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NEWSLETTER

OF THE

NEW ZEALAND MATHEMATICAL SOCIETY

Contents

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EDITORIAL

In this issue we continue to refocus the newsletter slightly more toward ideas, and there are three invited articles. These articles will be by NZMS prizewinners, describing their own research, or on topics that have received wide discussion internationally and have a New Zealand connection (either because the research was done by a local, or can be nicely explained by a local). This issue, we have Andre Nies, Geoff Whittle and Astrid an Huef filling each of these three roles very nicely.

The local news is being slightly refocused, and I intend to have special focus articles on the various departments in turn, in order to give a snapshot of current conditions. Small changes reported in the local news over many years can lead to huge changes in departments. In lieu of the first of these articles we have a longer traditional local news report from AUT in this issue.

In this issue there are no letters to the editor, and the local news is a bit shorter than desired. I have committed to the role as editor for 1–2 years, and will continue if I can see that the newsletter is fulfilling an important role in community-building. So, please give feedback, and make an effort to strengthen this community by contributing in whatever way you can, especially if you have committed to doing so! Hanging together seems preferable to hanging separately.

This issue comes to you straight after the 2013 NZMS Colloquium. I hadn't attended for 16 years, and it was interesting to see the mixture of old (look in the mirror!) and new colleagues. New Zealand's mathematical community is small, fairly isolated and never properly supported by government, so it is important that we stick together. I urge all members to try to attend the colloquium at least every few years. This year the colloquium was opened by recent Tauranga immigrant Roy Kerr, who lectured multivariable calculus to me (among hundreds) in my first year at university. I met a postdoc from Victoria who had me as a lecturer not so long ago, and was incredulous when I explained how I decided on which graduate school to attend in the pre-internet days. At the conference dinner my table included three generations of the same "mathematical PhD family". These kinds of links are important and the colloquium is a good place to foster them.

The summer break seems to become shorter each year, and applying to the Marsden Fund is no doubt top of the list for many members in early 2014. I thought it useful to solicit a report from the chair of the MIS Panel, Jari Kaipio, giving more details on the decision-making process. Now, if we can only get actual feedback from the panel on our application, there might be a chance of improving the quality of applications. Several discussions at the colloquium made it clear that there is a lot of support for reducing the size of grants in order to spread the money around, but it seems that as so often, decision-makers in Wellington dictate that mathematics must sleep in a Procrustean bed designed by biologists and chemists. Perhaps this is another issue on which the NZMS could make common cause with other societies in the mathematical sciences, as described in this month's President's Column.

To finish, I wish all readers a recharging festive season and summer. The following may be of interest for those celebrating a traditional Christmas: (thanks to Austen Bentley for the link)
http://www.shef.ac.uk/news/nr/debenhams-christmas-tree-formula-1.227810

Mark C. Wilson

PRESIDENT'S COLUMN

(Graham Weir's report delivered at the NZMS AGM on 4 December at the Tauranga Colloquium.)

This is my second and final report as President. The two main highlights for 2013 have been 2013 being the Year of Mathematics in New Zealand, and Pure and Applied Mathematics scoring top of all of the disciplines in New Zealand in the 2013 PBRF round.

The Year of Mathematics has provided a framework for mathematics to showcase itself, with the Royal Society of New Zealand's 10×10 Invited Speakers series allowing 10 New Zealand mathematicians to speak in a public forum on their area of speciality. Most of the talks were preceded by radio interviews to publicise the upcoming 10×10 talk. Each talk was well attended, and much appreciated by the public. In parallel, the NZMS and NZAMT (New Zealand Association of Mathematics Teachers) jointly organised a poster competition for Year 7–10 students, called the Maths Quest. The number, geographical extent and quality of the submitted posters showed that many younger members of New Zealand have a real passion for our discipline. On 28 August, 18 of the winning students in the Maths Quest travelled to Wellington, where they visited Te Papa, Parliament and Weta Digital.

One of the privileges I have enjoyed in the last decade has been to serve on fellowship, grant and medal awarding committees, which has enabled me to obtain some insight into the outputs of some of New Zealand's outstanding researchers. I continue to be amazed by the brilliance and energy of New Zealand's research community, and I am especially impressed by New Zealand's mathematical community. It was very reassuring then to hear of Pure and Applied Mathematics scoring top in the recent PBRF round.

Membership Our total membership is 265 (Ordinary: 162, which includes 6 first-year free; Reciprocal: 16; Student: 59 (32 are free, 2 are overseas); Honorary: 17; Life: 11). I would especially like to welcome the new Ordinary Members of Frederic Effenberger, Koh Ngin-Tee, Sooran Kang, Wenjun Zhang, Hyuck Chung, Julia Novak, Shonal Singh; and the new Student Members of Adam Tunney, Alistair Watt, Andrew Keane, Antoine Nectoux, Chris Stevens, Cris Hasan, Gemma Phillips, Karen McCulloch, Leon Escobar Diaz, Loveday Kempthorne, Matt Wilkins, Mohd Mohd Hafiz, Nick Stringer, Phuong T T Nguyen, Rosalie Hosking, Sebastian Boie, Sophie Calabretto, Sylvia Han, Tomohiro Uchiyama, Yuancheng Wang, Zahra Afsar, Dale Copeland, Dominic Searles and Christopher Laing.

Newsletter This year has seen the newsletter editorship move from Steven Archer to Mark Wilson. I would like to acknowledge the contribution from Steven, and thank him for his efforts. I would especially like to thank Mark Wilson for beginning the process of moving the newsletter into the electronic age, by focussing on electronic publications, and for his drive for interesting and topical articles in the newsletter.

The number of printed paper copies of the newsletter has reduced to about one tenth of its original number a year ago. There are several members who do not have email, so we send them hardcopies, and we send 26 printed copies to libraries, honours room, Legal Deposit Offices (3), RSNZ, NZAMT, NZSA, etc. There are about 4–6 past newsletters which are not in electronic form. John Shanks is hoping to have all back issues of the newsletter in electronic form by the end of this summer.

I am very pleased with the initiative in the last year to highlight the outputs from our leading mathematicians in the newsletter. Currently we feature one article per issue from either a Research Award or an Early Career Award winner. Sometimes we have multiple winners, and so together with the backlog of winners who have not described their work in the newsletter, we should be able to enjoy such articles essentially indefinitely.

Webpages The webpages continue to improve, thanks to the considerable input from John Shanks and Boris Baeumer, both at the University of Otago.

Inter-society linkages The mathematical community is a broad church, and is served by many different societies. An important challenge for the NZMS is improving our linkages within our community. This is not an easy aim, as it requires long and directed effort. The success obtained by the statistics community in promoting statistics indicates the value of strong ties between the university and secondary school communities, and hopefully we will be able to start down this path in the areas of traditional pure and applied mathematics. The current initiative to form a Maths Education Committee is progressing, with a major aim being that the NZMS will provide the New Zealand community with independent and hopefully influential commentary on mathematical education issues, such as the school syllabus. The current committee comprises of the NZMS President (Graham Weir), Angela Jones, Alex James, Pip Arnold, Winston Sweatman, Shaun Cooper, Stephen McConnachie, Jen Hudson, Luke MacEwan and Dillon Mayhew.

Recent data from Australia shows that Australian graduation rates in the mathematical sciences are only half that of the OECD average for men, and one-third for women. Perhaps contributing to this statistic is that more than

30% of secondary school mathematics classes in Australia are taught by staff not trained as mathematics teachers. If similar statistics hold in New Zealand, then this may become an issue of concern for the Maths Education Committee.

The Maths Quest has given a glimpse of what can be achieved when a common aim exists. The Year of Mathematics has linked the NZMS, NZSA, ORSNZ, NZAMT, ANZIAM, RSNZ and several of the COREs (MacDiarmid, Allan Wilson Centre) together (and some other groupings) in our celebration of mathematics in New Zealand.

Another issue is that mathematics is linked with Information Sciences in the MIS grouping. It is challenging but nonetheless important that we understand our values and differences in the MIS grouping.

Applied Mathematics Team, IRL The demise of IRL has seen the demise of the Applied Mathematics Team of IRL. Shaun Hendy and Dion O'Neale have moved to the University of Auckland; John Burnell and Warwick Kissling have moved to GNS; and Graham Weir will leave the new organisation, Callaghan Innovation, on 6 Dec 2013.

Maclaurin Fellowship The international linkages between the NZMS and the American Mathematical Society are continuing to strengthen. This year the inaugural Maclaurin fellow from the AMS was Terry Tao, arguably the world's greatest living mathematical prodigy, who generated considerable interest in New Zealand as he toured each university region. Robert McLachlan has interviewed Terry about his life and mathematics, and these interviews have been/will be published in the 2013 August and December issues of the newsletter. By all accounts, Terry really enjoyed his Maclaurin fellowship, and hopefully this enjoyable experience will encourage other outstanding mathematicians from the US to take up future Maclaurin Fellowships.

Aitken Lecturer Robert McLachlan was the 2013 Aitken Lecturer, and toured England and Scotland, giving lectures at Strathclyde, Leeds, Warwick, Cambridge, Bath, and Imperial College. Robert found the audiences very receptive and he was able to meet a wide variety of researchers – he was impressed at how active and enthusiastic all the groups he visited were. Mathematics in the UK is thriving at all levels. The NZMS has provided an ordering to an alphabetical list, provided by the London Mathematical Society, for the next Forder Lecturer to tour New Zealand in 2014, as part of the continuing Aitken-Forder Lectureship sequence.

NZMS Awards The Research Award for 2013 was presented to Steven Galbraith of the University of Auckland, for applying deep ideas from number theory and algebraic geometry to Public Key Cryptography to achieve world leading processing speeds without compromising security. The Early Career Award for 2013 was awarded to Florian Beyer of the University of Otago for his contributions to the understanding of the global structure of cosmological solutions of Einstein's equations using numerical and analytical methods, and in particular for the proof of the well-posedness of the singular initial-value problem for Fuchsian PDEs. The NZMS Aitken Prize for Best Student Paper for 2013 was awarded to Timm Treskatis of the University of Canterbury for his paper entitled "Trust-region SQP methods for numerical simulations of viscoplastic flows", and to Chris Stevens of the University of Otago for his paper entitled "The Friedrich-Nagy gauge for colliding plane gravitational waves".

Travel grants Six travel grants were awarded in 2013, along with one to the post-graduate student conference.

CORE Funding round It appears that there is not a CORE nomination specific to mathematics alone, but many mathematicians are named as part of nominated COREs. We wish them success in this round.

RSNZ Awards Professor Charles Semple of the University of Canterbury and Professor Jorg Frauendiener of the University of Otago were elected Fellows of the RSNZ from the Mathematics and Information Sciences panel in 2013. Marti Anderson of Massey University-Albany was also elected FRSNZ.

Other Honours Congratulations to John Butcher, Emeritus Professor of the University of Auckland's Department of Mathematics, for being appointed an Officer of the Order of New Zealand in the Queen's Birthday Honours, for his services to mathematics, on 4 June 2013. As Eamonn O'Brien writes, "This is an appropriate recognition of John's many contributions to mathematics and to the mathematical community in New Zealand and world-wide during a long and distinguished career." Congratulations to Jari Kaipio of the University of Auckland who was awarded Knight, First Class, of the Order of the White Rose of Finland, one of the highest civilian honours in Finland, for his work on tomographic solutions for industrial problems. Congratulations to Roy Kerr for being awarded the Einstein Medal. Congratulations to Hinke Osinga for being invited to speak at the International Congress of Mathematicians. Congratulations are also due to Rua Murray, from the Department of Mathematics and Statistics, University of Canterbury, for winning a Sustained Excellence in Tertiary Teaching award. The Tertiary Teaching Excellence Awards celebrate New Zealand's finest tertiary teachers – as recognised by their organisations, colleagues and learners alike. Marston Conder FRSNZ, University of Auckland; Rod Downey FRSNZ, Victoria University of Wellington; Gaven Martin FRSNZ, Massey University; and Vaughan Jones Hon

FRSNZ, University of California, Berkeley have been selected to join the inaugural class of Fellows of the American Mathematical Society in honour of their distinguished contributions to mathematics. They were officially inducted at the Joint Mathematics Meetings in San Diego on 11 January 2013. Congratulations to Matt Visser, who was awarded the Dan Walls Medal at the NZIP conference in Nelson on 21 October 2013, for his work on wormholes, dumbholes, Hawking radiation, etc. Congratulations to Shaun Hendy for being awarded the EO Tuck ANZIAM medal in January 2013. Congratulations to Emily Harvey and Shaun Cooper for being elected onto the NZMS Council.

Acknowledgements I want to thank Rod Gover for chairing the NZMS Awards Committee over recent years. I also want to thank the Council for all of their efforts. I particularly want to thank Alex James (Secretary) and Mark McGuinness (Treasurer) for their contributions in 2013; and Robert McKibbin, Peter Donelan and Tom ter Elst, for their assistance over several years. My best wishes go naturally to Winston Sweatman for his upcoming Presidency.

Graham Weir

INVITED ARTICLES

The study of randomness and computability

(André Nies, NZMS Research award winner, 2009)

Understanding randomness through computation seems to be a contradiction in terms. While a random object is by definition unpredictable, a computation is completely determined by the input and the program code. The apparent contradiction is resolved easily. A definition of algorithmic randomness for an infinite sequence Z of bits expresses that Z defies attempts to even partially compute it. For the formal definition, one introduces a computational test concept. To be random, Z has to pass all such tests, which means that any attempt to computationally find patterns in Z fails.

