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The Australian Mathematical Society

Gazette

David Yost and Sid Morris (Editors)

Gazette of AustMS, School of SITE,
Federation University Australia, PO Box 663,
Ballarat, VIC 3353, Australia

Eileen Dallwitz (Production Editor)

E-mail: gazette@austms.org.au
Web: www.austms.org.au/gazette
Tel: +61 3 5327 9086

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The *Gazette* publishes items of the following types:

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

Local correspondents submit news items and act as local Society representatives. Material for publication and editorial correspondence should be submitted to the editors. Any communications with the editors that are not intended for publication must be clearly identified as such.

Notes for contributors

Please send contributions to gazette@austms.org.au. Submissions should be fairly short, easy to read and of interest to a wide range of readers.

Please typeset technical articles using LaTeX or variants. In exceptional cases other editable electronic formats such as plain text or Word may be accepted. Please do not use definitions in your TeX files, as they may conflict with our style files. If you find such definitions convenient, please use a text editor to reinstate the standard commands before sending your submission.

Please supply diagrams as vector images (not bitmaps) where possible, as postscript (.ps) or encapsulated (.eps) files. Please supply photos at high-resolution (i.e. at least 400 pixels per inch (16 pixels per mm) at the final size of reproduction. For example, if the image is to be printed at 90 mm wide, it must be at least 1400 pixels wide. If JPEG format is used, images must be created with a high quality factor, i.e. artefacts such as halos of dots or jagged edges should not be obtrusive at high magnification. For more information, see *An Introduction to Computer Images* at delta-intkey.com/www/images.htm.

More information can be obtained from the *Gazette* website.

Deadlines for submissions to 41(4), 41(5) and 42(1) of the *Gazette* are 1 August, 1 October 2014 and 1 February 2015.

Volume 41 Number 3 2014

Editorial

Let me start by highlighting some positive news, public recognition of members of our broad community. This is reported in two brief articles: Terry Tao's receipt of the newly established Breakthrough Prize in Mathematics, and Order of Australia awards announced in the Queen's Birthday honours list. Our congratulations to all of these recipients.

A matter of ongoing concern is the health of the mathematical sciences in Australia. This is addressed both by AMSI, in its Discipline Profile http://www.amsi.au/index.php/publications-mainmenu/media-releases/1291-dealing-with-australia-s-mathematical-deficit, and by the NCMS, through the decadal plan http://www.mathscidecadalplan.org.au/. The alarming state of preparedness of secondary mathematics teachers is arguably our biggest problem. The recent release of the Discipline Profile, with its positive suggestions for remedies, led to some media interest, which we hope will continue. Read the columns by Geoff Prince and Nalini Joshi for more interesting ideas, and also the article by Bronwyn Welch from CSIRO Education about their Mathematicians in Schools program. Nalini also makes a comparison of the decadal plans across other disciplines.

The declining mathematical skills of school leavers means we cannot assume too much knowledge of students entering university. Deborah King and Joann Cattlin present a thorough discussion of the issues this involves.

In the President's column, Peter Forrester concentrates more on tertiary issues. For example, should the current generation of students attend our lectures? The increase in funding levels for Commonwealth Supported Places in Mathematics and Statistics is welcome, but takes place at the same time as a general decline in funding for universities.

This issue of the Gazette contains five book reviews, more than we have had for quite a while. We thank all the reviewers who have taken the time to prepare these.

We publish an obituary of Geoff Mercer, who passed away unexpectedly in April, far too young. Three of his colleagues give us some insight into his life and work.

Other regular features in this issue are reports on four workshops, news updates from local correspondents and the ever popular Puzzle Corner.

Sid and I hope you enjoy reading this issue.

STOP PRESS. Alex Gunning, now a year 11 student at Glen Waverley Secondary College in Melbourne, has for the second time won a Gold Medal at the International Mathematical Olympiad. This time, he also achieved a perfect score on every question, a distinction he shared with two other competitors. A radio interview with him is available at www.abc.net.au/radionational/programs/breakfast/australian-gold-at-international-mathematical-olympiad/5600310. A full report on the entire Australian IMO Team will appear in a subsequent issue.

David Yost, School of Science, Information Technology and Engineering, Federation University Australia, Ballarat, VIC 3353. Email: d.yost@federation.edu.au

David Yost is a graduate of the University of Melbourne, the Australian National University and the University of Edinburgh. He has lived in eight countries and ten cities, returning to Australia in 2003, where he has recently completed ten years at Federation University Australia and its predecessor institution, the University of Ballarat, including a three-year period as Deputy Head of School. While most of his research is in functional analysis, he has lately been interested in convex geometry.

President's Column

Peter Forrester*

Recently I received notice of the AMSI access grid room national seminar 'A new era in the development of our science: the American mathematical research community, 1920–1950', by Professor Karen Parshall of the University of Virginia. What caught my eye was the portion of the abstract referring to the 'corporation' and 'capitalisation' of the American Mathematical Society as key members worked to raise private, governmental and foundational monies. This immediately brought to my mind the far-sightedness of the founders of AustMS in their action of initiating the Society's journals. In addition to the international recognition that these bring, they have been an invaluable source of revenue. In more recent years, the decision to no longer self publish, but rather to rather to become titles of Cambridge University Press has similarly been shown to be well judged. Notwithstanding the many issues facing academic publishers in the web era, CUP has managed to increase its global subscriptions, thanks mainly to emerging universities in China. This in turn has generated an essential component of the AustMS budget right up to the present. New revenue sources must of course be explored, with one idea presently being investigated being that of a capitation fee per delegate at the annual conference.

On another revenue-centred news item, the federal budget proposal to revise funding tiers for commonwealth supported places (CSP) sees mathematics now bracketed with science and engineering. If this was to become legislation, from 2016 universities will be receiving more than 20% extra funding per CSP mathematics and statistics student. This funding alignment of mathematics with science and engineering can be viewed as an acknowledgement of the foundational role that mathematics plays in these disciplines, something which has been championed by the office of the Chief Scientist and AMSI, amongst others. But exactly how this will affect undergraduate education in the mathematical sciences remains to be seen. The 2007 budget saw a similar percentage increase to the funding of CSP mathematics and statistics students, following a recommendation of the National Strategic Review of Mathematical Sciences Research in Australia released late the year before. History shows that little of this, and in some cases none at all, made its way to the departments. The central university uses approximately 50% of funding for its operating costs, then allocates money to faculties, which in turn allocate money to schools and departments. Basically, the university is under no obligation to pass on the 20% funding increase to the benefit of mathematics and statistics students.

