sounds it makes. Many problems in mathematics are concerned with recognising mathematical objects using only accessible information about them. This project will develop methods to tell apart the important mathematical objects called algebraic curves from information that corresponds to their sound. Due to a remarkable recent connection, these methods for telling curves apart will yield a fast algorithm to factor polynomials over finite fields. Efficient factoring of polynomials is an essential tool in applications to error correcting codes, cryptography and random number generation.

Geertrui's project "The geometry underlying rank-metric codes" is in collaboration with John Sheekey, University College Dublin. Error-correcting codes make sure a receiver gets the correct message, even if the message is slightly distorted during transmission. The use of new types of code, called rank-metric codes, has been proposed for a variety of applications ranging from storing information in the cloud to public-key cryptosystems. For over 30 years, the only optimal rank-metric codes (MRD-codes) known were Gabidulin codes until Sheekey in 2016 constructed a new family of MRD-codes. He showed that, for certain parameters, MRD codes could be constructed using an object known from finite geometry, called a linear set. In recent work, Geertrui and John pinpoint the geometric condition under which a linear set gives rise to an MRD code and prove this for all admissible parameters. In this project, the connection between rank-metric codes and linear sets is exploited to tackle several interrelated questions from coding theory and finite geometry, to construct new linear sets satisfying their condition and to find out under which circumstances the corresponding MRD codes can be called 'new'. Tools from coding theory are used to investigate the weight distribution of linear sets and to find out the consequences for well-studied objects in finite geometry such as caps and blocking sets.

Miguel is associate investigator in the project "Indirect measurement of lava rheology" led by Mathieu Sellier (PI) from Mechanical Engineering, UC in collaboration with associate investigators Ben Matthew Kennedy (UC, Geological Science), Jérôme Monnier (INSA Toulouse) and M. Elise Rumpf (U.S. Geological Survey).

The ongoing volcanic eruptions in Hawaii are a timely reminder for New Zealand that lava flows are a threat to many inhabited areas. Understanding the rheology of lava is critical to predicting its flow path and inform hazard management plans but standard rheology measurement techniques are ill suited to the extreme environment of lava flows and do not fully replicate the evolving lava rheology. The increasing availability of aerial imaging of lava flows provides a rich set of information at the surface which contains a hidden signature of the rheology. This project which gathers a research team at the cross-road between thermo-fluid engineering, rheology, volcanology, and applied mathematics proposes to develop new techniques which will unravel this rheological signature and enable the remote identification of the lava rheology from observed free surface flow measurements in-situ and in real time.

In November the School welcomed two new continuing staff, *Gábor Erdélyi* and *Cameron Bell*. Gábor had been in the School on a visiting position since July. In his continuing position he will contribute to the data science programme in the School. His research centres on data science and the theoretical foundations of artificial intelligence — in particular the computational and algorithmic aspects of problems related to multi-agent decision making in the presence of big data sets – -as well as on AI's societal impacts. Gábor completed his PhD in computer science at Heinrich Heine University Düsseldorf, Germany. This was followed by a one-year post-doc at Nanyang Technological University Singapore. Prior to his appointment at UC, Gabor was chairing the Department of Decision and Organizational Theory at the School of Economic Disciplines at University of Siegen, Germany.

Cameron had been a Senior Tutor in the School on a fixed-term contract since 2017, contributing mainly to the School's data science programme and its administration. His connection with the School goes back further to 2012 when he started tutoring for us. Cameron is a keen mountain biker and gardener.

In early October *Jeanette McLeod* and *Phil Wilson* organised a Maths Craft in Class teacher training workshop. The two-day event was attended by 13 intermediate maths teachers (including one from Australia!) The workshop was in response to many requests

Cameron Bell

for Maths Craft (see www.mathscraftnz.org) to offer free professional development for school teachers. Its aims were for participants to improve their mathematical thinking and self-efficacy in mathematics, to learn concrete techniques for engaging their students with mathematics in the classroom, and to learn ways to decrease student fear of mathematics and increase mathematical confidence, with the ultimate goal of instilling a higher appreciation of its importance as a subject to continue studying.

During the workshop Jeanette and Phil offered four Maths Craft activities and assisted in creating draft lesson plans based on each of the activities together with David Pomeroy from UC's School of teacher education. Participants left with a portfolio of Maths Craft lesson plans which tie into the New Zealand curriculum, instructional handouts written by mathematicians, and craft material for their own classes. A month later the workshop was followed by a feedback session aimed at sharing participants' experiences of implementing Maths Craft activities in the classroom.

Rosalie Hosking, a former PhD student of *Clemency Montelle* and *John Hannah* in the School and a post-doctoral researcher at Yokkaichi University in Japan, has received a grant from the New Zealand Japan Exchange Programme to create a new Japanese devotional tablet, known as a sangaku, with mathematical problems on it, in the spirit of those created centuries ago. The new tablet will contain three problems constructed by Rosalie, Clemency Montelle, John Hannah, and Kevin Hannah (from UC Education Plus). Posing divine maths questions for contemplation, the tablet was dedicated in the Kitano Tenmangu shrine of Kyoto in late October. It is the first ever created by non-Japanese mathematicians, and now hangs alongside an original Edo period tablet.

Rosalie is an historian of Japanese mathematics,

Mr Terao, Rosalie Hosking, Tsukane Ogawa (Yokkaichi University)

specialising in the mathematical problems placed on wooden tablets and hung in shrines and temples during 1600–1868. These tablets contain eye-catching brightly coloured mathematical diagrams along with Japanese text which contains a mathematical problem pertaining to the figure. This tradition, started in the 1600s during the Japanese isolation period, died out in the early 1900s but has had a revival recently.