The classical algorithmic randomness notion was introduced by Martin-Löf (The definition of random sequences, Information and Control 9, 1967). A test is a computable sequence $(\sigma_i)_{i\in\mathbb{N}}$ of finite bit strings such that $\sum_i 2^{-|\sigma_i|}$ is finite. The bit sequence Z is Martin-Löf-random (ML-random, for short) if for each such test, Z extends only finitely many of the σ_i. This means that Z has no effective Vitali cover. The test concept given here is equivalent to the one defined by Martin-Löf, but easier to state.

Schnorr (1975) dismissed Martin-Löf's concept (and its equivalents) as too general. He said that Martin-Löf's tests are not actually computable. Rather, they are only computably enumerable: they can be listed by a machine, but one never obtains information about non-membership. To remedy this, he introduced a notion that seems closer to intuition (at least for people who like the Skycity casino). A computable betting strategy is a procedure that starts with capital 1. After seeing the first n bits of Z, it bets a portion of the current capital on the prediction that the next bit is, say, 0. If so, it wins that portion of the capital, otherwise it loses that portion. A bit sequence Z is computably random if no computable betting strategy has unbounded capital when betting according to Z. It can be shown that ML-randomness is strictly stronger than computable randomness.

Once a formal notion of randomness has been defined through algorithms, one can conversely use randomness to study the computational complexity of objects. Imagine a ML-random sequence Z that, when used as a query set (ROM) in computations, can determine membership in a computably enumerable (c.e.) set of numbers A. Hirschfeldt, Stephan and myself (Using random sets as oracles, J. London Math. Society 75, 2007) showed that, unless Z in fact can determine all c.e. sets (i.e., Z is omniscient anyway), A must be very close to computable. I showed in work starting from 2002 that close to computable is the same as far from random (Lowness properties and randomness, Advances in Mathematics 197, 2005). Technically, being "K-trivial" means that the initial segment complexity measured via a universal prefix-free machine is as low as possible.

During the years 2009/2010 a turning point in the study of randomness and its interaction with computability was reached. My 444-page Oxford university Press book "Computability and Randomness" appeared in early 2009. The over 800 page book "Algorithmic randomness and complexity" by Downey and Hirschfeldt followed in 2010. Over 1200 pages seemed to say that after a decade of intense study, randomness and its interaction with computability was firmly understood.

Not so. One major question left open was the converse of the result of Hirschfeldt et al. (2007) mentioned above: given a c.e. K-trivial set A, is there a ML-random Z that computes A, but not all the c.e. sets? This was eventually resolved by newly found interactions of randomness with concepts and results stemming from analysis, in particular the Lebesgue density theorem. Early work of Joseph Miller (now at UW Madison) hinted at interesting interactions; however, only a little of this was covered in the two books. During my 2009 sabbatical, I visited the computable analyst Vasco Brattka in Cape Town. I worked hard on understanding the connection to analysis, which involved remembering some long-forgotten facts from undergraduate calculus. With Joseph Miller, we eventually proved an effective counterpart of the classical theorem of Lebesgue that a nondecreasing function is a.e. differentiable. Let $z \in [0,1]$ be a real, and let the bit sequence Z denote the dyadic representation of z. Then Z is computably random if and only if (you guessed it) every nondecreasing computable function f is differentiable at z. Here, computability of f can be interpreted in various ways- the weakest is that $f(q)$ is a computable real, uniformly in each rational q.

A year later, I started working on another classical theorem of Lebesgue: Let $\mathcal{E} \subseteq [0,1]$ be measurable. Then $\mathcal{E}$ has density 1 at almost every real $z \in \mathcal{E}$. The simplest "computable" version of this is when $\mathcal{E}$ is effectively closed, namely, one can effectively list the open intervals with rational endpoints that are disjoint from $\mathcal{E}$. It turned out that ML-randomness of a real z (written in dyadic) is not quite sufficient for such an $\mathcal{E}$ to have density 1 at $z \in \mathcal{E}$. Each $\mathcal{E}$ has positive density at a ML-random z if and only if z is not omniscient, i.e. does not compute all c.e. sets (Bienvenu, Hölzl, Miller and Nies, STACS, 2012).

But is this different from density 1? This question became much more interesting after five researchers (Bienvenu, Greenberg, Kucera, Turetsky, and myself) got together for a research in pairs (!) stay in early 2012 at the Mathematisches Forschungsinstitut Oberwolfach. They showed that a ML-random real z at which some $\mathcal{E}$ does not have density 1 would as a query set be able to computationally determine each K-trivial set A. Day and Miller proved later in 2012 that there is a ML-random real z such that each effectively closed $\mathcal{E} \ni z$ has positive density at z, but some $\mathcal{E}$ fails to have density 1 at z. The combined work of these seven researchers answered the question posed above in the affirmative, and strongly so: there is a single non-omniscient ML-random Z that can computationally determine all the K-trivials. So, the intrusion of concepts from analysis closed the circle.

Recent directions make even more connections between randomness and other fields. The latest is with a branch called reverse mathematics, where one asks which axioms are needed to prove a theorem. In another direction, the strength of tools to define randomness is re-examined. If we only allow the more restricted "efficient" computability, we obtain polynomial time randomness. If instead we allow the much stronger tools from effective descriptive set theory, we obtain higher forms of randomness, such as not being in the largest Π^1_1 null set.

While New Zealand still plays its role as a centre for algorithmic randomness, very good young researchers have appeared in various other places, most recently in Japan. Where will the field go next?

André Nies

Rota's conjecture

In 1970, Gian-Carlo Rota posed a beautiful conjecture that provides a combinatorial characterisation of linear dependence in vector spaces over any given finite field. Recently Jim Geelen, Bert Gerards and I completed a 15-year project that culminated in a proof of Rota's conjecture. What follows is an attempt to give some insight, in language suited to a general mathematical audience, to Rota's conjecture itself together with a short discussion of the techniques that lead to its proof.

Collinearity, coplanarity and their higher dimensional analogues can be thought of as describing the *combinatorial* properties of a set of points in space. These properties can be captured, through the use of homogeneous coordinates, by linear independence. Thus, given a finite set E of vectors, the combinatorial properties of the vectors in E are captured by knowing those subsets of E that are linearly independent. The properties that we capture in that way are, of course, the properties of interest in classical projective geometry.

In 1935 Hassler Whitney attempted to capture this axiomatically. We are given a set E and a collection of subsets I of E that we call *independent*. We will say that the pair (E, I) is *representable over a field* $\mathbb{F}$ or $\mathbb{F}$-*representable* if we can find a bijection from E to a collection of vectors in a vector space V over $\mathbb{F}$ such that the independent sets are precisely the sets that are mapped to linearly independent subsets of V. The pair (E, I) is *representable* if there exists a field over which it is representable. Whitney observed that the following three conditions are necessary for (E, I) to be representable.

1. The empty set is independent.
2. Subsets of independent sets are independent.
3. If I and J are independent and $|J| > |I|$, then there is an element $x \in J - I$ such that $I \cup \{x\}$ is independent.

If the above properties are satisfied, then we say that (E, I) is a *matroid*. While the three conditions above are necessary for representability, they are by no means sufficient. It is easy to construct matroids that are not representable and Whitney posed the problem of characterising the matroids representable over a given field.

For infinite fields the evidence seems to suggest that there is no nice answer to Whitney's problem. For this reason, most attention in matroid theory has focused on finite fields. Whitney himself characterised the matroids representable over the two-element field, although a much nicer characterisation was found by Bill Tutte in 1958.

Consider an example. Let E be a 4-element set and let I be all subsets of E with at most two elements. Geometrically the matroid (E, I) represents the 4-point line. This matroid is traditionally denoted $U_{2,4}$. The matroid $U_{2,4}$ is representable over any field except $GF(2)$. This is because lines in binary space have only three points.

With typical prescience, Bill Tutte proved that $U_{2,4}$ played a fundamental role in the class of binary matroids. To understand that role we need to introduce our concept of substructure and discuss "minors". If e is an element

of the matroid M we can *delete* e to obtain a matroid whose independent sets are the independent subsets of M contained in $E - \{e\}$. Eliding a nuance we can *contract* e to obtain a matroid whose independent sets are the subsets A of $E - \{e\}$ having the property that $A \cup \{e\}$ is independent in M. Geometrically contraction corresponds to projecting the points of $E - \{e\}$ from the point e onto a hyperplane. Any matroid obtained from M by a sequence of deletions and contractions is a *minor* of M. Space forbids me to put forward the reasons here; but minors really are the natural notion of substructure for matroids.

A class $\mathcal{M}$ of matroids is *minor closed* if every minor of a member of $\mathcal{M}$ is also in $\mathcal{M}$. The matroid M is an *excluded minor* for the minor-closed class $\mathcal{M}$ if $M \notin \mathcal{M}$, but all proper minors of M are in $\mathcal{M}$. A minor-closed class of matroids is characterised by its set of excluded minors, but, in general, there may be infinitely many of them. For example, if $\mathbb{F}$ is an infinite field, then the class of $\mathbb{F}$-representable matroids has an infinite number of excluded minors. In striking contrast to this, Tutte proved the following theorem.

Theorem 1. *A matroid M is* GF(2)*-representable if and only if it does not have $U_{2,4}$ as a minor.*

In other words, $U_{2,4}$ is the unique excluded minor for representability over GF(2). Note that Tutte's theorem resolves Whitney's problem for the class of binary matroids. In 1970 Gian-Carlo Rota conjectured that a similar result held for all finite fields.

Conjecture 2 (Rota's conjecture)**.** *Let $\mathbb{F}$ be a finite field. Then there are only finitely many excluded minors for the class of $\mathbb{F}$-representable matroids.*

In 1979 Bixby and Seymour independently proved Rota's conjecture for GF(3) showing that there were four excluded minors for the class of GF(3)-representable matroids. Some twenty years later, Geelen, Gerards and Kapoor proved that there were seven excluded minors for representability over GF(4). They received the Fulkerson Prize for this work. Jim Geelen reported to me that when he discussed his proof of Rota's conjecture for GF(4) with Bill Tutte, the reply was simply "ah the next case." Deflated though he was at the time, Jim understood that Tutte was, in his inimitable way, pointing out that the constructive techniques that were used in these early cases would not suffice for a resolution of Rota's conjecture in general.

A completely different form of attack was needed. Inspiration came from an Oberwolfach workshop where Paul Seymour described an attempt to generalise some of the results of the Graph Minors Project to binary matroids. Readers familiar with graph minors will already have noticed parallels with Rota's conjecture. Indeed many readers will be familiar with Kuratowski's Theorem which says that the K_5 and $K_{3,3}$ are the only excluded minors for the class of planar graphs. Neil Robertson and Paul Seymour proved that this result is typical. As the culmination of a long series of papers they prove that graphs are well-quasi-ordered under the minor order. Stated in a form suited to this discussion their theorem says the following.

Theorem 3 (Graph WQO Theorem)**.** *Every minor-closed class of graphs has a finite number of excluded minors.*

That sounds a lot like Rota's conjecture. Associated with a graph is a matroid whose elements are the edges of the graph. This matroid is $\mathbb{F}$-representable for any field $\mathbb{F}$. Moreover, minors of graphs and their associated matroids correspond. Robertson and Seymour were aware that the Graph WQO Theorem was likely to be a special case of a more general result for matroids representable over finite fields. After much pain, Jim, Bert and I eventually proved this more general result.

Theorem 4 (Matroid WQO Theorem)**.** *Let $\mathbb{F}$ be a finite field. Then every minor-closed class of $\mathbb{F}$-representable matroids has a finite number of $\mathbb{F}$-representable excluded minors.*

It should be noted that both of the well-quasi-ordering theorems follow – with work – from theorems that give the qualitative structure of members of proper minor-closed classes of graphs or matroids. These theorems are the true workhorses of the projects.

Are we there yet? Definitely not. The Matroid WQO Theorem is about $\mathbb{F}$-representable excluded minors and Rota's conjecture says something quite different. But we have powerful tools and techniques and are well on the way. Space forbids a discussion of the other ingredients necessary to arrive at the final destination of a proof of Rota's conjecture.

Finally I note that it will be some time before a proof of Rota's conjecture appears. The task of writing up our results is lengthy, will require numerous papers, and will take several years.

Geoff Whittle

The Kadison-Singer problem

The Kadison-Singer problem, raised by Richard Kadison and Isadore Singer in [3] in 1959, has been a long-standing open problem in operator algebra. It has recently been solved by Adam Marcus (Yale), Daniel Spielman (Yale) and Nikhil Srivastava (Microsoft Research) in the affirmative. Here is one statement of the Kadison-Singer problem:

> Does every pure state on the algebra $\mathbb{D}$ of bounded diagonal operators on the Hilbert space ℓ^2 have a unique extension to a (pure) state on the algebra $B(\ell^2)$ of all bounded linear operators on the Hilbert space ℓ^2?

The Hilbert space ℓ^2 is the vector space of sequences (x_n) with entries in $\mathbb{C}$ that are square-summable, that is $\sum_n |x_n|^2 < \infty$, equipped with the inner product

$$\big((x_n) \mid (y_n)\big) = \sum_n x_n \overline{y_n}.$$

The sequences $e_i := (x_{i,n})$, where $e_{i,n}$ is 1 when $n = i$ and 0 otherwise, form an orthonormal basis for ℓ^2.

The algebra $B(\ell^2)$ of all bounded linear operators on the Hilbert space consists of linear maps $T : \ell^2 \to \ell^2$ that are bounded in the operator norm

$$\|T\| = \sup\{\|Tx\| : x \in \ell^2 \text{ with } \|x\| = 1\}.$$

Every T in $B(\ell^2)$ has an adjoint T^* which is the unique operator in $B(\ell^2)$ such that $(Tx \mid y) = (x \mid T^*y)$ for all $x, y \in \ell^2$. If it helps (but it usually doesn't) you can think of a bounded operator T as an infinite matrix, and then the adjoint T^* is the complex-conjugate transpose. The algebra $B(\ell^2)$ is what is called a C^*-algebra, and abstract C^*-algebras are normed $*$-algebras with properties like those of $B(\ell^2)$.