With CSP funding to science and engineering reduced in the budget, one concern is that a subvention policy at the faculty level will see the money diverted. AustMS

*Email: President@austms.org.au

calls on all universities to honour the federal governments initiative to fund CSP mathematics students at the same rate as science and engineering students. This apparent funding increase comes at a critical time in the teaching of our undergraduate students. As I've alluded to in a recent President's Column, we are right in the middle of a dramatic disengagement of the student body from our lectures. Just how real this is was only too evident in my recently concluded 3rd year level complex analysis course. The lectures were all at the student unfriendly time of 9 am, and were available through lecture capture. In the Tuesday lecture before Easter, I counted up that the total attendance was a meagre 29 — I say meagre because the official enrollment is actually 118. With the numbers not much better for the rest of the week, I decided that something had to change. The Easter break gave me an opportunity to do some on-line research. The main lesson I learnt was that the lecturer needs to offer the students in attendance something they can't otherwise get. Very dangerous for student surveys at the least, with the overwhelming majority not in attendance. What I did was introduce 'practice exam question' for each of the last twelve lectures. Time was allocated each lecture for the students in attendance to work through some sample exam type questions. I asked for them to hand in their workings at the end of the lecture in exchange for the worked solutions. Students who weren't in attendance had to email me personally to get the answer sheet, and they were asked to give me feedback on their circumstances and attitudes relating to lecture attendance. This has provided me some useful feedback, but it didn't make much of a difference to numbers, which only occasionally bettered 1 in 3 in attendance. Later this month the FYI (First Year in Maths) network will be hosting a workshop 'Teaching Practices in Undergraduate Mathematics'. I've been invited to give the opening address, and very much look forward to attending in person (!) the many talks which relate to student engagement in their mathematics studies.

Peter Forrester received his Doctorate from the Australian National University in 1985, and held a postdoctoral position at Stony Brook before joining La Trobe University as a lecturer in 1987. In 1994 he was awarded a senior research fellowship by the ARC, which he took up at The University of Melbourne. Peter's research interests are broadly in the area of mathematical physics, and more particularly in random matrix theory and related topics in statistical mechanics. This research and its applications motivated the writing of a large monograph 'log-gases and random matrices' (PUP, Princeton) which took place over a fifteen-year period. His research has been recognised by the award of the Medal of the Australian Mathematical Society in 1993, and election to the Australian Academy of Science in 2004, in addition to several ARC personal fellowships.

Puzzle Corner

Ivan Guo*

Welcome to the Australian Mathematical Society *Gazette*'s Puzzle Corner number 38. Each puzzle corner includes a handful of fun, yet intriguing, puzzles for adventurous readers to try. They cover a range of difficulties, come from a variety of topics, and require a minimum of mathematical prerequisites for their solution. Should you happen to be ingenious enough to solve one of them, then you should send your solution to us.

For each puzzle corner, the reader with the best submission will receive a book voucher to the value of $50, not to mention fame, glory and unlimited bragging rights! Entries are judged on the following criteria, in decreasing order of importance: accuracy, elegance, difficulty, and the number of correct solutions submitted. Please note that the judge's decision — that is, my decision — is absolutely final. Please email solutions to ivanguo1986@gmail.com or send paper entries to: Gazette of the Australian Mathematical Society, School of Science, Information Technology & Engineering, Federation University Australia, PO Box 663, Ballarat, Vic. 3353, Australia.

The deadline for submission of solutions for Puzzle Corner 38 is 1 September 2014. The solutions to Puzzle Corner 38 will appear in Puzzle Corner 40 in the November 2014 issue of the *Gazette*.

Notice: If you have heard of, read, or created any interesting mathematical puzzles that you feel are worthy of being included in the Puzzle Corner, I would love to hear from you! They don't have to be difficult or sophisticated. Your submissions may very well be featured in a future Puzzle Corner, testing the wits of other avid readers.

Surface temperature

For the purpose of this puzzle, let us assume that the Earth is perfectly spherical, and the surface temperature is a continuous function of the Earth's surface.

(i) Prove that there exist two antipodal points with the same surface temperature.

(ii) Fix a distance d less than the diameter of the Earth. Prove that there exist two points exactly d apart, that have the same surface temperature.

*School of Mathematics & Applied Statistics, University of Wollongong, NSW 2522, Australia.
Email: ivanguo1986@gmail.com

Triangle existence

(i) For which integer values of x does there exist a non-degenerate triangle with side lengths of 5, 10 and x?

(ii) In a triangle, an altitude length refers to the perpendicular distance from a vertex to the opposite side. For which integer values of x does there exist a non-degenerate triangle with altitude lengths of 5, 10 and x?

Colourful lattice

In the coordinate plane, points with integer coordinates are called *lattice points*.

(i) Suppose that each lattice point is coloured using one of n possible colours. Prove that there exist four lattice points with the same colour which are also the vertices of a rectangle.

(ii) Suppose that each lattice point is either coloured using one of n possible colours, or not coloured at all. Furthermore, suppose that it is not possible to find four lattice points with the same colour which are also the vertices of a rectangle. Prove that there exist arbitrarily large squares such that none of lattice points in their interior is coloured at all.

Drawing parallels

Two parallel lines are drawn on a sheet of paper. There is also a marked point which does not lie on either of these lines. Here is your challenge: using only an unmarked straight edge (and no compass), construct a new line through the marked point, that is also parallel to the two existing lines.

Bonus: Can you find two different ways to achieve this?

Solutions to Puzzle Corner 36

Many thanks to everyone who submitted. The $50 book voucher for the best submission to Puzzle Corner 36 is awarded to Jensen Lai. Congratulations!

World cup

In the soccer world cup, each group has four teams. Each team plays one game with every other team in its group. A win gives 3 points, a draw 1 point and a loss 0 points. From each group, two teams advance so that each advancing team gets at least as many points as each non-advancing team.

(i) *What is the smallest possible score of an advancing team?*

(ii) *What is the largest possible score of a non-advancing team?*

Solution by Alan Jones:

(i) The answer is 2. A team T which scores 0 or 1 points has lost at least twice. Therefore there are at least two others teams with 3 or more points, so T cannot advance.

However, if one team has three victories and the other three teams draw all of their other matches, there are three teams with 2 points, one of which must advance.

(ii) The answer is 6. A team T which scores 7 or more has won at least twice. Therefore there are at least two other teams with 6 or less, so T must advance.

However, if A beats B, B beats C, C beats A, and everyone beats D, then A, B and C all have 6 points and one of them does not advance.

Polynomial product

Let n be a positive integer. Consider the polynomial:

$$P(x) = (1+x)(2+x^2)(3+x^4)(4+x^8)\cdots(n+x^{2^{n-1}}).$$

Express the product of the non-zero coefficients of $P(x)$ in terms of n.