Finally, *Felipe Voloch* attended the ICM in Rio de Janeiro in August and hosted two research collaborators, Cecilia Salgado (UFRJ, Brazil) and Anthony Varilly Alvarado (Rice Univ, USA) at the School in October. Felipe's honours student Sam Frengley received a Woolf Fisher scholarship to do postgraduate studies at the University of Cambridge, UK.

Günter Steinke

UNIVERSITY OF OTAGO

DEPARTMENT OF MATHEMATICS AND STATISTICS

David Bryant is among the twenty New Zealand researchers who are newly elected as Fellows of the Royal Society. David is a world leader in the development of mathematical tools for inferring evolutionary relationships among biological organisms. He has made significant theoretical and practical contributions to phylogenetics — the field of biology studying the reconstruction of evolutionary history. Congratulations, David!

Boris Baeumer and *Fabian Montiel* were awarded Marsden grants in this year's funding round. In his project "Boundary conditions for non-local operators", Boris will investigate the largely unknown boundary conditions on finite domains. This is important for modelling the risk of spreading of an invasive species or an epidemic, for example. Fabien's Fast-Start project "Breaking the ice: process-informed modelling of sea ice erosion due to ocean wave interactions" intends to

improve forecasts of sea ice extend, thickness and concentration. This will be an essential ingredient for modern Earth System Models (ESM) that are used for accurate climate prediction. Well done, Boris and Fabien.

Besides his above-mentioned Marsden grant, *Boris Baeumer* also received a CALT Award from the Committee for the Advancement of Learning and Teaching (CALT) at the University of Otago. Boris' project is on "A robust tool to assess numeracy competency for first year students". May there be a gleam of hope for the decreasing numeracy skills observed in recent years? Good luck, Boris.

Our PhD student *Timothy Bilton* received the Division of Sciences 2018 award for the best research paper by a postgraduate student. Timothy is developing statistical methods for genetic analysis under the supervision of *Matt Schofield*. His work helps account for errors in high-throughput sequencing data.

Abstracts of PhD theses

Bran, Paula, University of Otago

Supervisors: Richard Barker, Matthew Schofield

Date: 2018

Title: **Properties of Gibbs samplers for inference in genetic mark-recapture models**

The aim of this thesis is to study the convergence properties of specific MCMC algorithms for sampling from a posterior distribution. The model considered incorporates the uncertainty in the assignment of a legitimate identity of individuals. In a collected sample, observations wrongly recorded might result in duplicates or missing data, which seriously affects the posterior inferences of parameters of interest. For instance, the actual sample size may be overestimated by duplicates or underestimated by the missing data. Thus, the underlying problem is a misidentification problem.[...]

Cao, Zhanglong, University of Otago

Supervisors: Matthew Parry, David Bryant

Date: 2018

Title: **Inference and characterization of planar trajectories**

Inference and characterization of planar trajectories have long been the focus of scientific and commercial research. Efficient algorithms for both precise and efficient trajectory reconstruction remain in high demand in a wide variety of applications.

Given time series GPS data of a moving object, trajectory reconstruction is the process of inferring the path between successive observation points. However, widely separated points and measurement errors can give rise to trajectories with sharp angles, which are not typical of a moving object. Smoothing spline methods can efficiently build up a more smooth trajectory. In conventional smoothing splines, the objective function is augmented with a penalty term, which has a single parameter that controls the smoothness of reconstruction. Adaptive smoothing splines extend the single parameter to a function that can vary, hence the degree of smoothness can be different regions. A new method named the V-spline is proposed, which incorporates both location and velocity information but penalizes excessive accelerations. In the application of interest, the penalty term is also dependent on a known operational state of the object. The V-spline includes a parameter that controls the degree to which the velocity information is used in the reconstruction. In addition, the smoothing penalty adapts the observations are irregular in time. An extended cross-validation technique is used to find all spline parameters.[...]

Hong, Chuen Yen, University of Otago

Supervisors: David Fletcher, Matthew Parry

Date: 2018

Title: **Focussed model averaging in generalised linear models**

Model averaging is often used to allow for uncertainty in the model selection process. In the frequentist setting, a model-averaged point estimate is the weighted mean of the estimates from each of the candidate models. Focussed model averaging is an approach to calculating the model weight which is tailored to the parameter of interest. For the important special case of generalised linear models, we propose a new method for focussed model averaging, in which the weights are chosen to minimise an estimate of the asymptotic mean squared error (MSE) of the model-averaged estimate of the parameter of interest. The procedure we put forward uses standard results for maximum likelihood estimation when the model is misspecified and, unlike existing methods, does not rely on a local-misspecification assumption, which shrinks each model towards the smallest model as the sample size increases. We use the more natural fixed-model framework in which the models do not converge asymptotically.

Jörg Hennig

REPORTS ON EVENTS

ANZIAM 2018 Conference

With the support of the NZMS Student Travel Grant I was able to attend the Australian and New Zealand Industrial and Applied Mathematics Conference 2018, held in Hobart, Tazmania, in February. It was the first ANZIAM conference I've attended and it was a great and very enjoyable opportunity to present our work. That was so especially due to the fact that studies on complex networks are a still small, but a growing, subject of interest in the community.

I could present a work done using parliamentary speeches of the members of the New Zealand Parliament. In our work we have identified topics of interest of each MP based on such speeches. From that we could create a network of interactions between politicians engaged in the same topic. The most striking result of our work, in our opinion, was the possibility to see how MPs interact differently, according to their topics of interest, when different parties are in government.