An operator T in $B(\ell^2)$ is diagonal if $(Te_i \mid e_j)$ is 0 whenever $i \neq j$. The collection $\mathbb{D}$ of diagonal operators is a maximal abelian C^*-subalgebra of $B(\ell^2)$. (Any other choice of orthonormal basis yields another maximal abelian subalgebra of diagonal operators.)

A state on a C^*-algebra A with identity 1_A is a bounded linear functional $f : A \to \mathbb{C}$ such $f(1_A) = 1$ and $f(a^*a) \geq 0$ for all $a \in A$. That $f(1_A) = 1$ ensures that f has norm 1. The set of states of A is a compact, convex subset of its dual. The Krein-Milman Theorem says that the set of states is the closed convex hull of its extreme points; these extreme points are the pure states of A.

Now let f be a state on $\mathbb{D}$. By the Hahn-Banach Theorem, f extends to a bounded linear functional of $B(\ell^2)$ with norm 1, and there is an extension which is a state. The set of state extensions of f forms a compact, convex subset of the dual of $B(\ell^2)$; if f is a pure state then the extreme points of this set of extensions can be shown to be pure states of $B(\ell^2)$. It follows that if a pure state has a unique extension to a pure state, then this set of extensions consists of only one pure state. Thus a pure state has a unique extension to a pure state if and only if it has a unique extension to a state. This explains the parenthetical "(pure)" in the statement of the Kadison-Singer problem above.

Over the years, several conjectures in other areas of mathematics have been shown to be equivalent to the Kadison-Singer problem, see, for example, [2]. Indeed, Marcus, Spielman and Srivastava arrive at their affirmative answer to the Kadison-Singer problem via two other conjectures, as explained in their abstract:

> We use the method of interlacing families of polynomials introduced in [4] to prove Weaver's conjecture KS_2 [7], which is known to imply a positive solution to the Kadison-Singer problem via a projection paving conjecture of Akemann and Anderson [1]. Our proof goes through an analysis of the largest roots of a family of polynomials that we call the "mixed characteristic polynomials" of a collection of matrices.

We expect solutions to long-standing open problems to be very influential in the areas involved. So the gift given to the mathematical community by the work of Marcus, Spielman and Srivastava, and those their work is based on, promises to be substantial.

Nik Weaver's conjecture KS_2 is a combinatorial form of the Kadison-Singer problem. Its statement is quite accessible (deceptively so!):

There exist universal constants $N \geq 2$ and $\varepsilon > 0$ such that the following holds. Let $v_1, \ldots, v_n \in \mathbb{C}^k$ satisfy $\|v_i\| \leq 1$ for all i and suppose

$$\sum_i |\langle u, v_i \rangle|^2 \leq N$$

for every unit vector $u \in \mathbb{C}^k$. Then there exists a partition X_1, X_2 of $\{1, \ldots, n\}$ such that

$$\sum_{i \in X_j} |\langle u, v_i \rangle|^2 \leq N - \varepsilon$$

for every unit vector $u \in \mathbb{C}^k$ and all $j = 1, 2$.

I, for one, am looking forward to an operator-algebraic proof of the Kadison-Singer problem. If you want to know more about the proof of the Kadison-Singer problem, the letter [6], currently in preparation, is a very accessible account of the story from a set-theoretic and operator-algebraic point of view.

[1] C. Akemann and J. Anderson. Lyapunov theorems for operator algebras, *Mem. Amer. Math. Soc.* **94** (1991), no. 458.

[2] P.G. Casazza, M. Fickus, J. C. Tremain and E Weber. The Kadison–Singer problem in mathematics and engineering: a detailed account. Operator theory, operator algebras, and applications, *Contemporary Mathematics*, **414**, 2006.

[3] R. Kadison and I. Singer. Extensions of pure states, *American Jour. Math.* **81** (1959), 383–400.

[4] A. Marcus, D.A. Spielman and N. Srivastava. Interlacing families I: bipartite Ramanujan graphs of all degrees, preprint, (2013), arXiv:1304.4132.

[5] A. Marcus, D.A. Spielman and N. Srivastava. Interlacing families II: mixed characteristic polynomials and the Kadison-Singer problem, preprint, (2013), arXiv:1306.3969.

[6] B. Tanbay. A letter on the Kadison-Singer problem, in preparation.

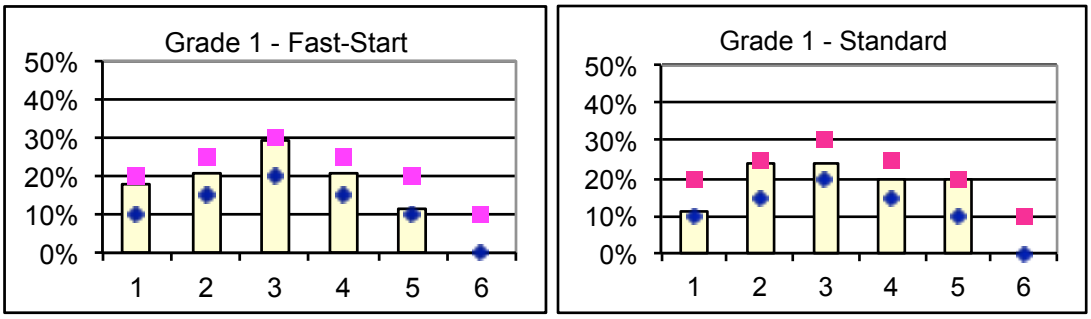
[7] N. Weaver. The Kadison-Singer problem in discrepancy theory. *Discrete Math.* **278** (2004), 227–239.

Astrid an Huef

The decision process of the MIS panel

Preliminary proposals

Both fast start (FS) and standard (STD) proposals are sent to the panel members. The panel members grade the proposals from 1 (best) to 6. The distribution of the grades has to fit an envelope such as the ones below:



(a) Fast-Start **(b)** Standard

The panel members also declare conflicts of interest (COI) and send this information to the Marsden Fund officers, who prepare a joint statistics and an overall initial ranking for both FS and STD proposals separately. The panel members do not grade the COI proposals.

In the panel meeting, a rough target is made for how many proposals (in both categories) should be invited to submit full proposals. This number is typically such that around 40% of the full proposals can be funded.

In the panel meeting, the proposals are discussed, and based on this discussion, the panel members may revise their grading of the proposals. Due to the time constraints, not all proposals can be discussed. However, an opportunity is given for any panellist to discuss any proposal that they think has merit. Most time, in general, is dedicated to those proposals on the borderline and/or that have a wide spread of initial scores. Based on the initial grading, the panel chooses (in both categories) a number of proposals for discussion. This number is around three times the number that can be invited for the second round. The panel members with a COI with a proposal will not be present in the discussion. The MFC Chair and several MF staff are also present in the panel meetings to ensure that the process is correct and consistent with the terms of reference agreed with the RSNZ and the Minister.

After the discussion, the results might look like the following list:

Proposal	**1**	**2**	**3**	**4**	**5**	**6**	**V**	**Grade**
13-YYY-012	6	0	1	0	0	0	7	1.3
13-XXX-201	4	2	0	0	0	0	6	1.3
13-XXX-061	4	3	0	0	0	0	7	1.4
13-ZZZ-103	0	4	1	0	0	0	5	2.2
13-GGG-012	0	4	3	0	0	0	7	2.4
13-FFF-046	0	5	1	1	0	0	7	2.4
13-JJJ-058	2	1	4	1	0	0	8	2.5
13-KKK-029	0	0	4	0	0	0	4	3.0
13-YYY-106	0	0	4	2	0	0	6	3.3

In the above, for example, the highest ranked proposal 13-YYY-012 got grade 1 from six panel members and grade 3 from one panel member. There were 7 grades, with one panel member (out of the 8 members) having a COI.

Once both categories have been handled and the final grading is ready the panel decides on how many of the highest ranked proposals will be recommended to be invited to the second round. The Marsden Fund Council makes the decision. There is some room when the panel decides on the number of FS and STD proposals.

Full proposals

The panel handles the full proposals with a similar process as the preliminary proposals. In the Full Round process, initial grading by panel members are made up only of panellists' scores but they take into account the referee reviews and the applicant rebuttals. The distribution of grades has again to fit an envelope.

With the full proposals, all proposals are discussed and the gradings may be revised. The panel recommendations are forwarded to MFC for decision.

Notes

1. The number of proposals that each panel can fund each year, depends on the allocation of the overall money to each panel. This corresponds roughly to a moving average of the number of proposals that were submitted to each panel over the 4–6 last years. The other factor is the maximum funding/year/project. This is different for different panels and reflects the cost structure in different fields. MIS proposals are usually not expected to contain an experimental aspect and the cap is therefore lower than, for example, with the EIS and PCB.

2. The panel members assist the Marsden Fund officers in finding reviewers for the full proposals.

3. It is often thought that, in the preliminary round, the proposals have to be written mainly keeping in mind the panel members' range of expertise. On the other hand, with the full proposals, the expert reviewers are the target audience. This is correct to a degree: the final rankings for Marsden proposals correlate well with the referee scores. However, since the second round proposals have been pre-selected, and most are fundable, the panel still has to make difficult decisions at the cut off for funding, when referees scores may be equal. Ensuring that a general panel can understand the full proposal is therefore also important.

Jari Kaipio

BOOK REVIEWS

In this issue we resume the reviews of recent books by New Zealand mathematicians. To the list in Issue 118 of reviewable books we can add Steven Galbraith's *Mathematics of Public Key Cryptography*.

Please send all material involving book reviews to the Book Review Editor, Bruce van Brunt. Offers to review are particularly welcome, as are suggestions for books to review. Contact: b.vanbrunt@massey.ac.nz.

Analytic Combinatorics in Several Variables

Robin Pemantle (Pennsylvania) & Mark C. Wilson (Auckland): *Analytic Combinatorics in Several Variables*
Cambridgae University Press — Part of Cambridge Studies in Advanced Mathematics
May 2013 Hardback ISBN: 9781107031579
378+xiii pp.

Faced with the problem of finding asymptotic estimates for the coefficients of a multi-variable generating function, a longstanding approach has been to do one of the following: attempt to eliminate all but one of the variables; extract coefficients one by one and hope for the best; or most commonly, give up and try a different problem. Since roughly the turn of this century the authors have been at the forefront of the development of more general, less ad hoc, techniques for such and related problems. This book develops, summarises and illustrates the results of their work both theoretically and in practice. As such, it fills a gap that was very much in need of filling.

The single variable case is of course much more classical, and better understood. It is admirably presented in Flajolet and Sedgewick's *Analytic Combinatorics* to which this book will inevitably be compared. That work is a giant compendium of theory, example and practice – everything including the kitchen sink. On the other hand, this one is a rather more traditional presentation in the mathematical literature. It contains a number of relevant and appropriate examples, but is driven much more by a desire to provide a complete exposition of a coherent body of theory. As a result it does sometimes seem to lack direction in that at the time material is introduced it is not quite clear how (or where) it is going to be used. However, the introductory chapter is excellent, and returning to it occasionally if you are feeling a bit lost will usually provide the direction you need.

Any review should pick a few minor nits, and this one will be no exception. At some point, I suspect, a global replace of "that is" by "i.e." was carried out. In places (e.g. pages 128 and 135) it does produce some unintentionally amusing usage. The use of typewriter font both for code samples and some sets is a bit jarring. In the same sort of vein, the typography in a number of the figures (e.g. Fig. 8.3) does not really match that in the text. Finally, an index of notation would not have gone amiss – particularly as I suspect that many readers will be sampling, rather than reading cover to cover.

The question of how or whether to present computational code in books of this sort is one that I suspect the mathematical community will need to spend some time coming to grips with. Nor do I doubt that there will be a diversity of strongly held opinions. Here the examples given all use *Maple* (though the authors note that the computations can also be carried out in other packages both commercial and open source). This seems like a pragmatic approach, albeit somewhat at odds with the general tone – rather than explicit code in text I'd have expected to see "a computation of a Gröbner basis for ... produces ...".

This is a book you must have if you intend to analyse multivariate generating functions. However, unless you have a lot of time to spare you are unlikely to be able to absorb it completely. How then should the more casual reader (of course "casual" here is applicable only in a rather specialised context) approach it? My first suggestion would be to arm yourself with a copy of the authors' 2008 paper "Twenty combinatorial examples ..." Starting there, choose your favourite or favourites, and then dive into the book as needed to understand the details. Indeed, it would have been nice to embed the material from that paper within this book. However, to do so would probably have led (eventually) to matching the size (and length of time in preparation) of Flajolet and Sedgewick, and I for one am very grateful to have it on my desk now.

Michael Albert

Counterexamples in Calculus

Sergiy Klymchuk (AUT): *Counterexamples in Calculus*
Mathematical Association of America — MAA Series: Classroom Resource Materials
2010, ISBN: 978-0-88385-765-6
112 pp.

"Then you should say what you mean," the March Hare went on. "I do, " Alice hastily replied; "at least I mean what I say, that's the same thing, you know." "Not the same thing a bit!" said the Hatter. "Why, you might just as well say that 'I see what I eat' is the same thing as 'I eat what I see!"' – Alice in Wonderland. Mathematicians know that the order of what we say matters and we usually choose our words carefully. However, we do not always explain the importance of this to students who are first being introduced to the rigours of our subject. Sergiy Klymchuk's book *Counterexamples In Calculus* can help you to address this in your classroom. The book consists of three main parts: 1. an introduction (for you) and opening chapter (for you and your students) explaining the importance of counterexamples and how you might use them in a calculus course; 2. carefully constructed untrue statements organised according to the main areas taught in calculus – functions, limits, continuity, differential and integral calculus; 3. suggested counterexamples for each of these statements.