Solution by Aaron Hassan: We first note that when $P(x)$ is expanded, there are exactly 2^n non-zero terms, in the following form:

$$P(x) = a_0x^0 + a_1x^1 + \cdots + a_{2^n-1}x^{2^n-1}.$$

This follows from the fact that each non-negative integer has a unique binary expansion, so each term x^i can be uniquely written as the product of a subset of $\{x^1, x^2, x^4, \ldots, x^{2^{n-1}}\}$. Hence the n brackets will produce 2^n terms with no like terms to be collected.

Now the 2^n coefficients of $P(x)$ are simply the products of the 2^n possible subsets of $\{1, 2, 3, \ldots, n\}$. To compute the overall product of the coefficients, it suffices to compute the number of times each element from $\{1, 2, 3, \ldots, n\}$ appears in the final expansion. In particular, when the bracket $(i + x^{2^i-1})$ is expanded, i will be used half of the time while x^{2^i-1} will be used during the other half. This implies that each i will appear in $2^n/2 = 2^{n-1}$ coefficients.

Therefore the required product of the non-zero coefficients must be $(n!)^{2^{n-1}}$.

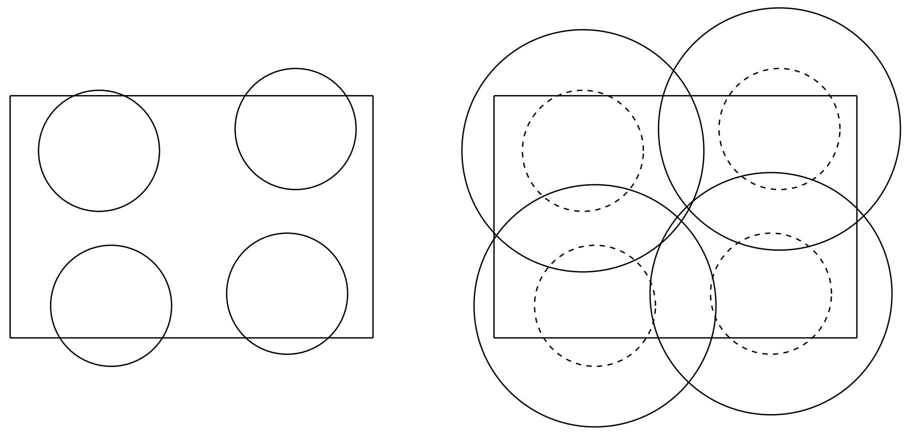
Coin coverage

One hundred identical coins lie on a rectangular table, in such a way that no more can be added without overlapping. We allow a coin to extend over the edge of the table, as long as its centre is still on the table.

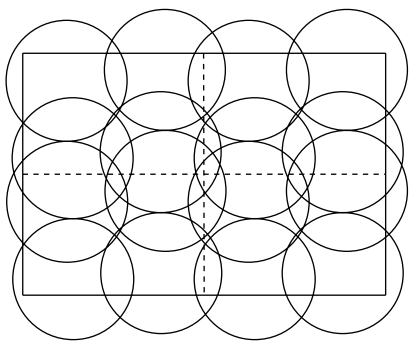
Prove that if overlapping is allowed, it is possible to start again and completely cover the table with four hundred of these coins.

Solution: Without loss of generality, let the radius of each coin be 1 cm. Initially, there are 100 coins with 100 *coin centres*. We claim that every point on the table is within 2cm of a coin centre. Suppose it is not the case at some point P. Then it is possible to place a new coin with centre P without creating any overlaps, since every other coin is more than 1cm from P. This is a contradiction.

Now let us replace the 100 coins by 100 over-sized coins with 2cm radii, but retaining the same 100 coin centres. Since no point on the table is more than 2cm from a coin centre, the new over-sized coins must cover the table completely.



With a little bit of magic, let us shrink the table as well as the coins by a length factor of 2. Now we have 100 normal-sized coins completely covering a small-sized table, which is half as long and half as wide as the original. Since a normal-sized table can be divided into four quarters, each identical to a small-sized table, we can complete the trick by simply repeating the same coin arrangement for each of the four quarters. As a result, we have managed to cover the normal-sized table with 400 normal-sized coins, as required.



Matching remainders

The numbers $1, 2, \dots, 2n$ are divided into two groups of n numbers. We form a list of the remainders formed by dividing the sums $a + b$ by $2n$, where a, b are in the same group (and may be equal).

Prove that the n^2 remainders from one group are equal, in some order, to the n^2 remainders of the other group.

Solution by Joe Kupka: Let the two sets of size n be S_1 and S_2. Fix a particular remainder $r \in \{0, 1, \dots, 2n-1\}$. We shall proceed by counting the number of of times r appears when summing within S_1 and within S_2.

We work under modulo $2n$. Consider the list of all possible ordered pairs from $\{1, 2, \dots, 2n\}$ which sum to r, they are:

$$P_1 = (1, r-1),\ P_2 = (2, r-2),\ \dots,\ P_{2n-1} = (2n-1, r+1),\ P_{2n} = (2n, r).$$

Note that each element of $\{1, 2, \dots, 2n\}$ appears exactly twice in the list. Since $|S_1| = n$, the elements of S_1 collectively appear $2n$ times in the list. The same holds for S_2.

Now define $f(P_i)$ to be the number of elements in P_i that is from S_1. So for each i, $f(P_i) = 0, 1$ or 2. But on average,

$$\frac{1}{2n}\sum_{i=1}^{2n} f(P_i) = \frac{1}{2n} 2n = 1.$$

Thus the number of occurrences of $f(P_i) = 0$ must equal the number of occurrences of $f(P_i) = 2$. In other words, the number of pairs with both elements in S_1 is equal to the number of pairs with both elements in S_2.

Therefore, the remainder r must occur the same number of times in S_1 and S_2. Since this is true for any remainder r, the n^2 remainders of sums in S_1 must be equal, in some order, to the n^2 remainders of sums in S_2.

Ivan is a Postdoctoral Research Fellow in the School of Mathematics and Applied Statistics at The University of Wollongong. His current research involves financial modelling and stochastic games. Ivan spends much of his spare time pondering over puzzles of all flavours, as well as Olympiad Mathematics.

Communications

Queen's Birthday Honours

Several members and friends of the mathematical sciences community received awards in the Queen's Birthday Honours announced last month. Our congratulations to all of them.

Dr Megan Elizabeth Clark, Chief Executive Officer, CSIRO

AC (Companion in the General Division of the Order of Australia). For eminent service to scientific research and development through fostering innovation, to science administration through strategic leadership roles, and to the development of public policy for technological sciences.

Dr Alan Simon Finkel, Chancellor, Monash University

AO (Officer in the General Division of the Order of Australia). For distinguished service to science and engineering, and to tertiary education administration, as an advocate for the protection of children, and to philanthropy.