I am pleased to report that my talk was very well accepted by the attendees. They showed their engagement with the presentation by either asking interesting questions or providing very productive feedbacks.

In general, the conference was an excellent opportunity for networking. I've made many new acquaintances and very interesting ideas were shared among us. Another valuable experience was the early career workshop that gave the participants fruitful insights towards career development in industry and academia.

I sincerely want to express my profound gratitude to the New Zealand Mathematics Society for their financial assistance for my participation in the conference.

Demival Vasques Filho (University of Auckland)

MINZ 2018

In June this year, due to the generous support of the New Zealand Mathematical Society Travel Grant, I was able to attend the MINZ 2018 study group. MINZ 2018 was hosted by Auckland University of Technology and consisted of six fascinating problems from industry. I was involved with the International Cable Protection Committee problem. This problem was rewarding as it utilised areas of mathematics that are new to me. Over the week I learned a lot from my follow group members and have a new appreciation for the study of real world data sets. The week was enjoyable and I look forward to attending these study groups again in the future. I am grateful to the New Zealand Mathematical Society for all the generous support I have received.

Emma Greenbank (Victoria University of Wellington)

Annual Meeting of the Society for Mathematical Biology, Sydney, Australia, 8–12 July 2018

The University of Sydney organized the 2018 Annual Meeting of the Society for Mathematical Biology (SMB2018) in July 2018. The conference sessions had presented useful topics in Mathematical biology. My research is about finding the optimal breathing frequency and amplitude while maintaining the physiological level of oxygen and carbon dioxide in the arterial blood. This conference was an ideal platform for the results of my work because it was an international forum, consists of researchers, education scientists, and industry representatives who were experts in this field. It was my first international conference outside New Zealand. I gave a poster presentation at the conference and received good feedback. This conference provided a full opportunity for practice and helpful discussion with others in the field. This conference allowed me to network with others scientist. As this is my last year of Ph.D., attending this conference provided me the opportunity for networking, which may help for a postdoc position.

Faheem Zaidi (Massey University)

Re(s)sources 2018 conference —- May 2018 (Lyon, France)

First and foremost, I would like to pay my sincere gratitude to the New Zealand Mathematics Society for granting a travel allowance to present my paper which was co-authored with my main supervisor, Emeritus Professor Mike Thomas, at the Re(s)sources 2018 International Conference which was held in Lyon, France. The paper was titled: "Documentational genesis during teacher collaborative development of tasks incorporating digital technology". I presented our paper at the three-day conference and attended the two-day workshop for young researchers. Attending both events provided an opportunity to learn about new research on Didactical Approaches of Documentation from researchers representing 30 different countries. It also allowed me to form very good relationship with other international mathematics education researchers. I had the opportunity to have productive discussions on my present and future research work with distinguished professors including Professors Michelle Artigue and Luc Trouche from France, and Professor Paul Drijvers from Netherlands. In addition to this, I met with Eugenia Taranto from Italy to discuss our joint paper with Emeritus Professor Mike Thomas (The University of Auckland) and Professor Ferdinando Arzarello (The University of Turin) during this conference. Therefore, this conference not only provided opportunity for me to present my work but also helped to extend my network with international researchers and opened paths to meet future research partners.

Iresha Ratnayake, (University of Auckland)

Second Mirzakhani Hui

Participants in the second Mirzakhani Hui.

The Mirzakhani Hui is a conference for women working in the mathematical sciences on the lower North Island. The Hui was named in honour of Maryam Mirzakhani, the distinguished Iranian mathematician who was the first female winner of the prestigious Fields Medal.

The second Mirzakhani Hui was held in August of 2018. It brought together 30 women involved in mathematics, statistics, data science, physics, marine geology, and fisheries from the Palmerston North and Wellington regions. It was an interesting mix with about 20 women working in academia, and 10 in industry or crown research institutes. The day involved sessions on promotable tasks, self promotion, successful writing, mentoring and supporting colleagues, and career stories. Sophie Mormede spoke about how she ended up working as a modeller for NIWA and Maree Luckmann gave an account of her amazing career as a Statistician through many technological and societal changes. Importantly, the conference continued to build a community of women across institutions, and created links that will help women in the mathematical sciences mentor each other.

The organisers of the Hui gratefully acknowledge funding from the New Zealand Mathematical Society, the Dodd-Walls Centre, the Mac Diarmid Institute, the Institute of Fundamental Sciences at Massey University and the School of Mathematics and Statistics at Victoria University of Wellington.

Astrid an Huef (Victoria University of Wellington)

Bologna; all about luxury sports vehicles

The Advance in Robot Kinematics (ARK) 2018 conference was biannually run by the Group of Robotics, Automation and Biomechanics (GRAB) at the Department of Industrial Engineering of the University of Bologna in a conjunction with International Federation for the Promotion of Mechanism and Machine Science (IFToMM) in Bologna, Italy.

In this conference, I presented two papers. One was a complement to another publication of mine which I presented last year at another conference. The other was focused on more theoretical aspect of my thesis — *Transversality theory and its applications to kinematics*. In this work, I discuss the impact of design parameters on the singularities of mechanism. This phenomenon occurs as long as the configuration space, which represents all feasible configurations for the given mechanism *transversally intersect* with the singular set which includes all configurations where Jacobian matrix is rank deficient.