It is a well-written, intriguing book that is a good resource for enhancing the learning experience of a single variable calculus course, as it sets out to do. Klymchuk points out that finding counterexamples is not a skill that students come to calculus with and they have to be trained to look at statements carefully. Students also need to learn that, even though one counterexample can disprove a statement, one example does not make a proof. Using the incorrect statements in this book can help students gain a deeper understanding of the concepts of calculus, as well as the nature of mathematics. For example, when defining the tangent line to a curve at a point, you could give students these two statements and ask them to draw curves to show the statement is false: 1.1 The tangent to a curve at a point is the line that touches the curve at that point, but does not cross it there; 1.2 The tangent line to a curve at a point cannot touch the curve at infinitely many other points.

My only quibble with the book is the level for which is written. Klymchuk organised the sections from easier to harder statements, so there are useful statements for all levels of calculus. However, for the most part it seems to me that the level is above the level of high school and many first year students; for example, references to the Dirichlet function and the Fresnel Integral. Most of the book would in fact be more suitable for a second year calculus or analysis course. Unfortunately, there are also a few curves missing off the graphs.

One last tip: when you read the book, read it with a pencil so you can make notes in the margins about which theorems or definitions this incorrect statement would be usefully introduced with. A few times in the solutions the author points out what the correct definition or statement should be, but not often.

Cami Sawyer

In brief

NZMS member, Dale Copeland (former mathematics teacher, and current artist) has just published *Complex Numbers in Graphs* via Puniho Art Press: http://dalecopeland.co.nz/Press/press.htm.

In her words, it is written "for undergraduates and senior college students who see complex numbers as way more than just another maths topic."

CYBERMATH

A theme arising from my reading over the last few months is the crisis in credibility of the scientific literature.The facts that scientific "truth" is always being refined, and that any given research finding may well be wrong, are well known to insiders, but it seems that many journalists, for example, don't know about this. The University of Auckland's Department of Statistics runs the blog StatsChat (http://www.statschat.org.nz/), in which Thomas Lumley seems to be correcting an overhyped NZ Herald article almost every day.

Apart from the ignorance of laypeople and policymakers, there is another problem, which is that scientists themselves make a lot of errors, and the publication system is not set up to correct these easily. Many journals refuse to publish negative results or results pointing out errors in papers published in that journal. When they publish retractions, they don't always explain why, or link them clearly to the original paper (another good reason to facilitate post-publication commenting and review for all papers). There is no central place to find retractions, and they are not well linked by search engines, etc., to the original paper (some journals even charge access fees for viewing retractions!)

However, the website Retraction Watch (http://retractionwatch.com/) is doing a good job, as far as it goes. Papers are retracted and discussed there for many reasons: fraud (there is one author in medicine who has had over 180 papers retracted), plagiarism, understandable errors, unforgivable sloppiness, joke/gibberish papers that slip through peer review somehow, etc.

An even more pervasive problem, according to some commentators, is that the lack of statistical rigour of many fields, combined with the pressure for "positive" results, means that "most published research findings are false" as claimed by John Ioannidis (http://www.plosmedicine.org/article/info:doi/10.1371/journal.pmed.0020124).

So, how different is mathematics from science in general? I have only anecdotes to give. Retraction Watch lists a few items in its "math" category (http://retractionwatch.com/category/by-subject/math-retractions/), which are depressing but worth reading in order to get an idea of the variety of human experience. Fraud is hard to carry out in mathematics – the reader doesn't have to take our word that we carried out experiments. Plagiarism is probably just as easy, if not easier, in mathematics than in other fields. This year, for the first time, I found a plagiaristic paper (http://www.heldermann-verlag.de/jgg/jgg01_05/jgg0402.pdf), now marked as such after I complained to the journal, when searching with Google for the real paper (http://link.springer.com/article/10.1007/BF02574688). Mathematics is difficult, so understandable errors can occur. A discussion at Math 2.0 turned up a few interesting examples including one by Fortnow and Sipser (http://dl.acm.org/citation.cfm?doid=258533.258677), very well known in computational complexity, and very recently I saw a retraction by Jordan Ellenberg (http://quomodocumque.wordpress.com/2013/11/23/). As far as sloppiness goes, the standard of proof in some papers is rather low, with too much hand-waving for my liking. I recall a particular case of a Russian paper I read in the late 1990s, whose results my co-author and I never quite believed. We couldn't manage to contact the authors, so we were forced to write our doubts in our own paper on the topic, but there is no easy way to connect these without careful reading of both papers. Another anecdote has a New Zealand connection. A few years ago I became aware, via Math Reviews, of a "deeply flawed" paper by some local colleagues (MR 2149410 at http://www.ams.org/mathscinet/). The paper has not been retracted to my knowledge. Joke/gibberish papers have been published, for example by the Elsevier journal Applied Mathematics Letters. No one has attempted a sting operation for mathematics journals like that recently tried by John Bohannon (http://www.sciencemag.org/content/342/6154/60.summary), to my knowledge.

Since mathematics has more standardised methodology than many fields, perhaps we can improve the situation simply by formalising proofs better and checking them by machine. This seems promising, but it is still hard work. Famous successes in this area include two projects led by Georges Gonthier, which formally proved in 2004 the Four Colour Theorem (2004) and in 2012 the Feit-Thompson theorem (http://hal.inria.fr/docs/00/81/66/99/PDF/main.pdf), using the proof assistant Coq (http://en.wikipedia.org/wiki/Coq).

I would be very interested to hear readers' views on these issues. How big a problem is reliability of the mathematics literature? Does it worry you? How can reliability be improved? Is there any proper research on this issue?

Mark C. Wilson

MATHEMATICAL MINIATURE

32: Van Wijngaarden Transformation

In 2010 I had the privilege of taking part in a seminar commemorating the contributions of the late Adriaan van Wijngaarden. I had never met this eminent scientist but I was aware of some of his footprints. He was a pioneer in computing languages as one of the designers of the Algol 68. This work was visionary but the programming language itself was never widely used; it is defined in terms of an ingenious two-level grammatical system, known as a vW grammar. Van Wijngaarden was also a pioneer in promoting the construction of an early series of computers built in the Netherlands.

In giving my own appreciation of Van Wijngaarden's work in 2010, I slightly overstated his contribution to the acceleration of slowly convergent series. This has its origins in a transformation due to Euler but Van Wijngaarden added to its understanding, including the observation that one need not iterate the transformation as far as possible to get the best results.

Given a slowly convergent sequence $s_0, s_1, s_2, \ldots$, for example the sequence of partial sums of a conditionally convergent series $a_0 + a_1 + a_2 + \cdots$, such as $1 - \frac{1}{3} + \frac{1}{5} - \frac{1}{7} + \cdots$, with known limit $\pi/4$, a single Van Wijngaarden iterate would be to form the averaged series $\frac{1}{2}(s_0 + s_1), \frac{1}{2}(s_1 + s_2), \ldots$. But we can do this over and over again with the hope of getting increasingly more rapid convergence. Here is how it works in the case of the notoriously slowly convergent $\pi/4$ series. The first column is the sequence 1, $1 - \frac{1}{3}$, $1 - \frac{1}{3} + \frac{1}{5}, \ldots$, denoted by s and the succeeding columns are accelerated using the Van Wijngaarden transformation T. Also shown is the difference of the sequence values from $\pi/4$.

s	Ts	T^2s	T^3s	T^4s	$s-\frac{\pi}{4}$	$Ts-\frac{\pi}{4}$	$T^2s-\frac{\pi}{4}$	$T^3s-\frac{\pi}{4}$	$T^4s-\frac{\pi}{4}$
1.0000000					0.2146018				
0.6666667	0.8333333				−0.1187315	0.0479352			
0.8666667	0.7666667	0.8000000			0.0812685	−0.0187315	0.0146018		
0.7238095	0.7952381	0.7809524	0.7904762		−0.0615886	0.0098399	−0.0044458	0.0050780	
0.8349206	0.7793651	0.7873016	0.7841270	0.7873016	0.0495225	−0.0060331	0.0019034	−0.0012712	0.0019034

Observe, as Van Wijngaarden did, that the full number of T iterations is not taken to give the best results.

The transformation also gives good results for $1 - \frac{1}{2} + \frac{1}{3} - \cdots$ with limit $\log 2$.

s	Ts	T^2s	T^3s	T^4s	$s-\log(2)$	$Ts-\log(2)$	$T^2s-\log(2)$	$T^3s-\log(2)$	$T^4s-\log(2)$
1.0000000					0.3068528				
0.5000000	0.7500000				−0.1931472	0.0568528			
0.8333333	0.6666667	0.7083333			0.1401861	−0.0264805	0.0151862		
0.5833333	0.7083333	0.6875000	0.6979167		−0.1098138	0.0151862	−0.0056472	0.0047695	
0.7833334	0.6833333	0.6958333	0.6916667	0.6947917	0.0901862	−0.0098138	0.0026862	−0.0014805	0.0016445

Something can be learnt about the behaviour of the entries in these tables by writing them as integrals, starting with

$$s_n = 1 - \frac{1}{2} + \frac{1}{3} - \cdots - \frac{(-1)^{n+1}}{n+1} = \int_0^1 \frac{1-(-z)^{n+1}}{1+z}\,dz = \log 2 - \int_0^1 \frac{(-z)^{n+1}}{1+z}\,dz$$

and concluding with

$$(T^n s)_0 = \log 2 + \int_0^1 \frac{z(1-z)^n}{2^n(1+z)}\,dz.$$

By substituting $z \to (1-z)$, rewrite the integral term as

$$\int_0^1 \frac{(1-z)z^n}{2^n(2-z)}\,dz \le \frac{1}{2^n(n+1)}.$$

This explains the rapid convergence of the Euler transformation but what about $(-1)^{n-m}(T^m s)_{n-m}$? For fixed n, which choice of m minimises this expression? Are the conclusions similar for $a_n = (-1)^n/(2n+1)$?

J. C. Butcher
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CENTREFOLD

Eamonn O'Brien

When I think back over the 25 years I've known Eamonn O'Brien, two particular events stand out in terms of highlighting Eamonn's character. These were the two times Eamonn was interviewed for positions at the University of Auckland — once for a lectureship, and once for an advertised associate professorship. Both times, as is usual, the appointment panel decided a few minutes beforehand which questions each person on the panel would ask, and then Eamonn was given an opportunity at the start to say why he had applied for the position. What was unusual (that is, for most people other than Eamonn) was that he took his opportunity with both hands, and spent 25 minutes not only explaining why he had applied, but also answering everyone's questions before they had a

chance to ask them! This is a great feature of Eamonn's personality — the careful and thorough approach that he takes to issues of importance. Perhaps needless to say, he was successful both times.

Eamonn was born and educated in the western part of Ireland. In 1980 he won the Peel prize for outstanding undergraduate at the National University of Ireland, in Galway, where he graduated with a BSc degree (with first class honours in Mathematics) in 1983. He then undertook graduate study at the Australian National University (Canberra), under the supervision of Mike Newman.

In his work as a research student, Eamonn developed and successfully implemented new mathematical and computational methods for the construction and classification of groups of prime-power order, and applied these to completely determine all the finite groups of order 128, and then all the finite groups of order 256. (There are 2328 and 56092 of these groups, respectively.) His PhD oral was held at a workshop at the Mathematical Research Institute at Oberwolfach (Germany), with three of the world's leading experts in this field as examiners. Eamonn's PhD thesis was an exceptional piece of work, remarkable not only for its accuracy, but also for the way in which it pushed the subject forward. It provided a great spring-board for Eamonn's career.

Following the completion of his PhD in 1988, Eamonn took up a position at Marquette University (Wisconsin), before being offered a 5-year research fellowship at the ANU from 1990 to 1995. This was followed by a research fellowship from the Alexander von Humboldt Foundation, under which he spent 15 months at the RWTH Aachen (Germany). Eamonn moved to the University of Auckland in February 1997, and he quickly won promotion to a Senior Lectureship in 1999, was appointed to Associate Professor in 2002, and promoted to Professor in 2006. For his sins, he is currently serving a 3-year term as Head of Department.

In the 25 years since his PhD, Eamonn has expanded his fields of interest and expertise, to cover a wide section of group theory and computational algebra. He is now easily one of the top five of the world's leading figures in computational group theory, with several outstanding achievements to his credit. A highlight was the 'millennium project', in which he and Bettina Eick and Hans-Ulrich Besche found all the finite groups of order up to 2000. Another was his work (with four others) in developing the 'product replacement algorithm', which is a method for constructing close-to-random elements of finitely-generated groups. A further highlight was his work with Martin Liebeck, Aner Shalev and Pham Tiep in proving in 2010 a long-standing conjecture by Ore (1951), namely that every element of a non-abelian finite simple group can be expressed as a commutator $[x,y]$ of two elements x and y.

Eamonn is co-author (with Derek Holt and Bettina Eick) of the *Handbook of Computational Group Theory*, and author or co-author of over 80 research articles and book chapters. His collaborations with Charles Leedham-Green have been particularly productive. Eamonn is also a well known contributor to the development of computational software. In particular, he is helping to lead the development and implementation of algorithms for the constructive recognition of linear groups, and for finding and analysing certain kinds of quotients of finitely-presented groups.

Eamonn's achievements have been recognised by a number of awards and honours. His work has been supported by the Marsden Fund continuously since 1998. He won the NZ Mathematical Society's Research Award in 2004, for "outstanding achievements in using computation, backed up by deep algebraic theory, to solve long-standing and difficult problems in group theory." He was awarded a Maclaurin Fellowship by the NZIMA in 2007, and elected as a Fellow of the Royal Society of New Zealand in 2009.