Emeritus Professor Barry William Ninham, ANU

AO (Officer in the General Division of the Order of Australia). For distinguished service to physical sciences through landmark theoretical and practical advances in colloids and surfaces, and as an academic, educator and mentor.

Emeritus Professor Graham Alfred Jones, Griffith University

AM (Member in the General Division of the Order of Australia). For significant service to mathematics education as an academic and leader in the profession, and to the community.

Professor Anne Penfold Street, NSW; Honorary Professor, University of Queensland

AM (Member in the General Division of the Order of Australia). For significant service to science education in the field of mathematics.

Breakthrough Prize in Mathematics awarded to Terry Tao

Our congratulations to Australian Mathematician Terry Tao, one of five inaugural winners of the Breakthrough Prizes in Mathematics, announced on 23 June. Terry is based at the University of California, Los Angeles, and has been awarded the prize for numerous breakthrough contributions to harmonic analysis, combinatorics, partial differential equations and analytic number theory.

The Breakthrough Prize in Mathematics was launched by Mark Zuckerberg and Yuri Milner at the Breakthrough Prize ceremony in December 2013. The other winners are Simon Donaldson, Maxim Kontsevich, Jacob Lurie and Richard Taylor. All five recipients of the Prize have agreed to serve on the Selection Committee, responsible for choosing subsequent winners from a pool of candidates nominated in an online process which is open to the public. From 2015 onwards, one Breakthrough Prize in Mathematics will be awarded every year.

The Breakthrough Prizes honor important, primarily recent, achievements in the categories of Fundamental Physics, Life Sciences and Mathematics. The prizes were founded by Sergey Brin and Anne Wojcicki, Mark Zuckerberg and Priscilla Chan, and Yuri and Julia Milner, and aim to celebrate scientists and generate excitement about the pursuit of science as a career. Laureates will receive their trophies and $3 million each in prize money at a televised award ceremony in November, designed to celebrate their achievements and inspire the next generation of scientists. As part of the ceremony schedule, they also engage in a program of lectures and discussions.

See https://breakthroughprize.org and http://www.nytimes.com/2014/06/23/us/the-multimillion-dollar-minds-of-5-mathematical-masters.html?_r=1 for further information.

Forum on assumed knowledge in maths

Deborah King* and Joann Cattlin*

Time to change the maths message: what does 'assumed knowledge' really mean for students?

Many universities in Australia no longer have prerequisite mathematics subjects for entry to degrees in science, mathematics, engineering and technology, opting for an 'assumed knowledge' entry requirement. There is growing concern in universities across the country that students entering science, engineering and technology degrees do not have the required mathematical background. In response, most universities now offer to commencing students, a variety of mathematics subjects at various levels, a range of support programs or have reviewed their teaching approaches and curriculum to accommodate the diversity of student backgrounds. The impact on universities is significant in terms of the cost of extra service provision, but is most commonly felt by frontline academic staff struggling to teach large classes of first-year students who don't have the required assumed knowledge. While these academics are making significant efforts to adapt their teaching, course content and program structure to improve student outcomes, these efforts do not make up for the deficit in mathematical knowledge. The consequences for students are not only high failure rates in their first-year subjects, but difficulty in applying mathematical skills throughout their science and engineering degree.

These issues were the focus of a National Forum on 'Assumed knowledge in maths: its broad impact on tertiary STEM programs', held on 13 and 14 February at the University of Sydney. The forum was attended by 145 academics and education specialists from mathematics, science and engineering from universities across Australia and New Zealand, along with representatives of state curriculum authorities, the Australian Association of Mathematics Teachers, the Catholic Education Office and peak science and mathematics bodies like the Australian Mathematical Sciences Institute (AMSI) and the Australian Mathematical Society (AustMS). The forum was organised by the First Year in Maths (FYiMaths) project (funded by the Office of Learning and Teaching) and supported by the Institute of Innovation in Science and Mathematics Education (IISME) at the University of Sydney.[1]

*Department of Mathematics and Statistics, The University of Melbourne, VIC 3010.
Email: dmking@unimelb.edu.au, joann.cattlin@unimelb.edu.au

[1]The FYiMaths project is investigating the challenges facing first-year mathematics coordinators and has recently interviewed academics at universities across the country. IISME hosted the forum as part of its activities in encouraging engagement in the scholarship of teaching and learning in science and mathematics.

The Chief Scientist, Professor Ian Chubb gave the opening keynote address in which he expressed concern that while the numbers of students studying high-level maths at high school were falling, there continues to be growth in students enrolling in STEM degrees. He identified a range of issues that had led to the decline in students' studying higher level maths, including a lack of incentive due to the removal of prerequisites for mathematics by universities and resulting perception that even intermediate level maths wasn't necessary to study STEM. He characterised the forum as a significant community of interest who could influence policy through working with the secondary sector to enhance understanding of the importance of mathematics for studying STEM and to provide support to teachers through specialist professional development.

A key element of the forum was the collection of presentations by academics on their institutions' approaches to teaching mathematics to diverse student cohorts and the adaptive responses developed through program and curriculum reviews. Most of the presentations are available on the FYiMaths project website (visit www.fyimaths.org.au).

The presentations revealed that institutions are developing a range of teaching approaches that scaffold learning through tasks and assessments that focus on developing key mathematical skills, building student's confidence and self-awareness. Different class formats have also been trialled, including smaller seminar-style classes, 'flipped classrooms' and variations of lecture recording.

One of the key tools used by many institutions is diagnostic testing of mathematical skills for incoming first-year students. Tests can be administered before, or early in, the first semester of first year, they may be compulsory or voluntary, and may direct student enrolment in specific courses, or serve as formative assessment. A number of institutions have developed their own test, while others have adapted those used at other institutions.

Bridging programs are a common mechanism to enable students without mathematics from school to develop the required mathematical skills for STEM programs. There are two main models of bridging program: a pre-semester short course that is fee based and open to the public, and a semester course that is credited as part of a degree program. The presenters reported mixed results from their bridging programs, with concerns expressed about the depth of knowledge developed, and the problems of teaching mathematics alongside other first-year STEM subjects requiring this knowledge.

A key element of course and degree program redesign at many institutions was the collaboration that happened between the staff teaching mathematics and their colleagues in science and engineering disciplines. On a practical level consultation enabled mathematicians to identify the key mathematical skills their students need for science and engineering and to contextualise examples of maths applications. Most importantly consultations established an understanding and ongoing consultative relationship that further enhanced the integration of mathematics subjects into the degree programs, increasing student engagement and linking the maths they learnt in first year to later courses in their degree.