I could get some good feedbacks after my talk. For example, a discussion that I had with Dr Jon Selig led me to think about application of an extension of the method of constrained optimisation to detect other types of singularities (e.g. input and output singularities) that occur in the kinematic analysis of a mechanism. This idea was finally developed very well and I gathered the results in a paper and submitted it to the world congress that will run by IFToMM next year in Krakow, Poland.

Besides, I had chats with a several other senior academics about a possible opportunity to commence a postdoc position at their institutes. For instance, I had several discussions with Dr Georg Nawratil about kinematics of self-motion hexapods that is going to be an interesting research proposal. He also encouraged me to apply for a funding through the Austrian Science Fund (FWF). We believe my proposal will be significant enough to get a governmental fund.

Hamed Amirinezhad (Victoria University of Wellington)

The 6th Heidelberg Laureate Forum

The Heidelberg Laureate Forum is a week long event which brings together 200 young researchers from around the world, and many distinguished laureates, in the

fields of Mathematics and Computer Science. September 2018 marks the 6th time this prestigious event has run. I am incredibly grateful to be one of the young researchers selected for this year's forum, and would like to thank the Heidelberg Laureate Forum Foundation for organising such an amazing event. I would also like to thank the NZMS for nominating me for a Student Travel Award, and the University of Auckland Department of Mathematics. Their funding was essential in supporting me in my travels to Heidelberg, Germany.

The forum involved talks given by the laureates and other researchers, discussion groups, as well as several excursions and social events. I found the whole experience to be highly academically stimulating, and a huge amount of fun. Every day afforded me with opportunities to spend time with amazing young researchers, and have thought-provoking conversations with some of the laureates, including Sir Michael Atiyah (Fields Medal), Caucher Birkar (Fields Medal), and Leslie Lamport (ACM Turing Award).

One of my highlights of the forum included a boat trip along the Neckar river, which was incredibly pleasant and offered many opportunities to interact and network with the other participants and laureates. I greatly enjoyed all of the talks, especially those given by Leslie Lamport, Caucher Birkar, Wendelin Werner (Fields Medal), Constantinos Daskalakis (Rolf Nevanlinna Prize), as well as participating in the workshop on the future of Mathematical Physics, headed by Sir Michael Atiyah. The final dinner at the Heidelberg Castle was also incredibly impressive, and afforded a final opportunity to connect with everyone and reflect on the week.

The Heidelberg Laureate Forum is a once in a lifetime opportunity. Heidelberg is a beautiful town, the event itself is incredibly well organised, and the opportunity to interact with so many esteemed laureates at such an early stage of one's academic career is exceptionally unique. I would highly recommend any young researchers, with interests in either Mathematics or Computer Science, to apply for the Heidelberg Laureate Forum.

Peter Huxford (University of Auckland)

2018 Netsci conference, Paris, France

I received a NZMS student travel award to attend the 2018 Netsci conference in Paris from the 11–15 of June, where I presented at the session People, Places and Things. My talk (which can be found here: stur600.github.io/Netsci2018/) discussed the use of networkanalysis to understand patterns of course selection for students studying mathematics and sciences in New Zealand. The talk was well received and I acquired valuable feedback on my work. The conference has not only given me ideas to improve my analytical approach, but has also led to a collaborative project with students from Florida International University.

Steven Turnbull (University of Auckland)

GENERAL NOTICES

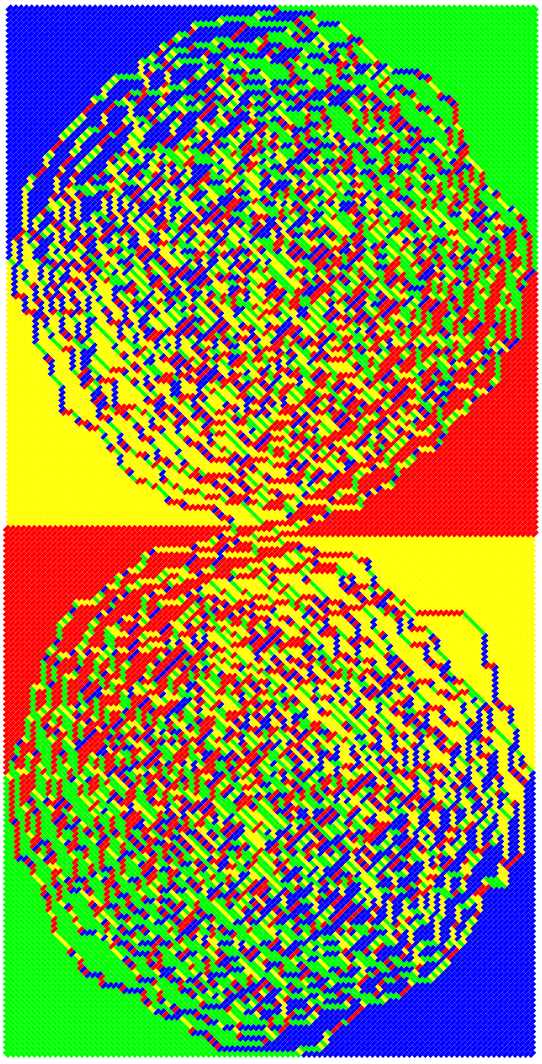
Modern Analysis and Geometry 2019: A conference to celebrate Gaven Martin's 60th birthday

A two-day conference will be held at Massey University's Albany campus on Thursday and Friday January 24–25, 2019. More information, including registration details, are at the conference webpage ctcp.massey.ac.nz/index.php?group=conference&page=home&menu=conferencee.