Eamonn's commitment to high quality mathematics extends to his teaching and other professional contributions. He has been supervisor or advisor to ten PhD students, plus numerous Masters and Honours students and summer research students, at the ANU and Auckland. He has also been a mentor for several postdoctoral researchers, and is well known as a frequent and generous host to international visitors, both young and distinguished. He has also organised several conference and workshops himself, both here in New Zealand and in other places overseas. He is a member of the editorial board of *Journal of Algebra*, the top journal in his field. He receives frequent invitations to speak at international conferences (such as the 4-yearly Groups St Andrews conference, and meetings at MSRI (Berkeley) and Oberwolfach), and to give seminars and lectures at other places (including Berlin, Cambridge, Chicago, Oxford, Stanford and Yale).

And on top of all this, he is a wonderful colleague and friend to many of us. It is a pleasure to pay this tribute to him.

Marston Conder

INTERVIEW

Terence Tao talks to Robert McLachlan - Part II

Terence Tao toured New Zealand as the inaugural Maclaurin Lecturer on behalf of the American Mathematical Society. He was interviewed by Robert McLachlan in Palmerston North, 28 August 2013. The second part of this interview follows. For the first part, see Issue 118.

RM: I read this great quote of yours in your paper "What is Good Mathematics" [Bull. AMS 44(4) (2007), 623-634]: "It seems to me that the pursuit of such intangible promises of future potential is at least as important an aspect of mathematical progress as the more concrete and obvious aspects of mathematical quality [listed previously]." Are you saying that we should just trust our intuition and our experience and just go for it?

TT: This rhetorical question, What is Good Mathematics – by the way it was not my choice of title, I was solicited by Susan Friedlander to write an article on What is Good Mathematics – what I'm trying to get at is you can't prescribe in advance what it is. Mathematics is a basic science. If you do cancer research then you've got this obvious goal of curing cancer and so you can structure all your research programme around that, but there's nothing like that in mathematics. The key problems, the key things, the key questions that you should be asking you only find out along the way. For example, one of the central problems in number theory is the Riemann hypothesis but if you're just starting out in number theory it is not obvious that this is the important problem, this is something that you discover along the way. It just keeps showing up. There's a limit to how much you can use metrics – how many theorems have you proven or how many applications have you got, or what impact factor, or whatever. There's a lot of serendipity in mathematics – someone pursues some crazy idea which by all the sort of standard metrics doesn't seem to be fruitful, doesn't connect with existing results, doesn't have an immediate application or something but they have some vision that this could be something interesting, something unexpected about this direction that's worth exploring further. Sometimes it doesn't pan out, in fact often it doesn't pan out, but occasionally really unexpected breakthroughs come out from that field because someone saw something which just smells funny.

RM: There's also serendipity in terms of someone knowing two unrelated things and being able to see that there is a connection. With modern search and communication could it be possibly easier to do that in future?

TT: This is certainly a big cultural change, mathematics has become much more interdisciplinary, much more collaborative. I have seen it in my lifetime but if you read about mathematics in 30s or 40s or 50s, it was much more secretive and individualistic. The subfields of mathematics didn't talk to each other nearly as much as they do now. For its time maybe it was the right thing to do because each separate field, algebraic geometry, functional analysis, they were still maturing. But they reached a level of development where to make further progress in one field you really have to import ideas from other fields and so people have opened up now. With the internet there are these amazing new ways to find out things – it used to be that if you had a problem in, say, algebraic geometry and you wanted to contact a geometer you'd have to basically go to your department and talk to your local algebraic geometer to solve your problem but now for example there's this great question and answer site on the web called Math Overflow, have you heard about that?

RM: Yes, it's very successful and the previous attempt 10 years ago to get that going didn't work, nobody was there, so it's great that this one is actually working.

TT: Some of the technology is finally there to make it work, it's hit the right balance of being easy to use and not overwhelming – you can sign into it and just look at the questions you are interested in. It's one of many sites that do a great job of matching up: you have a question which is obvious to somebody but not to you, but you don't know who that somebody is.

RM: It needs a critical mass of people reading it, doesn't it? It seems to have reached that.

TT: Yeah, it works, it's a great success and there's also these Polymaths projects.

RM: Like the Prime Gaps project, it was so fast, it was phenomenal!

TT: So fast, because the project naturally identified the people who could best contribute, there's about a dozen of us who are involved in that and we have managed to make a lot of progress.

RM: There were a small number of key people really contributing a lot, right?

TT: We don't want to fight and divide who the person is, it's sort of counterproductive. The thing is before the project started if you asked me who would be the best people to make progress on this, I wouldn't have guessed half the people in there. So I think part of the strength of the internet style of collaboration, is that they can identify who they can collaborate with, it's not just people you know, or the people in your department, or whoever you just happened to meet at the conference.

RM: Polymath is new, are you hoping that it will grow and become thousands of people involved in many projects?

TT: It's still a very boutique project right now, I mean there's only 8 projects and not all of them have succeeded. We haven't yet sort of found the secret sauce that somehow guarantees that it works.

RM: The right problem.

TT: Picking the right problem is important, and like a traditional project, sometimes it doesn't work. But one down side of traditional research is that if you try something and it doesn't work you just put it in your drawer or your computer and you forget about it and no one knows. The point is to get it out in the open, say "I'm stuck", yes it can be a little awkward, but also that has some value. Some of the feedback we got from the first Polymath project was from postgrad students saying thank you for showing how research really works, how much failure is involved, how many dead ends and backtracking and "Oh, that was stupid"s before they hit on the right path. Because when you write up the results you don't go too much into all the dead ends and things you tried that were embarrassingly wrong, but those are an important part of the process. Often you have to make the obvious mistake and say, "Oh, okay, I should not apply Cauchy-Schwarz before I do this", or "I should not use this lemma, unless I can do this" and once you know the obvious mistakes then you can say "Oh, then I can proceed if I do this first, this first and this first" and then you find the right path, but then when you read the paper people just say "Oh, I will pull this out of the hat", and it all magically works and you don't see where it came from – the guy must be a genius! – but often it's because they tried all the obvious things first.

RM: You've also been involved with this debate over maths publishing and you were involved early on in the Elsevier boycott, is that correct?

TT: I am part of the Elsevier boycott, I've stopped publishing papers in Elsevier journals.

RM: It's a situation that's in flux and apart from the fact that there's a lot of unhappy scientists, it's very hard to see where it's going to go.

TT: So this is the problem: everyone agrees that somehow the current status quo is unsustainable and it's somehow ridiculous that we have got to this point, that we give up our own research. We work on our own research, we give it to journals who give it back to us to referee and then we have to pay them to get them back to read. It evolved from a decision that did make sense, when the societies were in charge of journals and because of technology there was an important service for journals, to actually distribute papers, but now distribution of papers is basically free, you can do it online. I almost never go to the library anymore, most papers I can find on the internet from the arXiv or whatever. But journals still perform two irreplaceable functions, one is refereeing and the other is certifying for the purposes of promotions that this person is doing research.

RM: Both of those are a bit problematic.

TT: Journals do them imperfectly, but no other system that we know of does them any better, so that's a problem. Somehow we've given the control of many of our journals to big commercial companies who don't care so much about the academic, they're focused on maximizing profit, so there's this mismatch of different incentives. There's a lot of experimentation with different types of journals now. There's low-cost journals and there's even zero-cost journals with everything online, the authors do their own typesetting. Then there is open access, you pay the journal some fixed amount and the paper is then freely accessible for everyone, or you just put the paper on your own website or the arXiv. The journal is basically a whole bunch of links. So it's not clear what will work.

RM: Has anybody stopped publishing in journals and only releases preprints?

TT: I have a lot of mathematics on my blog which I do convert into a book, much of it, but there are lots of math blogs now with quite serious math content, where they don't end up publishing it in any formal venue. Now one downside to that is it's a bit more difficult to cite. Every so often someone will want to cite one of my blog posts because I have something which is not contained in a formal article. One nice thing about a journal citation is that it's permanent. If you cite Annals of Mathematics 1986, they're never going to change the content. But a blog can change. So it's not a perfect replacement for the journal system. People do cite arXiv preprints quite frequently now. There needs to be some sort of cultural shift. Part of the reason why everyone still uses journals is because other people only accept mathematics as sort of finished or certified if it comes from a journal. Somehow

we need this critical mass. Once we have a good alternative system which a critical mass of people start accepting, then it can take off. The arXiv is like this. A huge fraction of mathematicians now use the archive.

RM: Huge?

TT: Why not?

RM: More than before, maybe, although mathematicians were certainly slow adopters.

TT: It depends on the field, I know some fields where it's almost total, but certainly everyone's heard of the arXiv and there's no controversy about citing something from the archive, it looks like it's here to stay.

RM: The other players are the employers and the research funders, they could press for open access as some of them do.

TT: The best solution is to have these consortia where the top universities and the funding agencies fund the open access journals for researchers in those countries. Right now, funding agencies have to pay universities for library costs to subscribe to journals, millions of dollars in some cases – those same funds could be used much more cost effectively to fund open access journals but it's a different pot of money and so you can't just transfer it so easily. People are trying all kinds of experiments, its not clear what's going to work. One experiment that just started up is something called the Selected Papers Network. What you can do there, you can take a paper online from the archive and anybody can write a comment on the article, pointing out citations or pointing out maybe an improvement to a lemma or something and the thing is you can post your comment on one of the social networks, like Twitter or Facebook, Google+, and this network will just collect all these comments and put it in one location so every time you go to look up a paper online you can, if you want, also look up all the comments. So this is not quite the same as peer review, it could be different.

RM: Sort of a facebookisation of the project.

TT: Putting it that way it doesn't sound so good! As you say it's in flux, there's a lot of possibilities for what could happen. It sort of clear that things have to change. Already many small libraries can't subscribe even to all the must-have journals in a field. I think there's a lot of people who once they know of an alternative which already has enough acceptance that it can be used for things like refereeing and promotions and so forth, there will most probably be a dramatic shift. We are not at that stage yet.

RM: Getting back to education, do you have PhD students?

TT: Yes, at any time I have like four or five students plus one or two who are talking to me about maybe becoming my students.

RM: Do you like to have them in all different areas?

TT: Yes, I try to keep them apart from each other and to some extent apart from what I'm currently working on. I think it's important that students' first work should really be their own. I'm a great believer in collaboration in general, just not for your very first paper.

RM: They're mostly working independently, is that your philosophy?

TT: Yes, they meet me once a week, they talk to each other, but I kind of want my students to develop some maturity and independence so they shouldn't expect that even after they graduate I should still supply them with a source of problems to work on, they should be able to have their own research projects.

RM: It's sort of a critical time but you don't realize it at the time, you don't see the choices that you are making and how influential they are going to be.

TT: Yes, for example I know several students who keep trying, they reach their fourth or fifth year and they've already done enough to get a PhD but they are kind of afraid to go out in the real world and become a postdoc and be responsible for their own research. "Can I stay here for another year?" and have this comfortable life as a graduate student where you don't have responsibilities. Sometimes you have to actually push them out a little bit, it's actually better to start, if you finish one year earlier then everything else happens one year earlier too, you get your promotions one year earlier and so forth. It's better to go out once you are ready. It's true when I was a grad student I had no clue how the academic world worked, I did what my advisor told me to do. Fortunately I had a good advisor.

LOCAL NEWS

ANZIAM

The John Butcher Prize, administrated by the New Zealand branch of ANZIAM, was awarded this year at the SciCADE meeting in Valladolid, Spain, September 16–20, 2013. The John Butcher Prize in Numerical Analysis was established to recognise Professor John Butcher's long and productive career in numerical analysis, and in particular in the numerical solution of ordinary differential equations. The prize is for the best student talk, considering both the academic merit of the content and the presentation itself. The winner of the John Butcher Prize this year was *Yuto Miyatake* from the University of Tokyo, Japan. He presented an invited contribution entitled: "On the derivation of energy-preserving H^1-Galerkin schemes for Hamiltonian partial differential equations". Yuto received a monetary prize equivalent to 500 euros and a certificate. John Butcher presented the prize on behalf of ANZIAM.

At the 2013 Colloquium, the prize for the best poster was awarded to *Katie Sharp* from the University of Auckland. The title of her poster was "Cystic Fibrosis: the mathematics of fluid recycling". *Jennifer Creaser* from the University of Auckland was highly commended for her poster presentation. The title of her poster was "Alpha-flips and T-points in the Lorenz system".

Alona Ben-Tal

AUCKLAND UNIVERSITY OF TECHNOLOGY

SCHOOL OF COMPUTING AND MATHEMATICAL SCIENCES

New colleagues

Ji Ruan, Lecturer in Computer Science, completed his PhD in Computer Science from the University of Liverpool in 2009. He joined in the School of Computer and Mathematical Sciences in August. Ji's research interests include logic, games, formal verification, multi-agent systems, and knowledge representation in artificial intelligence. Prior to joining in AUT, he worked as a post-doc research fellow at St Francis Xavier University and the University of New South Wales. Ji also has an MSc in logic from the University of Amsterdam and a BA in logic from Beijing University.

Alna van der Merwe was appointed Lecturer in Mathematical Sciences, in the School of Computer and Mathematical Sciences in November. Alna came to New Zealand in June 2010 and has been on fixed term contract at SCMS since August 2010. She obtained a PhD in Applied Mathematics at the University of Pretoria in 1993, where she was a senior lecturer in Applied Mathematics until 2001. After that she worked as a senior lecturer in Engineering Mathematics at the Cape Peninsula University of Technology in Cape Town. Her research deals with various aspects of linear vibration models.