The outcome of the forum has been to develop a consensus amongst STEM academics, peak mathematics bodies and education specialists on the need to work together to arrest the declining maths skills of students. In the coming months the FYiMaths project will initiate actions intended to promote further discussion about how to redress the concerns about how the removal of prerequisites is influencing student choices.

Dr Deborah King is the Director of First Year in the Department of Mathematics and Statistics at the University of Melbourne, and is the project leader of First Year in Maths. She is also involved in a number of teaching and learning projects, including assessment practices, communication skills, and mathematical misconceptions. She has been involved in curriculum design at both tertiary and secondary level.

Joann Cattlin is the project manager of the First Year in Maths project. She has been a project officer and researcher on ALTC and ARC projects utilizing her background as a university librarian and experience in government policy work. She is currently completing a Master of Information Management and her research interests include communities of practice and information seeking behaviours.

Mathematicians in schools: What's going on out there?

Bronwyn Welch*

'We cannot hope that many children will learn mathematics unless we find a way to share our enjoyment and show them its beauty as well as its utility' [1]. Mary Beth Ruskai may well find that CSIRO Education's Mathematicians in Schools (MiS) is a way to address this. Over 160 mathematicians around Australia are participating in 220 Mathematicians in Schools partnerships. Currently, we have approximately 40 mathematicians registered with the program who identify themselves as members of the Australian Mathematical Society.

There is a critical shortage of STEM skills within industry [2] and this is compounded by the declining number of students undertaking advanced mathematics in secondary school [3]. Furthermore, the proportion of school student participation in STEM subjects has flat-lined over the past decade at around 10% [4].

Here's a glimpse of how a few AustMS members are helping to address the STEM skills shortage through the MiS program:

Finnur Larusson, Associate Professor at the School of Mathematical Sciences, University of Adelaide is partnered with Candice Mangan of Belair Primary School. Finnur visits Candice's class twice a term and engages students in some well-known maths investigations. The investigations include the Seven Bridges of Konigsberg, the Four Colour problem, Prime numbers and their mysterious patterns, to name a few. The beauty of these investigations, which are pitched perfectly for the year 4/5 class, is that the concepts lead to serious mathematical content.

Finnur considers the most fun topic to be investigating pi. He guides the students through finding areas of rectangles to estimate the area of a circle and hence discovering this famous number and 'there is great suspense as we collect the students' approximations ... wait to see who came closest to the true value of this mysterious number. The answer is only revealed at the end.'

Meanwhile in Canberra, PhD candidate Lucia-Marie (Billie) Ganendran and teacher Stephen Robey, are engaging Year 11/12 students with statistics at Gunghalin College. Billie is part of a research team conducting a detailed examination of the effects of several environmental factors, such as sea surface temperatures, wind strength, ambient temperature and rainfall, on the survival of Little Penguins *Eudyptula minor*. Through a lecture to the students she explained how the study will assist in predicting the potential effect of climate change on the viability of this species.

*Mathematics and Engineering Coordinator, Scientists and Mathematicians in Schools, CSIRO Education. www.mathematiciansinschools.edu.au Email: bronwyn.welch@csiro.au

Armed with the context of the research, the students have heard how statistics helps to understand the variables that affect the survival of these special penguins. The students will be conducting their own analysis of various aspects of the data from the study at the end of the term. Billie states her experience has been 'immensely satisfying to be able to engage students' and 'they were a fantastic class full of enthusiasm ... I always like to get across to students the collaborative nature of applied maths and science, and the sheer enjoyment and productivity that collaboration generates.'

In the warmer clime of Brisbane, Andy Wilkins, a Research Projects Officer at CSIRO Earth Science and Resource Engineering and his teacher partner Ruth Burnett have set up a STEM program in Brigidine College, catering for about 25 scientifically bright students in Years 8 and 9. Each Friday at lunchtime they run focused activities including the building of batteries out of different metals and solutions, the dynamics of water rockets, and robotic programming.

Andy's aim is for the students to see that maths lies at the core of everything, even if they are not explicitly doing the maths. Of course, the activities and the projects cover a multitude of mathematical topics including statistics, parabolic flight paths and drag, convection and diffusion, algorithms and orders of magnitude. According to Andy, the best part of the partnership is 'having fun exploring and explaining. Oh, and everyone thinks I'm brainy which is nice!'

These opportunities are provided through MiS, which matches volunteer mathematicians with teachers to form tailored ongoing partnerships in schools. MiS partnerships are designed to bring mathematics to life inside the classroom, enriching curriculum delivery and enthusing students and teachers about the subject. Volunteer mathematicians can share their passion and reveal the power, subtlety and beauty of maths to the current generation of mathematics learners and educators.

Suspense, mystery, enthusiasm, exploring, explaining, enjoyment ... perhaps this is where your story begins.

If you want to know more, contact Bronwyn Welch (bronwyn.welch@csiro.au).

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Recent developments of nonlinear PDEs ANU, 25–29 November 2013

Yihong Du*

The international workshop 'Recent developments of nonlinear PDEs' was held at the ANU during 25–29 November 2013. This workshop was one of two major events of the 2013 ANU special year on 'Nonlinear partial differential equations', an area where Australian mathematicians have been playing a leading role in many of its research fronts internationally. The workshop focused on recent progress made in several major directions of nonlinear PDEs, including variational theory of nonlinear equations arising in mathematical physics, fully nonlinear equations arising in geometry and optimal transportation, evolution equations arising in fluid mechanics and other nonlinear problems. The workshop was jointly supported by the MSI of ANU, AMSI, and the Australian Mathematical Society.

There were 23 invited 50-minute talks given by international experts (mostly research leaders in the field, with seven former ICM invited speakers), and four short talks each of 25 minutes by early career researchers (including two PhD students). The talks covered state-of-the-art research works in semilinear and fully nonlinear PDEs of elliptic, parabolic and hyperbolic types (almost the full range of second order PDEs), proving a highly inspiring and stimulating environment for interactions. The conference program, which includes the title and abstract of the talks, can be found at the conference webpage http://maths.anu.edu.au/events/recent-developments-nonlinear-pdes.

The workshop had 54 formally registered participants, including 28 Australian, 26 international, 11 PhD students and 4 postdoctoral fellows. The conference was held in a lecture theatre next to the MSI building and the morning and afternoon teas were provided in the common room of the MSI. This had given the added 'at home' feeling for the participants, and provided a friendly and convenient environment for participants and local people to interact.

The participants were generally very impressed by the quality of the talks and the breadth of the topics covered, with several research leaders commenting particularly on the variety of topics in the talks that had made the workshop much more interesting and stimulating.

The workshop created a superb opportunity for the junior participants to learn about the new progresses in research in PDEs and to meet the world authorities in their areas.