Shaun Cooper

2019 NZMRI SUMMER SCHOOL

New Zealand Mathematics Research Institute (Inc.)



The Unreasonable Effectiveness of Random Matrix Theory: Achievements and Challenges since Hurwitz, Wishart and Wigner

Waikanae, New Zealand/Aotearoa

LECTURERS:
- Peter Forrester
- Alice Guionnet
- Iain Johnstone
- Jon Keating
- Craig Tracy

VENUE:
El Rancho, Waikanae

The theory of random matrices lies at the crossroads of many sub-disciplines within mathematics - probability theory, mathematical statistics, representation theory, approximation theory, integrable systems theory - and has profound implications for an ever-widening horizon of diverse applications.

Participants will be taken on a pedagogical journey by the lecturers towards problems of contemporary importance.

REGISTRATION:
http://www.massey.ac.nz/nzmri2019

CONTACT:
Nicholas Witte (Massey University)
N.S.Witte@massey.ac.nz
Tel: 64 6 951 7655
Stephen Marsland (Victoria University of Wellington)
stephen.marsland@vuw.ac.nz

JAN. 6 - 11

Sunil Chhita: *Prob. Theory Relat. Fields* **162, 275 (2015)**
Uniformly random domino tiling of a Double Aztec Diamond with the overlap parameter set to 2.

42nd Australasian Conference on Combinatorial Mathematics and Combinatorial Computing (42ACCMCC)

The 42nd Australasian Conference on Combinatorial Mathematics and Combinatorial Computing (42ACCMCC) will be held at the University of New South Wales in Sydney, Australia, 9–13 December 2019. The webpage is conferences.maths.unsw.edu.au/e/42accmcc.

ACCMCC is the annual conference of the Combinatorial Mathematics Society of Australasia. The conference covers all areas of combinatorics in mathematics and computer science. The following is a list of confirmed invited speakers.

- Michael Albert, University of Otago
- Joachim Gudmundsson, University of Sydney
- Camilla Hollanti, Aalto University
- Daniel Horsley, Monash University
- Ken-ichi Kawarabayashi, National Institute of Informatics, Japan
- Cheryl Praeger, University of Western Australia
- Wojciech Samotij, Tel Aviv University
- Maya Stein, Universidad de Chile
- Stephan Thomassé, École Normale Supérieure de Lyon

The CMSA Anne Penfold Street Student Prize will be awarded to the best student talk at the conference.

For more information about 42ACCMCC or to be added to a mailing list for future announcements, please contact the organisers at accmcc2019@unsw.edu.au.

Catherine Greenhill

Call for applicants to attend the 7th Heidelberg Laureate Forum

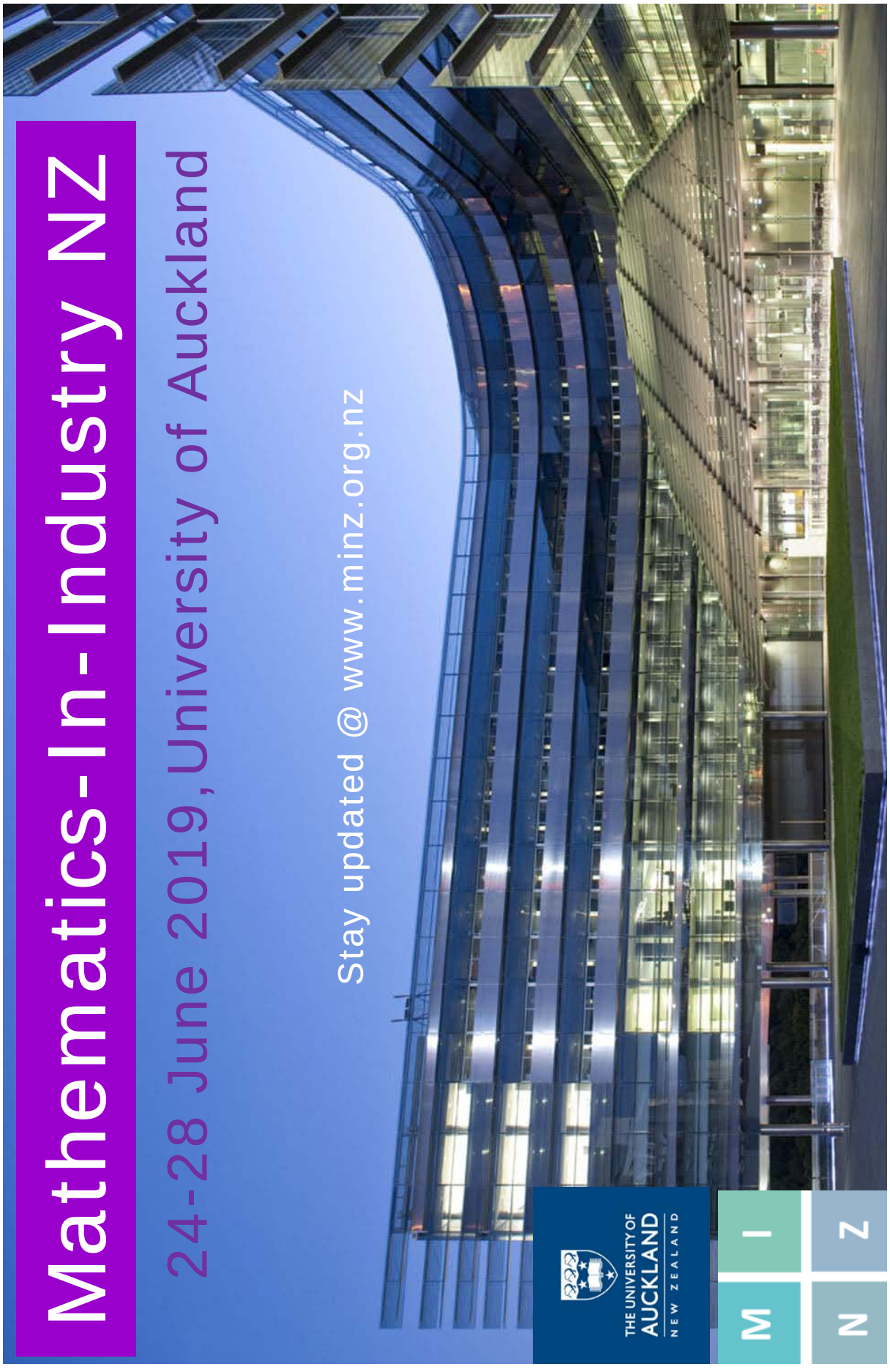
The 7th Heidelberg Laureate Forum (HLF) will take place in Heidelberg, Germany during September 23—27, 2019.