Events

Jiling Cao had a fruitful sabbatical leave in the first half of the year and returned to the School at the end of July. During his sabbatical leave, Jiling received financial support from the São Paulo Research Foundation to work with Artur H. Tomita at the University of São Paulo in May. In June, Jiling visited Heikki J. K. Junnila at the University of Helsinki to work on the Wijsman topology. In July, Jiling presented a plenary talk at the 16th Galway Topology Colloquium, held at the National University of Ireland, Galway. After the Colloquium, he stayed at NUI Galway for two more weeks to initiate research collaboration with Aisling McCluskey on "Quasi-continuous dynamical systems". Jiling's visit and stay in Galway was financially supported by the NUI Millennium Fund. After his successful visit in NUI Galway, Jiling participated in the 13th SAET (Society for the Advancement of Economic Theory) Conference on Current Trends in Economics, held at MINES ParisTech, 22–27 July. He presented a talk "Aggregate preferred correspondence and the existence of a maximin REE". In addition, he met his research collaborator Nicholas C. Yannelis, who is from the University of Iowa. The two discussed some possible themes for future research collaboration. In September, Jiling participated in the International Conference on Topology and Geometry 2013 jointly with the 6th Japan-Mexico Topology Symposium, and presented an invited talk "Bornologies, topological games and function spaces" in the Set-theoretic Topology session. It was at this conference where Jiling heard from the VC office of AUT that his promotion application to Professor was successful. As one of main organizers for the next conference of this conference series, he was honoured to give a conference dinner speech and announced that the next conference would be held at Min Nan Normal University in China in December 2015.

In July, *Hyuck Chung* attended the 11th Recent Advances in Structural Dynamics Conference, organized by the Institute of Sound and Vibration Research at the University of Southhampton, held at the University of Pisa. The first conference of this series was held in 1980. This conference is devoted to theoretical, numerical and experimental developments in structural dynamics and their applications to all types of structures and dynamical systems. Hyuck also attended the 20th International Congress on Sound and Vibration, held in

Bangkok in July. Over 500 papers in wide-ranging areas of acoustics were presented. In November, he attended the 2013 Conference of the Australian Acoustical Society, held in Victor Harbour, South Australia. With its theme of "Science, Technology and Amenity", this conference had plenary speaker sessions addressing the impact of science and technology on acoustics and amenity.

Paul Cowpertwait has received an external research/consultancy fund of $30,000 from Auckland Council to develop a spatiotemporal stochastic rainfall model for the region. The model will be used to infill missing values and disaggregate data to fine resolution time series, which will be used in flood studies and urban drainage studies throughout the region. Two research projects have been developed from this. One with Katharina Parry, Oliver Hannaford and Kate Lee, is on developing a Bayesian statistical inference procedure for point process models of rainfall. And a further Summer Student Project, with Jiamou Liu, is on developing an algorithm to match best fitting synthetic data to observed historical series.

Jeff Hunter has continued to pursue his research in Markov chains during this year. During the first week of July, Jeff was an invited plenary speaker at PIM 2013 (Preconditioning of Iterative Methods) that was held at the Czech Technical University in Prague. The meeting honored the 80th birthday of Professor Ivo Marek (Professor of Mathematics at Charles University, Prague until 1996 and now Professor at the Czech Technical University in Prague). Ivo has made contributions to Markov chains and Jeff was invited to talk on "The role of generalized matrix inverses in Markov chains". Returning to New Zealand via Brisbane, in the second week of July, he was both a speaker at ANZAPW, the 3rd Australia and New Zealand Applied Probability Workshop, and a member of the Organizing Committee. The Workshop was held at the Womens College of the University of Brisbane and Jeff delivered his talk on "The role of generalized matrix inverses in Markov chains". Jeff is a member of the International Organizing Committee (IOC) of the International Workshop on Matrices and Statistics. The 22nd IWMS Workshop (IWMS, 2013) in the series was held at the Fields Institute on the campus of the University of Toronto, Canada over the period August 12-15, where Jeff organized a Special Session on Applied Probability with 5 speakers. He was also requested by the IOC to organize a Memorial Session to honour Professor Emeritus Shayle Searle, Hon DSc (VUW), Hon FRSNZ, ex-Cornell University, a prominent New Zealand statistician who died in February this year. Currently, Jeff is writing an article on Professor Searle's contributions – he was a pioneer in the use of matrix theory in statistics and has authored (in some cases with co-authors) eight research books in this field. En route to IWMS 2013, Jeff also visited the University of North Carolina at Chapel Hill, where he graduated with his PhD degree in Statistics in 1968. Jeff met with colleagues whom he knew well including a lunch with Professor Walter Smith, who supervised his PhD dissertation, and now lives in a retirement village with his wife. In September, Jeff travelled to Hangzhou, China and Ho Chi Minh City, Vietnam to represent the School and the University at the Opening of the academic year at China Jiliang University (CJLU) and at the Ceremony to honour students at HCMUS who were graduating with a BCIS degree from AUT. On Monday 9th September, Jeff delivered an invited Seminar at CJLU to the Applied Mathematics graduate students on "The Role of Kemeny's Constant in Markov Chains". On Thursday 12th September he also gave an invited Seminar to the staff and students of the Faculty of Mathematics and Computer Science at HCMUS on "The role of generalized matrix inverses in Markov chains".

Jiamou Liu travelled to France as an invited researcher of the Laboratoire d'Informatique Algorithmique: Fondements et Applications (LIAFA), Universite Paris VII, in July. In Paris he has been working with Tayssir Touilli on designing an abstract model for self-replicating programs. The trip was funded by the Foundation Sciences Mathmatiques de Paris. In Paris Jiamou also worked for a week with his visitor Martin Huschenbett from Technical University of Ilmenau on the project of Ramsey theory in automatic structures. Their paper titled "A Polychromatic Ramsey Theory on Ordinals" was published and presented at the 38th International Symposium on Mathematical Foundations of Computer Science (MFCS2013), 26-30 August 2013, Klosterneuburg, Austria.

Farida Kachapova attended the Asian Logic Conference and presented a paper "Beth model with many types of functionals" in September. In October, she presented a talk "Intuitionistic multi-typed theory" at the School's logic seminar.

Ji Ruan published a paper titled "Model Checking for Reasoning About Incomplete Information Games" (co-authored with Xiaowei Huang and Michael Thielscher) at the 26th Australasian Joint Conference on Artificial Intelligence (AI2013), 1-6 December 2013, organized by the University of Otago. He traveled to Dunedin in December to present his work at the conference.

Alla Shymanska attended the AMMCS-13 (Applied Mathematics, Modelling, Computational Sciences) Conference at Waterloo, Ontario, Canada. The conference was organised by SIAM, and she was invited to give a special talk, "Mathematical and Computational Modelling of Noise Characteristics of Channel Amplifiers", in the Computational Photonics session.

Wenjun Zhang was invited to give a talk at the 2013 National Centre for Theoretical Science Conference on Mathematical Physiology. The title of his talk was "Wave solutions in models of intracellular dynamics". After the conference, he visited Je-Chiang Tsai at the National Chung Cheng University in Taiwan to continue their research collaboration.

Visitors

On 19th and 20th November, a two-day workshop on Algebra, Logic, Geometry and Combinatorics was held at AUT and the University of Auckland, featuring a number of lectures by visiting mathematicians from the State University of Novosibirsk, and some locals. The workshop was organised by Alex Gavrushkin (AUT) and Nikolay Abrosimov (Novosibirsk).

Bin Chen, from the University of Ji Nan (China), started his visit at the School in December. He has been awarded a scholarship by Shandong Province, under the International Cooperation Program. He will visit the School until May 2014 and work with Jiling Cao on a joint research project "Topological properties of soft sets and their applications in decision making".

Jiling Cao

UNIVERSITY OF AUCKLAND

DEPARTMENT OF MATHEMATICS

Jianbei An, together with *Marston Conder* and *Eamonn O'Brien*, has received a Marsden Fund grant of $417,391 for their project on "Group actions, structure and representations". *Rod Gover* has received a Marsden Fund grant of $434,783 for his project on "New directions at the geometry–analysis frontier". *Igor Klep* has received a Marsden Fund grant of $300,000, for his project on "Free Analysis and Complexity".

John Butcher received his award of Officer of the New Zealand Order of Merit at Government House.

Julie de Saedeleer has arrived as our new Professional Teaching Fellow.

Arkadii Slinko was on Research and Study Leave for Semester 2. He visited a large number of research centres in Europe and delivered many talks, and has now returned to Auckland. *Ben Martin* is still on leave in York and returns in early February.

Claire Postlethwaite gave the 9th public lecture in the RSNZ series 10×10 at the Hawke's Bay Planetarium on November 19, on "Why Did The Pigeon Cross The Road?" She employed mathematical models to understand animal behaviour, using examples from homing pigeons, opossums, bees and electric rays.

Ben Green, who toured New Zealand in 2011 as the Forder Lecturer, is now the Waynflete Professor of Pure Mathematics at the University of Oxford, and he is visiting our Department on sabbatical leave until April 2014. His research lies at the interface of analysis, discrete mathematics and number theory; one of his best-known results (with Terence Tao) proved that for every $k > 2$ there are infinitely many arithmetic progressions of k primes. On September 10, Ben gave the 2013 Aldis Lecture here on "Sum and product–free sets".

We had many international visitors in November, and so we took that opportunity to hold a workshop on Thursday, November 21, with the following lectures: Adam Thomas (Imperial College), "Irreducible subgroups of exceptional algebraic groups"; Ben Green (University of Oxford), "Finite simple groups of Lie type as expanders"; Arjeh Cohen (Technische Universiteit Eindhoven), "The generalized polygons in general and the smallest generalized octagon in particular"; and Said Sidki (Universidade de Brasilia), "Automorphisms of trees and automata".

A group of mathematicians from the Sobolev Institute of Mathematics at the State University of Novosibirsk visited AUT and our Department in November, and gave some lectures: Nikolay Abrosimov, Evgeny Baklanov, Olga Bogoyavlenskaya, Alexander Buturlakin, Alexander Bystrov, Pavel Emelyanov, Vitaliy Lukinov, Artem Pyatkin and Evgeny Vdovin.

Other recent visitors include: Prof. Wolfgang Arendt (Ulm University), Thomas Connor (Université Libre de Bruxelles), Dr Matthias Geissert (TU Darmstadt), Dr Cecile Gonçalves (École Polytechnique, France), Prof. David Holgate (University of the Western Cape, South Africa), Dr Tony Humphries (McGill University), Prof. Heikki Kälviäinen (Lappeenrata University of Technology, Finland), Prof. Martin Liebeck (Imperial College, London), Prof. El Maati Ouhabaz (University of Bordeaux I), Dr Edoardo Persichetti (Warsaw University) and Dr Travis Willse (ANU).

Some new PhD students have arrived: Nina Anchugina (supervisor Arkadii Slinko), Barak Shani (Steven Galbraith) and Wei–Juan Zhang (Marston Conder). Rui Gong started his PhD with Shixiao Wang early this year. Ali Hameed has successfully passed his oral exam, subject to minor corrections to his thesis on "Simple Games with Applications to Secret-Sharing Schemes".

Garry J. Tee

UNIVERSITY OF WAIKATO

DEPARTMENT OF MATHEMATICS

After over a dozen years as an Honorary Research Associate in the Department, *Ross Barnett* has moved

to Wellington to be closer to his family. During his time in the Department, Ross collaborated with *Kevin Broughan* in research on number theory with emphasis on the Riemann zeta function. Besides these contributions, Ross's expertise in special functions was called upon as a validator for the 2010 NIST Handbook of Mathematical Functions. This handbook and its electronic version are a replacement for the well-known "Abramowitz and Stegun". We wish Ross all the best for the future.

As reported in the last issue of the Newsletter, *Frederic Effenberger* has joined the Department as a postdoctoral research fellow. Details about him in the last issue were quite brief as he had just recently arrived at the time. So in more detail, his research interests are in numerical methods to solve kinetic equations for suprathermal particle populations in space plasmas and the magnetohydrodynamical description of the underlying turbulent plasma background. Recently, he became especially interested in aspects of anomalous diffusion characteristics, connected to fractional derivatives in the relevant kinetic equations and related non-Gaussian stochastic processes. In his spare time, he is interested in music, movies, reading and discovering new places around the world.

Nick Cavenagh is one of five Scrabble players who will play for New Zealand at the Scrabble Champions Tournament to be held in Prague in December. However, don't tell anyone that Nick is actually Australian. The tournament was formerly known as the World Scrabble Championship and is the pinnacle of the game. Despite the game being about words, Nick says "It's not really a literary game. It's the ability to re-arrange letters into words in your head; to see anagrams." Perhaps it's then not surprising that Nick's research interests are in the area of combinatorics.

Stephen Joe

INSTITUTE FOR NATURAL AND MATHEMATICAL SCIENCES

The first Institute of Natural and Mathematical Sciences Postgraduate Conference was held on October 23. Dongxi Ye and Ali Ashher Zaidi received first and second prize, respectively, for their talks in the Mathematics/Statistics session.

In early November, Graeme Wake attended (along with fellow invitees: colleagues Robert McKibbin and Winston Sweatman, and ex-PhD students Professor Busaya Pimpunchat, from Thailand and Associate-Professor Norhayati Hamzah, from Brunei) the Forum for Mathematics-in-Industry in Fukuoka, Japan. This was organised by the Institute for Mathematics for Industry in Kyushu University. The theme of the forum was "The Impact of Applications on Mathematics". Both Winston and Graeme presented papers, Robert

Frederic Effenberger

was on the Organizing Committee, and Busaya won a prize (a travel grant) in the poster competition.