*ydu@turing.une.edu.au

The Scientific Committee of the workshop was chaired by Professor Neil Trudinger, with members Professor Norm Dancer, Professor Yihong Du, Professor Changshou Lin (National Taiwan Univ), Professor Andrea Malchiodi (University of Warick) and Professor Xu-Jia Wang.

Members of the organising committee were Dr. Florica Cirstea (Sydney), Professor Yihong Du (UNE, Chair), Ms Brittany Shoard (ANU, Secretary), Professor Neil Trudinger (ANU), Professor Xu-Jia Wang (ANU) and Dr Bin Zhou (ANU).

Constructive Optimisation Workshop in Honour of Professor Vladimir Demyanov's 75th birthday

Ballarat/Melbourne, 16–17 April 2014

Andrew Eberhard, Alexander Kruger, Vera Roshchina* and Nadezda Sukhorukova

This two-day workshop took place at the Federation University Australia and RMIT University on 16 and 17 of April 2014. The main goal of the meeting was to celebrate the scientific contribution of Professor Vladimir Demyanov, to build closer links between different groups of local researchers, and to expose students and Early Career Researchers to a broad range of topics in nonsmooth and discrete optimisation. Professor Demyanov's work has had a significant impact on the development of nonsmooth optimisation in Australia: he collaborated closely with many Australian mathematicians, and visited the University of Ballarat on several occasions.

There were 19 research talks and 35 participants from Federation University Australia, Melbourne University, The University of Newcastle, RMIT University, Swinburne University of Technology, National ICT Australia and the International University of Hochiminh City, Vietnam. The conference turned out to be very popular with students, while several researchers working in close areas met for the first time and had a chance to discuss their research. The full program is available at http://federation.edu.au/faculties-and-schools/faculty-of-science/school-of-science-and-technology/research/conferences-and-workshops/constructive-optimization-workshop/workshop-program.

The workshop was sponsored by Federation University, RMIT University and Swinburne University of Technology.

Sadly, Professor Demyanov passed away on the day after the workshop, after a long and serious illness. Comments and memories about Professor Demyanov can be communicated at http://constructiveoptimisation.com/vfd/.

*vroshchina@federation.edu.au

ANZIAM early career workshop Rotorua, New Zealand, February 2014

Katrina Treloar* and Catherine Penington**

Rotorua played host to the biennial ANZIAM Early Career Workshop on 7 February 2014 at the Millenium Hotel, which was attended by over 60 PhD and post-PhD researchers. Based on past feedback, the workshop focused on advice sessions including career pathways in academia and industry, writing CVs and balancing research with other commitments. The event was sponsored by ANZIAM and AustMS who generously provided registration, food and accommodation for participants.

The day commenced with short talks from several invited speakers and the organisers about their own journeys from university life into academia or industry. It was interesting to hear about the different career pathways. In particular, Dr James McCaw spoke about moving between different fields of research while Dr Pen Holland spoke about research outside academia. In the subsequent session, the students discussed writing CVs and the mistakes that many make. The organisers showed us their successful CVs, and it was very helpful to be able to see what makes a good CV, and what to avoid.

An interactive session was held, in which participants were asked to submit questions for the panel of invited speakers and organisers to answer. The panel answered academic-related questions such as balancing research with other commitments, publishing and looking for work overseas. In addition, they also provided advice on personal questions such as family life and the two-body problem.

The day was a great opportunity not only to learn about beginning a career in research but also to get to know our fellow PhD students and post-docs from other universities. We spoke about networking as a group, and were given a chance to put it into practice, and get to know our contemporaries in a more informal setting. The day concluded with a workshop dinner at a local Indian restaurant, where we took the opportunity to wind down after a very insightful day.

Overall, the day was a great success and the feedback from other participants was overwhelmingly positive with many appreciating the strong focus on advice sessions. In future, it would be great to have a balance of invited speakers, from both academia and outside academia, attend the event. On the academic side, it would be useful to discuss the transition between PhD study and Post Doctoral

*katrina.treloar@connect.qut.edu.au
**c.penington@student.unimelb.edu.au

research. Finally, given the large number of participants who were considering careers outside academia, a session on different career pathways and finding jobs outside academia could be very helpful.

The ANZIAM Early Career Workshop is an important part of ANZIAM and would not be possible without the efforts of the organisers Associate Professor Alex James, Dr Roslyn Hickson and Dr Richard Brown. Thank you to the invited speakers who gave up their time to share their thoughts with us; Dr Clemency Montelle, Dr Pen Holland, Dr Claire Postlethwaite and Dr James McCaw. Finally, many thanks to the sponsors of the event; ANZIAM and AustMS.

Sydney Random Matrix Theory Workshop
The University of Sydney
13 to 16 January 2014

Sheehan Olver*

The Sydney Random Matrix Theory Workshop brought together experts on a variety of random matrix theory topics — computational methods, free probability, Riemann–Hilbert problems and applications. Random matrix theory is an exciting research area, undergoing active development, and the workshop gave an opportunity for international and Australian researchers across these different subfields to interact. The workshop lasted for four days, with six talks and one discussion session per day. The days were roughly themed: the first day was on computation, the second on two matrix models and determinantal point processes with boundary conditions, the third on normal random matrices (i.e. matrices with spectrum in the complex plane but unitary/orthogonal eigenvectors), and the last day on various topics with a discussion on random linearized Hamiltonians.

The discussion sessions were hosted by different participants each day, including Alan Edelman (MIT) on computation, Dong Wang (NU Singapore) on determinantal point process with boundary conditions, Pavel Bleher (IUPUI) on normal random matrices and Peter Miller (U Michigan) on random linearized Hamiltonians. Most of the discussion session contained an introduction to a topic of ongoing research with audience participation. This allowed for attendees to make connections to other research areas, and to help with understanding the problems undergoing active research.

The AustMS support of the workshop was extremely beneficial, helping to partially support several prominent early career researchers in the field (including the most recent awardee of the SIAM Richard C. DiPrima Prize), who may not have otherwise been able to attend.

Email: Sheehan.Olver@sydney.edu.au

Geoffry Norman Mercer

Born: 1 June 1962, in Adelaide.
Passed away: 12 April 2014, in Canberra, aged 51.

Geoffry Norman Mercer, one of Australia's leading Applied Mathematicians, died suddenly on 12 April, 2014, at the age of 51. He was passionate about the sport of rogaining, and suffered a heart attack while competing in the ACT Rogaining Championships with his partner Alex Tyson. He is deeply missed by the mathematics and scientific community, both in Australia and abroad.

Geoff Mercer's contributions to Applied Mathematics and Epidemiology were cut short at the peak of his career. If Geoff was to categorise his research area he would probably say that he was a 'real applied mathematician' not just an 'applied mathematician'. The distinction was important to him as he liked to work in areas that were intimately linked to applications. This led him to publish papers covering a wide range of interests, resulting in over 100 journal articles, and the award of $2.5 million in external grant funding, including ARC and NHMRC grants.