At HLF all winners of the Fields Medal, the Abel Prize, the ACM A.M.Turing Award, the Nevanlinna Prize, and the ACM Prize in Computing are invited to attend. In addition, young and talented computer scientists and mathematicians are invited to apply for participation. The HLF serves as a great platform for interaction between the masters in the fields of mathematics and computer science and young talents. The previous HLFs have been an exceptional success.

Applications for participation at the 7th HLF are open in three categories: Undergraduates, PhD Candidates, and PostDocs. See the webpage www.application.heidelberg-laureate-forum.org for the online application and further information. The NZMS can nominate young researchers to attend the Forum. Nominated persons get "priority treatment", but there is no guarantee that nominees will be offered a place at the Forum. If you wish to be nominated by the NZMS, email Vivien Kirk v.kirk@auckland.ac.nz by February 1st, 2019.

A PhD student from New Zealand attended the 6th HLF in September 2018; you can read a report on the experience on page 32.

Vivien Kirk


Mathematics-In-Industry NZ
24-28 June 2019, University of Auckland
Stay updated @ www.minz.org.nz
THE UNIVERSITY OF AUCKLAND
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M I N Z

NZMS NOTICES

NZMS Council Statement on Women in Mathematics

The New Zealand Mathematical Society is concerned about under-representation of women in the mathematics community, from participation in mathematics classes in high school through to the higher levels of research and teaching. This situation results in missed opportunities for the advancement of mathematics.

Under-representation occurs for a variety of reasons, including:

- There is unconscious bias in the assessment of the talents and inclinations of girls, often resulting in them being directed toward "people-based" subject choices and careers and away from the mathematical sciences;
- There is unconscious bias in the tasks that women mathematicians are asked to undertake, often resulting in them being directed toward "people-based" activities rather than "research-based" activities, sometimes to the detriment of their own professional development.
- Women are more likely to have had disrupted career patterns or to have worked part-time on account of child-rearing and family responsibilities;
- Women are often overlooked when names are sought for speakers or for prizes;
- Those few women who reach the higher levels are disproportionately called on to sit on committees etc., which leaves less time for developing their own research and teaching.

The Society recognises the need to give active consideration to ensuring that all people are treated equally in their prospects, recognition and progression. Such disadvantages as do occur are often the unintentional outcome of the formulation of regulations and procedures which do not give adequate attention to the needs of people in such positions.

Accordingly, the Society will:

- ensure an appropriate gender balance on its committees and working groups, keeping in mind that diversity in decision-making bodies must be balanced against the risk of over-burden to those in minority groups;
- keep under review the regulations governing its membership, prizes, awards and grants to ensure that they do not inadvertently deter or fail to recognize people with non-standard career patterns;
- actively encourage and facilitate the nomination of women for its prizes and awards, and ensure that it considers women when it is proposing nominees for external prizes and positions;
- ensure appropriate numbers of women speakers in its meetings and workshops;
- require that the organisers of conferences and activities who are given grants by the Society: invite both male and female speakers, or explain why this is not appropriate or possible; and give consideration to the provision of mechanisms to enable participation by people with children or family responsibilities;
- develop material and activities to promote equitable participation of women and girls as learners, teachers, researchers, and users of mathematics, at all levels;
- collect data and thereby monitor trends in the above.

The NZMS acknowledges the London Mathematical Society Council Statement on Women in Mathematics; we are grateful to the LMS for leading the way and for allowing us to adapt their statement.

Approved by NZMS Council: December 3, 2018.

Fellowship of the NZMS

The NZMS constitution (Article IV) makes provision for members to be recognised as Fellows. The constitution stipulates that a high level of attainment or responsibility must be demonstrated, and specifies four areas in which a substantial contribution could be made. The Council has revised the rules for the award of Fellowship to clarify that Fellowship applications may be based on any of these four areas. The new rules incorporate Article IV of the constitution and an expectation that Fellow's contributions reflect the purposes of the Society (see Article II of the constitution).

Rules for Fellowship

1. Shall be a Member of the NZMS.
2. Shall have had the qualifications of an Accredited Member for a period in excess of three years.
3. Shall have satisfied criteria (3.1 or 3.2 or 3.3 or 3.4) and 3.5:
   - 3.1 Have made a substantial and sustained contribution to the mathematical sciences;
   - 3.2 Have made a substantial and sustained contribution to the profession of mathematical scientist;
   - 3.3 Have made a substantial and sustained contribution to the teaching and learning of the mathematical sciences;
   - 3.4 Have made a substantial and sustained contribution to the application of mathematical sciences;
   - 3.5 Have made a substantial and sustained contribution to the NZ mathematics community.