While in Japan, Graeme also gave a public open seminar under the auspices of the Centre for Mathematical Biology in Kyushu University. His talk was entitled "Modelling of Cancer Treatment". This is a very distinguished "postgraduate-only" Centre , situated, remarkably, within a medical school. The students were impressive and question-time extended to over 2 hours, and was followed by an exquisite traditional Japanese banquet. Graeme and Lil attempted a climb of Mt Fujiyama the following weekend which was called off because of very bad weather.

Shaun Cooper

UNIVERSITY OF CANTERBURY

DEPARTMENT OF MATHEMATICS AND STATISTICS

Congratulations to *Charles Semple* who has been elected to the Fellowship of the Royal Society of New Zealand at the 48th Fellows Annual General Meeting of the Academy of the Royal Society of New Zealand in Wellington in November.

Best wishes to *Maarten* and Alexandra *McKubre-Jordens*, who were overjoyed to welcome their second son, Bramwell Pieter, to the world on 27 August 2013. He weighed 3.82kg and is a picture of health. Congratulations to *Sukanthan* and Kalpana *Thavanayagam* on the birth of their son Suwaythan, their third child, in November. Sukanthan is a PhD student in the department, supervised by David Wall.

Dominic Lee was granted leave of absence for 2014 to take up an opportunity with the Wynward Group and will be based outside UC next year. This is an exciting development for Dominic, and also for the department to strengthen our connections with the company. *James Degnan* will be leaving us at the end of the year to take up a position at his home university, the University of New Mexico, in the U.S.

Hannes Diener (University of Siegen, Germany) and Brendan Creutz (University of Sydney) have formally accepted offers for fixed-term 5 year positions. Both will start here early next year.

The University of Canterbury International College (UCIC) was officially launched in October. The role of UCIC is to recruit and prepare international students for degree study at UC by giving them an opportunity to study first-year courses at the College and, on successful completion, enter their second year of study at UC. The initial programme includes the equivalent of STAT101 and will eventually expand to offer the equivalent of first-year courses MATH102, EMTH118, 119 and 171. Although the department is not directly teaching into UCIC programme, there is considerable input from the department during the set-up phase.

The university is undertaking further remediation work in the Erskine building to repair earthquake damage. Straight after exam had finished in mid November we had to decant the teaching side of building. This meant relocation of departmental servers and disruptions to IT and telephone services. There is also work done on the exterior of the northern side housing staff offices. Although staff can still occupy their offices, noise levels can become high at times. This is particularly unwelcome during the 'quit' research time during summer. The remediation work is scheduled to be finished for semester 2 next year.

Raaz Sainudiin was granted an outgoing Canterbury-Oxford Erskine Fellowship, which he spent at the University of Oxford from October to December. The stay in Oxford allows Raaz to sample relevant courses there and to prepare for a course on advanced statistical methods in the department's new Masters of Engineering in Engineering Mathematics programme about to commence in 2014.

In September the department welcomed Erskine visitor Professor Martin Buhmann, from the Institute of Mathematics at Justus-Liebig University in Giessen, Germany. Martin was in the department for 6 weeks and was hosted by Rick Beatson. His special interests are Approximation Theory and Numerical Analysis.

The Canterbury Statistics Open Day was held on Wednesday, 20 November, with about 45 people attending from different Canterbury-based organisations. This event, which run for the second time this year, is designed to showcase the work of researchers in the Canterbury region, as well as being a networking opportunity for people in statistics and related fields, such as biostatistics, econometrics, geo-statistics, health statistics, official statistics, etc. *Jennifer Brown* and Jan Evans-Freeman (for the College of Engineering) opened the day followed by a keynote talk by Kevin Ross from Fonterra.

Günter Steinke

UNIVERSITY OF OTAGO

DEPARTMENT OF MATHEMATICS AND STATISTICS

Jörg Frauendiener was selected Supervisor of the Year in the Division of Sciences at the University of Otago. The supervisors are nominated and voted for by the students. Francisco Hernandez, president of the students' association, says that the awards "recognise the supervisors that go above and beyond for their students during their post graduate study." Congratulations Jörg!

John Harraway had the coordinating role organising the Joint IASE (International Association for Statistics Education) and IAOS (International Association for Official Statistics) Satellite Meeting in Macao, 22–24 August. He also presented a paper on training in Official Statistics. The Satellite Meeting was followed by the World Statistics Congress in Hong Kong. As well as Chairing the General Assembly of IASE and the Advisory Board of the International Statistics Literacy Project, John attended Council Meetings of the ISI, presented an invited paper, organised a second invited paper session discussing training in statistics in Russia, China, Italy and South Africa, and chaired a third session on inference. John's two year term as President of IASE ended after the Hong Kong Conference. He now serves two years as past President on the IASE Executive.

Jörg Frauendiener is among the 13 leading New Zealand researchers who are newly elected as Fellows of the Royal Society. Jörg is an international expert in Einstein's theory of general relativity, working mainly on mathematical issues and numerical simulation techniques. Congratulations Jörg!

Richard Barker, *John Harraway* and *Ting Wang* have received awards from the New Zealand Statistical

Association. Richard was presented with the Littlejohn Research Award, which recognizes excellence in research, based on publications during the past five years. John received the Campbell Award, which recognizes an individual's sustained contribution to the promotion and development of statistics. Ting was awarded with the Worsley Early Career Research Award, which is given in recognition of outstanding recent published research in the early stages of the career.

Florian Beyer received the NZMS's Early Career Award "for his contributions to the understanding of the global structure of cosmological solutions of Einstein's equations using numerical and analytical methods, and, in particular, for the proof of the well-posedness of the singular initial-value-problem for Fuchsian PDEs." Congratulations Florian!

Chris Stevens, a PhD student of Jörg Frauendiener, received the Aitken Prize for the best contributed talk by a student at the NSMZ Colloquium 2013. Chris' talk was entitled "The Friedrich-Nagy gauge for colliding plane gravitational waves".

As part of the Royal Society's 10×10 Lecture Series (with 10 mathematicians speaking at 10 locations in 10 months), *Boris Baeumer* has given examples, results and conjectures about the seemingly ubiquitous pattern of power laws in complex systems like ecosystems, landforms, social networks and seismic activity in his lecture "The power of nature" at the University of Canterbury.

Ben Whale, who has been a postdoc in the Department's general relativity group, left us in September. We were delighted to have him here for more than three years. Ben went to Australia to be with his wife Karen again. We wish you two all the best for your future!

Congratulations to *Jessica Leigh* and her husband Steffen on the birth of their son Thomas David. We wish all the happiness to the new mom and dad!

The Department's *Megan Drysdale* got married in October. Congratulations to you and Rachel! We wish you much love, happiness and all the best for your future.

Matthias Geissert from the TU Darmstadt, Germany, visited for three weeks in August in order to work with *Misi Kovács* on stochastic Volterra equations. Moreover, we had short term visits from Hinke Osinga and Bernd Krausskopf from the University of Auckland, hosted by *Astrid an Huef* and *Lisa Clark*.

Jörg Hennig

A selection of photos from the 2013 Colloquium, taken by Mark McGuinness. Anticlockwise from top right: Katie Sharp explains her winning poster; local dignitary Roy Kerr, who opened the meeting; Tom ter Elst; Matt Visser; Aitken prizewinners; Steven Galbraith, NZMS Research Award winner (with Graham Weir); Rachel Kuske; Graeme Hocking.

For more pictures, see https://www.dropbox.com/sh/ao0swokwdqu47tn/A1oTRJnt_l.

More photos from the colloquium:

REPORTS ON EVENTS

Report on the LMS Aitken Lectureship 2013

The Aitken Lectureship was established in 2011 as a joint venture between the LMS and the NZMS, extending the successful Forder Lectureship. The Forder Lectureship has brought a UK mathematician to New Zealand every 2 years since 1987, and it now alternates with the Aitken Lectureship in which a New Zealand mathematician will give a speaking tour in the UK. The first Aitken Lecturer was Geoff Whittle and I was fortunate enough to be invited this year.

The tour was extremely busy and stimulating for me. My lecture, "Successess and prospects of geometric numerical integration", was delivered as follows:

Strathclyde University, Glasgow, 24 September; University of Warwick, 27 September; University of Leeds, 30 September; Imperial College, London, 2 October; Cambridge University, 3 October; University of Bath, 4 October.

I also had my arm twisted to visit the University of Edinburgh, which I squeezed in on 25 September.

As I travelled south, my tour coincided with the southward movement of the start of the academic year, giving the impression that UK universities are absolutely flooded with students, especially international students. This quick tour gave the impression that mathematics is thriving in the UK. All the departments I visited were bursting with students and new staff and all the campuses were under construction. I learned of many large and exciting research projects. The scale and resources are almost difficult to comprehend – a large mathematics research grant might be 2.5 million pounds and include six 3-year postdocs. Fifty percent of all PhD funding is now channeled into "Doctoral Training Centres", in which the programme is 4 rather than 3 years, with many cohort experiences included. The two I visited, in Analysis (Cambridge) and Complexity Science (Warwick), had 50 PhD students each. Rebidding was in progress and as all departments essentially need one of these centres; the competition is furious. (When the DTCs were introduced four years ago, PhD scholarships were removed from nearly all research grants.) Intense competition seems to feature in all levels of British academic life, and probably beyond. Anecdotes of virtually all of several hundred mathematics graduates from a single department being hired at university job fairs before graduation made me realise how differently things are organised, if that is the word I am looking for, in New Zealand.

The RAF is also in progress and a new feature in this round is [nonacademic] impact. The weighting for this factor was reduced following complaints and is now 20%. One detailed impact story (of research done since 1986) is submitted per 10 portfolios. Imagine the fate of 4 researchers in a department of 24 strong pure mathematicians with only 2 impact stories to submit.

The tour was extremely ably organized by the LMS and I would like to thank the LMS, and especially the LMS Programmes Officer Elizabeth Fisher, for this stimulating opportunity.

Robert Mclachlan

Spending time with the postgraduates

A couple of months ago we all had an invitation from our postgraduate students to give a talk at the Mathematics and Statistics Postgraduate Conference. After some brief thought and a realisation that someone has to say yes, we agreed. It also helped that November felt like a long time away! As the time passed we suddenly realised the conference was next week, we each had to plan an hour long talk for a very general audience, and we had given up two days of our scarce research time to watch student talks. On the positive side we would get a couple of days in the hills, albeit inside looking at a screen.

Within our community the postgraduate conference has a mixed reputation. On the one side it's an excuse for our students to skive off and drink too much using tax-payers' money, it's yet another distraction from their research, it stops them attending the colloquium, etc. Conversely, it's an opportunity for them to meet their peers, it's a trial run at giving a conference talk in a friendly environment, it allows some to add conference planning to their CV, etc.

So where does the truth lie? As you would expect it's somewhere between these extremes. However, we can assure you it contains a far greater proportion of the latter. Whilst there were a few bleary-eyed faces at the early morning talks, can you remember a conference where that wasn't true? The average quality of the talks

easily equalled and possibly excelled the average "grown-up" conference. The time keeping and planning aspects definitely out did the last international conference one of us attended.

Beyond this, the most striking feature of the conference was the level of discussion that accompanied each talk. We had gone prepared to ask the token question at the end of talks when silence prevailed at the call for questions. This was never needed, and in most cases the chair did an excellent job of ensuring the flurry of raised hands were all given an opportunity to raise their point. Notably, questions also came from every corner of the room rather than the vocal minority that dominate most conference question sessions. It is clear that the postgrad conference operates on a slightly different time scale to most conferences but this is appropriate for a group with more time on their hands and fewer deadlines to meet.

Should we as a community and as individuals support the postgrad conference? After personally seeing it in action we would heartily say yes.

Alex James, Jeanette McLeod, Elena Moltchenova

Grant recipient report

In May 2013 I attended the the SIAM conference on Applications of Dynamical Systems, the largest conference in applied dynamical systems. I was fortunate enough to receive financial assistance from the NZMS student travel grant. This conference is attended by specialists in the field and I was able to put faces to names of international experts and to discuss my research. In particular, I met with Roberto Barrio to discuss his work on terminal points, or T-points, in the Lorenz system, which feature in my upcoming paper. I attended the mini-symposium on Homoclinic Phenomena Organizing Global Dynamics organised by Barrio and where Tingli Xing, PhD student of Andrey Shilnikov, presented their work on kneading sequences in the Lorenz system. This area is related to T-points and the talk was illuminating, allowing me to make the connection between their work and mine. I am completing my first academic journal article, which I plan to submit this year.

At the conference I presented the poster "The Lorenz system near the loss of the foliation condition" on my study of the Lorenz system in a parameter regime where the foliation condition fails and the reduction to a one-dimensional map is not possible. The poster presentation was a two hour event where dessert was provided, although I didn't have time to eat any due a constant stream of interest in my poster. In particular, James A. Yorke, a pioneer on the Lorenz system, came to see and discuss my poster; see picture below. Networking at this event and surrounding myself in an atmosphere of curiosity and enthusiasm for dynamical systems was enjoyable and educational. Through conversations with Barrio, Yorke and others I gained invaluable insight and this experience has helped guide the direction of the next and final year of my PhD.

Presenting poster to James A. Yorke at the Snowbird conference 2013

Jennifer Creaser

Grant recipient report

With the generous help of the NZMS, Rachelle Binny and Nick Stringer each attended and presented at two international conferences in August: MMEE (University of York, UK) and MPDE (Osnabrück University, Germany). Together the two conferences showcased the latest findings and trends in mathematical modelling in ecology, evolution and population dynamics. Packed programmes comprising plenary talks, contributed talks and poster sessions gave a flavour of the cutting-edge research being carried out in these rapidly expanding fields. Nick presented his work on modelling the growth of Tradescantia flumentis and the effects of biological control methods, while Rachelle discussed the modelling of cell invasion across different biological scales.