Geoff Mercer was born on 1 June 1962 in Adelaide to Nancy and Norman Mercer. Both his parents ended their formal education in primary school to go to work due to financial needs. However, they greatly valued education and Geoff went to the local state primary and high schools. Marion High was not renowned for academic achievement but he was lucky as his cohort had a small group of similar students with a desire to learn and sights set on university. Family life was simple — a paper round, gymnastics, roaming around the foothills with mates on their bikes (a passion that never waned), beach and caravan holidays and endless card games where he learnt how to bet and the fundamentals of probability. When convalescing after having had his appendix removed he completed the two weeks of maths work in a few days and just went on and completed the book. The teacher wisely provided another one and Geoff says he knew then that maths was what he wanted to do.

Geoff completed his BSc Honours in Mathematics (1st Class) in 1984 from Adelaide University and later his PhD (also from Adelaide University) under Tony Roberts working on shallow water waves and center manifold theory (thesis title: *On standing waves and models of shear dispersion*). Geoff's PhD thesis was a substantial piece of work, with one examiner noting: 'This thesis deals with two distinct topics in mathematical fluid dynamics, each of which could constitute a slim but successful PhD. Together they comprise an impressive and substantial contribution.' Neither of the referees required any changes to the thesis.

During the period of 1985–1993 Geoff worked as a tutor, firstly in the School of Mathematics and Computer Studies (South Australian Institute of Technology) and later in the Applied Mathematics Department (Adelaide University). The latter was mostly during his PhD. He was immediately singled-out by students to be the 'tutor of choice' since he would take time to explain difficult concepts and would never 'put students down'. He always had time for the students despite the fact that he oversaw the computing classes which had over one thousand students.

On 11 January 1993 Geoff arrived at the University of New South Wales at the Australian Defence Force Academy in Canberra as an ARC funded post-doctoral Research Associate working in the area of bushfire modelling. He immediately showed that he was a flexible person who could join a team and be relied upon to make a contribution. In a very short period of time, he established himself as a successful, productive researcher. Geoff remained at UNSW Canberra for 16 years in the following positions: Research Associate (1993–1995), Senior Research Associate (1995–2000), Lecturer (2000–2002), Senior Lecturer (2002–2008) and then Associate Professor (2008). It was during this period that his research interests diverged from bushfire modelling into mathematical combustion modelling and heat transfer, flow through porous media, dispersion and hydrodynamics, mathematical biology, dynamical systems and movement in a threat environment. He published papers in such diverse areas as modelling breast-feeding through to agricultural spraying, wool scouring, and optimal routes through minefields. It is also noteworthy that he published a paper with his partner Alex, in the area of sexual health. Some of these problems came through his active participation at Mathematics in Industry Study groups where he was project coordinator on five occasions, a member of various MISG organising committees, and a participant in many more problems. The MISG projects upon which he worked have been very successful, leading to ongoing interactions with industry and to successful ARC linkage grants. A high profile MISG project Geoff moderated in Wollongong was on the shelf life of wine, for a South Australian wine company. This project led to an article and photo in the local newspaper, the Illawarra Mercury, and fitted nicely with Geoff's love of a nice glass of red.

In February 2009 Geoff was appointed as a Fellow in Infectious Disease Modelling at the National Centre of Epidemiology and Population Health (NCEPH) at the Australian National University. He embraced an entirely new research area, and, freed from teaching, he was able to quickly make significant contributions to this field, resulting in his rapid promotion from Research Fellow to Professor, leader of the Infectious Disease Epidemiology and Modelling group, and finally acting Director of NCEPH. As always, his interests were wide and he worked on projects studying Dengue, pandemic H1N1, Salmonella and Campylobacter in the poultry food chain and Tuberculosis.

Geoff's considerable success in a range of research areas was due to his ability to understand the fundamental mechanisms in an application (physics, biology or epidemiology) and how to translate this into meaningful mathematics, derive elegant solutions and write computer programs to perform the numerical analysis. He also had the rare ability to combine high-end theory with practical attention to data. In addition, he was equally adept at communicating his work through well-written publications and conference presentations. He was overwhelmingly the students' choice for the best non-student talk at ANZIAM 2007 (The Cherry Ripe Prize), and in February 2014, Geoff gave an excellent invited talk at ANZIAM 2014 which gave the audience insights into the impact of disease modelling on policy decisions.

Besides outstanding research, Geoff excelled in undergraduate and postgraduate teaching. He would have taught thousands of students and was known for his perfectly clear lecture notes and presentations. In his days at the University of Adelaide, at UNSW Canberra and at the ANU, he would have taught almost all applied and computational mathematics courses to both science and engineering students. He loved teaching, and even when his positions were classified as research only, Geoff would volunteer his time to teach courses in mathematical modelling.

Geoff made an outstanding service contribution to Applied Mathematics in Australia and New Zealand, especially to professional bodies such as ANZIAM and MISG. Most recently, he was Secretary of ANZIAM (2008–2012), a key role involving the oversight and organisation of many society activities, as well as providing continuous support to the Chair and Treasurer. His advice, sound judgment, and knowledge of ANZIAM history and procedure were invaluable to our professional body. In addition, he contributed to a wide range of other ANZIAM activities, such as being the Founding Chair of the ANZIAM special interest group in Mathematical Biology, chair and member of the ANZIAM ACT branch, Secretary of the Engineering Mathematics Group, ACT representative on the Executive Committee of ANZIAM on numerous occasions, and member of various conference organising committees including ANZIAM 2002 and CTAC 2008. Furthermore, he was an editor for the Proceedings of the Engineering Mathematics and Application Conference 2007 and the Proceedings of the Computational Techniques and Application Conference 2008, both published as part of *The ANZIAM Journal (E)*, and a subject editor for the journal *Applied Mathematical Modelling*. His contributions to MISG also included being an editor of the Proceedings of the 2007, 2008 and 2009 MISG meetings.

Geoff played a pivotal and influential role in the support of Applied and Industrial Mathematics in Australia and New Zealand. In addition, he used the multi-disciplinary nature of his research to effectively promote the discipline of Applied

Mathematics at a national and international level. He was also involved in the successful supervision of five PhD students and was the current supervisor of four PhD students. Geoff Mercer was a tireless champion and campaigner for the promotion of mathematics, particularly for research students. He was often heard muttering words such as 'we must do more for the students' and was always keen to seek travel funding for students to attend maths meetings.

Geoff's outstanding achievements have been recognised by the joint award of the prestigious, inaugural 2013 EO Tuck Medal 'for outstanding research and distinguished service'. The Medal, which is awarded by the Australia and New Zealand Industrial and Applied Mathematics division of The Australian Mathematical Society, recognised Geoff's contributions to Applied Mathematics research, as well as his teaching and communication of research results, his supervision of PhD and masters students and his community leadership.