Draft minutes of the 44th AGM of the NZMS

University of Otago, 4th December 2018, SDAV1.

Present: Anna Barry, Alona Ben-Tal, Florian Beyer, Bruce van Brunt, David Bryant, Peter Donelan, Tanya Evans, Maire Graff, Catherine Hassell Sweatman, Joerg Hennig, Joshua Howie, Astrid an Huef, Alex James, Vivien Kirk (Chair), Igor Kontorovich, Bernd Krauskopf, Carlo Laing, Woei Chet Lim, Tammy Lynch, Rua Murray (minutes), Dion O'Neale, Michael Plank, Iain Raeburn, Dominic Searles, Cami Sawyer, Winston Sweatman, Melissa Tacy, Chris Tuffley, Geertrui Van de Voorde, Alna van der Werwe, Phil Wilson.

Apologies: Boris Baeumer, Kevin Broughan, John Butcher, Marston Conder, Shaun Cooper, David Gauld, Emily Harvey, Stephen Joe, Stephen Marsland, Mark McGuinness, Robert McKibben, Nicolette Rattenbury, Tom ter Elst, Rachael Tappenden, Graeme Wake.

Meeting opened: 5.01 pm.

1. Minutes of the 43rd Annual General Meeting were accepted.
   (Moved from Chair, passed.)
2. There were no matters arising.
3. President's report. The President began by thanking the Colloquium organising committee. The President highlighted the work of the Nominating Committee and the Prize Committee. She also highlighted the Council's work on diversity in the NZ Mathematics community, and drew the meeting's attention to the newly approved Council statement on Women in Mathematics.
   The President due attention to a number of honours and awards achieved by members this year.
   The President thanked outgoing Newsletter editors Phil Wilson and Miguel Moyers-Gonzalez, and welcomed Fabien Montiel to the role.
   The President thanked outgoing Council members Mark McGuinness (6 years on Council) and Astrid an Huef (7 years on Council, including 4 years as Vice-president and President) for their excellent service to and leadership of the Society.
4. Astrid an Huef updated the meeting about developments with the RSNZ Code of Conduct. This is now in second revision, and includes both general and specific standards. All members of the RSNZ must abide by this code. The NZMS is a Constituent Organisation of the RSNZ, and therefore a member.

5. The Treasurer's report was tabled, showing 2018 financial performance in line with budget, and setting a similar budget for 2019. A member queried the below-budget spending on student grants. The financial report was prepared prior to all 2018 grants being disbursed, so the final figure will be much closer to budget. The Treasurer's report was accepted. (Moved from Chair, passed.)

6. Appointment of auditors. The current auditor, Nirmala Nath from the School of Accountancy, Massey University, to be re-appointed as Auditor. (Moved from Chair, passed).

7. Membership Secretary's report. This was presented (as tabled) and accepted.

   Following a question from a member, discussion occurred about whether membership should be both automatic and completely free for postgraduate students. Current arrangements to continue.

   2018 fees to remain unchanged for 2019.

8. Election of councillors:

   (a) Mark McGuinness has finished a second term on Council, and Astrid an Huef has completed her term as Outgoing President; the Society thanks them for their service.

   (b) There was a single nomination for Incoming President: Shaun Hendy (Kirk/Murray).
   The meeting confirmed Shaun Hendy as Incoming President.

   (c) There were 3 nominations for Council: Melissa Tacy (Raeburn/Beyer), Phil Wilson (McLeod/Moyers-Gonzalez), Nicholas Witte (van Brunt/Smith). Astrid an Huef and Chris Tuffley were apppointed returning officers, and an election was held by secret ballot. Ballots were taken outside the room for counting at 5.29pm. At 5.31pm, Melissa Tacy was declared elected to Council for a term of three years.

9. Forthcoming colloquia:

2019 Massey University Manawatu will host in 2019.

2020/21/22 AUT will host in 2020. Canterbury and VUW to be considered for 2021,2022.

2023 Joint AMS/NZMS/AustMS meeting - Auckland to host; 4-8/12/23.

10. The report on NZ Journal of Mathematics was accepted by the meeting, and the retirement of Rob Goldblatt from the Journal Committee was noted.

11. The report from the NZMS Education Group was spoken to by Cami Sawyer. Cami highlighted the subcommittee's work on Secondary/Tertiary transition and submitting on the NCEA review. The report was accepted.

12. The Council has received a list of possible Forder lecturers for 2020, and will be consulting about preferences in the New Year.

13. There were no items of general business.

Meeting closed 5.35 pm.

Next deadline for applications for Financial Assistance — 15 February 2019 (for travel commencing after 15 March 2019)

The NZ Mathematical Society has quarterly deadlines for financial assistance applications. Applications must be made well in advance (at least one month before the funded activity, but the earlier the better) and retrospective applications will not be considered. The deadlines for applications for 2019 are: 15 February, 15 May, 15 August, and 15 November. You will hear back from the Council within a month of the deadline. The types of grants are as follows.

NZMS Student Travel Grants

The NZMS invites applications from students for financial support for the presentation of research at conferences, attending workshops, and developing new collaborations. Typical grants for travel within NZ and Australia

are in the range $200–$600. For travel further overseas, larger grants may be considered. To be eligible, a student must be based at an institution in New Zealand and be active within the New Zealand mathematical community. NZMS Student Travel Grants can contribute to costs including: flights, conference registration, accommodation, and travel-related costs associated with family responsibilities.