The fourth biennial Mathematical Models in Ecology and Evolution (MMEE) conference was hosted in the historical city of York on 12th-15th August. MMEE was aimed at the more biologically-minded members of the mathematical biology community. The applications of modelling within ecology and evolution presented at the conference were diverse and therefore required the use of a variety of mathematical tools. The modelling of ecological systems across a vast range of different scales was discussed, from models of individual species to much larger-scale problems. For instance, Dr Drew Purves conveyed the broad scope of ecological modelling in his plenary talk on "Modelling all life on Earth. Yes, really!". Climate change, an increasingly popular topic in recent times, can have a dramatic effect on ecosystems and cause drastic changes in the size and structure of populations. There is great potential in using modelling to understand spatial structure in ecosystems and how changes in spatial pattern can act as an indicator of these ecosystem shifts. This idea was well communicated by plenary speaker Dr Sonia Kefi in her talk on "Spatial structure and ecosystems' resilience: insights from drylands".

From York it was then on to Osnabrück, a city with an equally rich history (and equally high reputation for brewing excellent beer), for the annual Models in Population Dynamics and Ecology (MPDE) conference on 26th-29th August. The majority of talks at MPDE had a more theoretical focus and tended to discuss generalised models rather than reviewing specific ecological applications. A number of key topics in ecological modelling were explored in depth through minisymposiums, for instance bifurcation theory, meta food-webs, social-ecological systems and multi-scale approaches to movement ecology. Stochastic individual-based models stole the limelight during Dr Volker Grimms plenary talk in which he discussed the importance of IBMs in the modelling of systems in which individual variability, local interactions, and adaptive behaviour are essential traits. The benefits of multi-scale spatio-temporal models for improving pest insect monitoring in agricultural ecosystems was also popularised by plenary speaker Prof Sergei Petrovskii.

Together, the MMEE and MPDE conferences demonstrated how powerful a tool mathematical modelling can be in unlocking the complexity of ecological systems. In addition to NZMS, Rachelle and Nick would also like to thank the University of Canterbury Mathematics and Statistics Department for providing funding towards travel and attendance costs for MMEE and MPDE.

Rachelle Binny & Nick Stringer

NZMS NOTICES

(the following minutes were unfortunately not circulated in a timely fashion – normally the minutes of the AGM will be published in the April issue of the Newsletter)

38th Annual General Meeting of the NZMS (incorporating the 2012 NZMS Colloquium business meeting)

Massey University, Palmerston North, Tuesday 4th December 2012 at 5pm

Present: Iain Raeburn, Boris Baeumer, Astrid an Heuf, Bruce van Brunt, Dean Halford, Tammy Lynch, Chris Tuffley, Bernd Krauskopf, David Simpson, John Butcher, Hinke Osinga, Rua Murray, Florian Beyer, Winston Sweatman, Lynette O'Brien, Graeme O'Brien, Ali Ashher Zaidi, James Sneyd, Miguel Moyers, Mark McGuinness, Ian Hawthorn, Charles Little, Gunter Steinke, Ken Pledger, Alona Ben-Tal, Stephen Joe, Peter Donelan, Robert McLachlan, Graeme C Wake, Robert McKibbin (minutes), Graham Weir (chair).

1. The minutes of the 37th AGM (incorporating the 2011 NZMS Colloquium business meeting) were considered. The following amendments were noted: Present, line 1: "Bivan Bubs" changed to "B van Brunt" 5., line 1: "Amala Alev" changed to "Nirmala Nath" 12., line 2: "Her PhD student" changed to "A PhD student". With the above amendments, the minutes were accepted [Chair: passed nem con].

2. Matters arising: included in various agenda items below.

3. President's Report: GW read his report (attached), welcomed new members, noted the matter of the visiting lecturers (Forder, Aitken, Maclaurin). He reported that Steven Archer is now the Newsletter Editor, the Centrefolds are back on track, and the mathematical content is increasing. He thanked the various NZMS award committees for their work, and noted the recipients. NZMS members who have received other awards (RSNZ Fellows, Jones Medal, Callaghan Medal, Inaugural Fellows of the AMS, ICMI presidency just completed, PM's Science Media Communication Prize) were all congratulated. 2013 is the be the Year of Mathematics in NZ, and internationally is designated the Year of Mathematics of the Planet Earth. Various ideas are extant, and members were urged to contribute ideas and to the various planned activities. GW thanked the Council for their work in 2012. The report was accepted [Butcher/Lynch: passed nem con].

4. Treasurer's Report: The summary of accounts was presented by PD. [Note: the 2011 Financial Statement and Audit was not available at the AGM, but it was subsequently made available the next day, and was accepted by a quorum of members.] The report was accepted, subject to the financial statement and auditor's report being made available for members [Chair, McGuinness: passed nem con].

5. Auditor: The current auditor was recommended for a further appointment. That Nirmala Nath (from the School of Accountancy, Massey University) be re- appointed as Auditor [Donelan/McGuinness: passed nem con].

6. Membership Secretary's Report: Received from John Shanks. The report was accepted [Chair/McGuinness: passed nem con]. That John Shanks be thanked for his continuing good work [moved Pledger, seconded with heartfelt consent by all others].

7. Election of Councillors: Charles Semple concluded his term as Immediate Past President. Alex James and Boris Baeumer stood down. Alex was available for re-election, Boris was not but agreed to continue as Webmaster. Elections were required for Incoming President and two other Councillors. Incoming President: Only one nomination for the one position: Winston Sweatman [McLachlan/Wake] and so elected (with acclamation). Councillors: Only two nominations for the two positions: Mark McGuinness [McLachlan/Wake], Alex James [Baeumer/van Brunt] and so elected (with acclamation). It was agreed that, in future, the call for nominations will be in advance of the AGM. Also, the Chair indicated that Council would like the meeting to consider that there be a student member on the Council. There was a positive response by members. Issues raised included: Would the Constitution need to be changed? Who would vote? Only student members? It was agreed that students would be contacted by e-mail to ascertain interest, and that Council would take action on the feedback (and, if necessary, initiate a change in the Constitution).

8. Report on 2011 Colloquium: Published in the NZMS Newsletter (no. 15, August 2012, pp. 22-23), so was taken as read.

9. Report on 2012 Colloquium: Director Charles Little reported that the number of attendees (87 paid) were down a little from 2011 (110), but a small $$ surplus was still expected. It was remarked that there were a lot of students, but the drop in numbers is in staff. MMcG noted funding constraints for attendance at NZMSC from VUW. JS remarked that, due to budgetary pressures, UoA pulled funding for NZMSC in 2012 and will also do so for 2013. It was agreed that GW will write to HoDs and Deans expressing the importance of continued departmental funding for the national meeting.

10. Forthcoming Colloquia: 2013: It seems that Waikato was expecting and preparing to host the 2013 meeting, and will do so at the Trinity Wharf Hotel in Tauranga during the first week of December next year. 2014: Joint meeting with AustMS in Melbourne the 8th ANZMC. 2015: Either VUW or UoC yet to be decided.

11. NZJM: ref. President's Report 12. Forder and AMS Lecturers: ibid 13. Research Awards and Medals: ibid

12. General Business: Graeme Wake remarked on the tragic death of Charles Pearce earlier this year. Graham Weir had already written on behalf of NZMS, and his letter was read during the funeral.

The meeting closed at 5:55 pm. The next meeting will be held in Tauranga.

GENERAL NOTICES

ANZIAM 2014

Millennium Hotel, Rotorua, New Zealand, 2–6 February 2014

Registration and information about the conference: http://anziam2014.auckland.ac.nz

Early bird registration is available until 15 December 2013.

The annual conference of ANZIAM (in cooperation with SIAM) is an established gathering of applied mathematicians, scientists and engineers, which will be hosted by the New Zealand Branch in 2014. Rotorua's lakes, geothermal activity, forests and adventure activities make it an attractive location for a conference. Just a 2.5 hour drive from Auckland and with its own airport, Rotorua is easily accessible.

Invited Speakers:

- Alison Etheridge (Oxford): Modelling evolution of different genetic types in spatially structured populations.
- Lisa Fauci (Tulane): Modeling the bio-fluid dynamics of reproduction: successes and challenges.
- Douglas Heggie (Edinburgh): Mathematics, Astronomy and Physics – a Three-Body Problem.
- Shane Henderson (Cornell): Real-Time Control of Ambulance Fleets through Statistics, Simulation and Optimization. (Fonterra speaker).
- Shaun Hendy (Victoria University of Wellington, Tuck Medalist) Slippery issues in micro and nanoscale flows.
- Bernd Krauskopf (Auckland): Discovering the geometry of chaos. Geoff Mercer (ANU, Tuck Medalist) Disease modelling and its impact on policy decisions.
- Terry O'Kane (CSIRO, Michell Medalist): The statistical dynamics of geophysical flows with application to ensemble prediction and data assimilation.

Student attendance is supported through the CSIRO-ANZIAM student support scheme:
http://www.anziam.org.au/The+CSIRO-ANZIAM+Student+Support+Scheme

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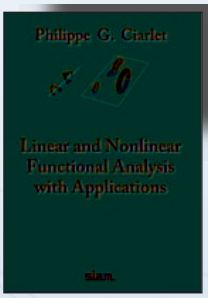
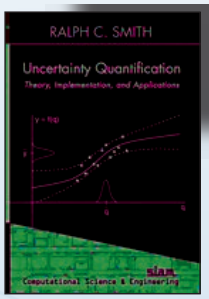
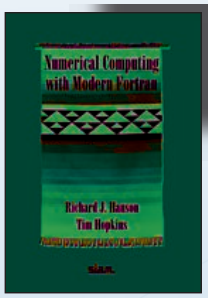






Uncertainty Quantification: *Theory, Implementation, and Applications*

Ralph C. Smith

The field of uncertainty quantification is evolving rapidly and this new text provides readers with the basic concepts, theory, and algorithms necessary to quantify input and response uncertainties for simulation models arising in a broad range of disciplines.

2013 • xviii + 382 pages • Hardcover • 978-1-611973-21-1
List $74.00 • SIAM Member $51.80 • CS12

Linear and Nonlinear Functional Analysis with Applications

Philippe G. Ciarlet

This single-volume textbook covers the fundamentals of linear and nonlinear functional analysis, illustrating most of the basic theorems with numerous applications to linear and nonlinear partial differential equations and to selected topics from numerical analysis and optimization theory. It features self-contained and complete proofs of most of the theorems, plus 401 problems and 52 figures.

2013 • xiv + 832 pages • Hardcover • 978-1-611972-58-0
List $98.00 • SIAM Member $68.60 • OT130

The Radon Transform and Medical Imaging

Peter Kuchment

This book surveys the main mathematical ideas and techniques behind some well-established imaging modalities as well as a variety of newly developing coupled-physics or hybrid techniques. It emphasizes mathematical techniques and ideas arising across the spectrum of medical imaging modalities and explains important concepts critical to all medical imaging methods.

2013 • xvi + 240 pages • Softcover • 978-1-611973-28-0
List $82.00 • SIAM Member $57.40 • CB85

Numerical Computing with Modern Fortran

Richard J. Hanson and Tim Hopkins

The Fortran language standard has undergone significant upgrades in recent years. The authors illustrate many of these improvements through practical solutions to a number of scientific and engineering problems. Readers will discover techniques for modernizing algorithms written in Fortran and examples of Fortran interoperating with C or C++ programs.

2013 • xvi + 244 pages • Softcover • 978-1-611973-11-2
List $89.00 • SIAM Member $62.30 • OT134

Chaotic Signal Processing

Edited by Henry Leung

This book presents up-to-date research results on chaotic signal processing, including the application of nonlinear dynamics to radar target recognition, an exactly solvable chaos approach for communications, a chaotic approach for reconfigurable computing, system identification using chaos, and much more.

2013 • x + 179 pages • Softcover • 978-1-611973-25-9
List $79.00 • SIAM Member $55.30 • OT136

Applied and Computational Measurable Dynamics

Erik M. Bollt and Naratip Santitissadeekorn

This book connects concepts in dynamical systems with mathematical tools from areas such as graph theory and ergodic theory. The authors introduce practical tools for applications related to measurable dynamical systems, coherent structures, and transport problems.

2013 • xiv + 368 pages • Softcover • 978-1-611972-63-4
List $89.00 • SIAM Member $62.30 • MM18

Analytic Perturbation Theory and Its Applications

Konstantin E. Avrachenkov, Jerzy A. Filar, and Phil G. Howlett

Includes comprehensive treatment of analytic perturbations of matrices, linear operators, and polynomial systems, along with original applications in Markov chains, Markov decision processes, optimization, and applications to Google PageRank™ and the Hamiltonian cycle problem.

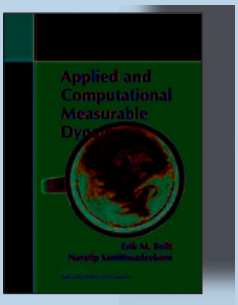
2013 • xii + 372 pages • Hardcover • 978-1-611973-13-6
List $89.00 • SIAM Member $62.30 • OT135

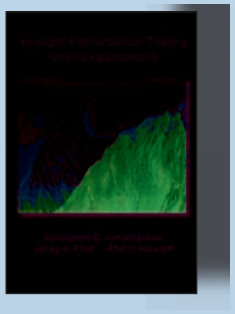
Approximation and Modeling with B-Splines

Klaus Höllig and Jörg Hörner

With an emphasis on key results and methods that are most widely used in practice, this textbook provides a unified introduction to the basic components of B-spline theory: approximation methods, modeling techniques, and geometric algorithms.

2013 • xiv + 214 pages • Softcover • 978-1-611972-94-8
List $85.00 • SIAM Member $59.50 • OT132





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