NZMS Student Travel Grants are generously supported by an annual grant from the Margaret and John Kalman Charitable Trust.

NZMS Financial Assistance

The NZMS invites applications for financial assistance with the costs of mathematical research-related activity. Any research-related activity will be considered. For example: hosting mathematical visitors; organising conferences, workshops, or outreach activities; and conference attendance, including costs associated with family responsibilities.

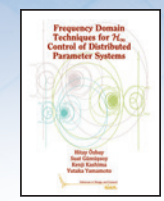
Applications

Further information and application details can be found on the NZMS website: nzmathsoc.org.nz/?assistance.

New and Notable Titles from SIAM

Frequency Domain Techniques for H∞ Control of Distributed Parameter Systems

Hitay Özbay, Suat Gümüşsoy, Kenji Kashima, and Yutaka Yamamoto

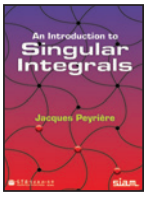


This book presents new computational tools for the H∞ control of distributed parameter systems in which transfer functions are considered as input-output descriptions for the plants to be controlled. The emphasis is on the computation of the controller parameters and reliable implementation. The authors present recent studies showing that the simplified skew Toeplitz method is applicable to a wide class of systems, supply detailed examples from systems with time delays and various engineering applications, and discuss reliable implementation of the controller, complemented by a software based on MATLAB®.

2018 / vii + 192 pages / Softcover / 978-1-611975-39-0
List $79.00 / SIAM Member $55.30 / DC32

An Introduction to Singular Integrals

Jacques Peyrière



In just over 100 pages, this book provides basic, essential knowledge of some of the tools of real analysis: the Hardy–Littlewood maximal operator, the Calderón–Zygmund theory, the Littlewood–Paley theory, interpolation of spaces and operators, and the basics of H1 and BMO spaces. This concise text offers brief proofs and exercises of various difficulties designed to challenge and engage students.

2018 / viii + 115 pages / Softcover / 978-1-611975-41-3
List $59.00 / SIAM Member $41.30 / OT159

Finite Element Exterior Calculus

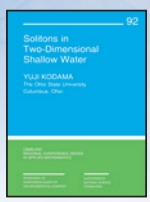
Douglas N. Arnold

The finite element exterior calculus, or FEEC, is a powerful new theoretical approach to the design and understanding of numerical methods to solve partial differential equations (PDEs). The methods derived with FEEC preserve crucial geometric and topological structures underlying the equations and are among the most successful examples of structure-preserving methods in numerical PDEs. This volume aims to help numerical analysts master the fundamentals of FEEC, including the geometrical and functional analysis preliminaries, quickly and in one place.

2018 / xii + 120 pages / Softcover / 978-1-611975-53-6
List $54.00 / SIAM Member $37.80 / SIAM Member $48.30 / CB93

Solitons in Two-Dimensional Shallow Water

Yuji Kodama

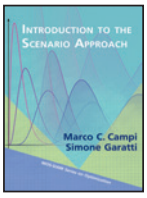


Web-like waves, often observed on the surface of shallow water, are examples of nonlinear waves. They are generated by nonlinear interactions among several obliquely propagating solitary waves, also known as solitons. In this book, modern mathematical tools—algebraic geometry, algebraic combinatorics, and representation theory, among others—are used to analyze these two-dimensional wave patterns. The author's primary goal is to explain some details of the classification problem of the soliton solutions of the KP equation (or KP solitons) and their applications to shallow water waves.

2018 / xiv + 252 pages / Softcover / 978-1-611975-51-2
List $69.00 / SIAM Member $48.30 / CB92

Introduction to the Scenario Approach

Marco C. Campi and Simone Garatti



This concise, practical book provides readers with an easy access point to make the scenario approach understandable to nonexperts and offers an overview of various decision frameworks in which the method can be used. It contains numerous examples and diverse applications from a broad range of domains, including systems theory, control, biomedical engineering, economics, and finance. Practitioners can find "easy-to-use recipes," while theoreticians will benefit from a rigorous treatment of the theoretical foundations of the method, making it an excellent starting point for scientists interested in doing research in this field.

2018 / viii + 114 pages / Softcover / 978-1-611975-43-7
List $54.00 / SIAM Member $37.80 / MO26

Scientific Computing: *An Introductory Survey, Revised Second Edition*

Michael T. Heath

This book differs from traditional numerical analysis texts in that it focuses on the motivation and ideas behind the algorithms presented rather than on detailed analyses of them. It presents a broad overview of methods and software for solving mathematical problems arising in computational modeling and data analysis, including proper problem formulation, selection of effective solution algorithms, and interpretation of results. This edition has been updated to include pointers to Python software and the Chebfun package, expansions on barycentric formulation for Lagrange polynomial interpretation and stochastic methods, and the availability of about 100 interactive educational modules that dynamically illustrate the concepts and algorithms in the book.

2018 / xx + 567 pages / Softcover / 978-1-611975-57-4
List $94.00 / SIAM Member $65.80 / CL80

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Order at bookstore.siam.org

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Or send check or money order in US dollars to: SIAM, Dept. BKNZ18, 3600 Market Street, 6th Floor, Philadelphia, PA 19104-2688 U.S.
Members and customers outside North America can also order through SIAM's distributor, the Eurospan Group, at *eurospanbookstore.com/siam*