> Dr Mercer is a committed applied and industrial mathematician and has demonstrated through his enthusiasm, energy and sustained achievements that he well and truly meets the criteria for this mid-career award.

Many would agree that Geoff was easy to get on with, which explains his wealth of collaborators from every state in Australia, across the Tasman, and overseas. Geoff has been described by many as a 'quiet achiever', but it was always clear that he had a lot to offer in all sorts of ways. Alex aptly described Geoff's unassuming nature in her eulogy. When Geoff arrived home from ANZIAM 2013, she asked him how the conference was. He replied that it was pretty good and then, as an afterthought, he told her that he was given an award — the E.O. Tuck award. This was typical of Geoff!

Geoff's skills and interests extended beyond Academia. He was a keen traveller, bushwalker and skier, and was able to entertain others with stories of his adventures in Africa, South America, Nepal and around Australia. It was these interests that led him into the sport of rogaining which is similar to Orienteering except that it is completed over rugged natural terrain for up to 24 hours, with the added dimension of weighted controls and the need to 'optimise a weighted travelling-salesman problem with time-constraints and spatially variable route impedance'. Geoff's energy for rogaining led him to act as the ACT Rogaining Association president and secretary for many years, as well as the organiser and course setter for numerous rogaines, including the 2002 Australian Championships. His contribution to rogaining in the ACT cannot be measured. As stated on the ACT Rogaining Association's website, Geoff 'established many of the ways we [ACTRA] do things' and he was always 'a great source of wise counsel and thoughtful guidance for many people both competing and organising events'. This is a clear example of Geoff's skill in mentoring that he applied to all areas of his life.

Geoff was always able to establish a healthy balance between family and work life. From 1998 to 2011 Geoff was employed on a part-time (0.8) basis, so that he could spend more time with his family, particularly when his daughters Adele and Isobel were very young. This aspect was very nicely captured by Peter Taylor in his eulogy at Geoff's funeral . . .

> The fact that Geoff was able to make this choice, and still achieve as much as he did in his academic career, is both a testament to his enormous ability and a demonstrator to other academic staff that, far from being career-limiting, a healthy work–life balance can be career-enhancing.

The Australian Mathematics Society has decided to posthumously accredit Geoff as a Fellow of the Australian Mathematical Society (FAustMS). Furthermore, the Research School of Population Health (RSPH) has decided to honour Geoff's contributions and to continue his legacy of mentoring and supporting students by establishing the Geoff Mercer Endowment. This will fund an annual award for postgraduate RSPH students to undertake an activity in pursuit of their academic goals, including travelling to a national or international conference.

Geoff is survived by his partner Alex, his two daughters Adele and Isobel, and by numerous past students and colleagues who have been positively affected by his life and work.

Harvi Sidhu, Steve Barry and Tim Marchant

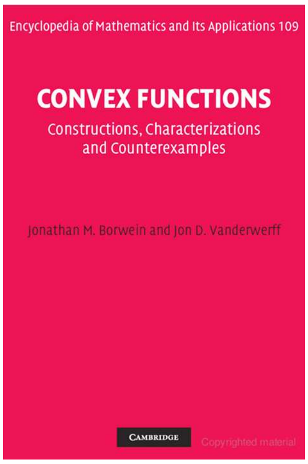
Book Reviews

Convex functions:
Constructions, characterizations and counterexamples

Jonathan M. Borwein and Jon D. Vanderwerff
Springer, 2011, ISBN 978-0-387-87856-0

I think the best way to begin is to quote some introductory remarks from the book.

> Like differentiability, convexity is a natural and powerful property of functions that plays a significant role in many areas of mathematics, both pure and applied. It ties together notions from topology, algebra, geometry and analysis, and is an important tool in optimization, mathematical programming and game theory. This book, which is the product of a collaboration of over 15 years, is unique in that it focuses on convex functions themselves, rather than on convex analysis. The authors explore the various classes and their characterizations, treating convex functions in both Euclidean and Banach spaces. . . .
> The book can either be read sequentially as a graduate text, or dipped into by researchers and practitioners. Each chapter contains a variety of concrete examples and over 600 exercises are included, ranging in difficulty from early graduate to research level.



I am, I suppose, a *researcher and practitioner*. I am not an expert on convexity but I use it continually. I have always wished I knew more but have never quite had the energy or drive to make myself both learn and understand the topic in any great depth. Until now, my most successful attempt — which was a major step forward for me — was to purchase the book *Convex Analysis and Nonlinear Optimization: Theory and Examples* by Jonathan M. Borwein and Adrian S. Lewis. To date, I have read and become quite familiar with around the first third of this book — which incidentally is a delight to read and study — and that is essentially my starting point for this review. When the opportunity arose to review the new book I was both unable to resist and yet reluctant to be drawn in. Unable to resist because I have really enjoyed my reading of the first book but reluctant because the new book promised to be more comprehensive and much deeper. And here was I, in my *spare* time, still struggling through the original. I love thinking and talking about mathematics but I am a reluctant reader. So — what have I found? My first observation is that the new book rests comfortably on the previous book by Borwein and Lewis. At least in the first three chapters there are frequent references to the earlier work and although there is inevitably common ground it is, to my mind, deftly managed.

The first chapter introduces the basic properties of convex functions. The concept of an epigraph — the region above the graph — is fundamental as is the idea of a subdifferential. If E is a Euclidean space and $f\colon E \to [-\infty, +\infty]$ then the epigraph is the set $\operatorname{epi} f := \{(x,t) \in E \times \mathbb{R} \mid f(x) \leq t\}$. If $\operatorname{epi} f$ is closed in $E \times \mathbb{R}$ then we say that f is closed. The domain of f is the set $\operatorname{dom} f = \{x \in E \mid f(x) < \infty\}$. The *subdifferential* of f at $\overline{x} \in \operatorname{dom} f$ is the set

$$\partial f(\overline{x}) := \{\phi \in E \mid \langle \phi, y - \overline{x}\rangle \leq f(y) - f(\overline{x}),\ \forall y \in E\}.$$

If $\overline{x} \notin \operatorname{dom} f$ then the subdifferential is the empty set. That is $\partial f(\overline{x}) = \emptyset$. If $\partial f(\overline{x}) \neq \emptyset$ and $\phi \in \partial f(\overline{x})$ then ϕ is a subgradient for f at $\overline{x}$. The *indicator function* of a nonempty set $C \subset E$ is the function δ_C defined by

$$\delta_C(x) := \begin{cases} 0 & \text{if } x \in D \\ +\infty & \text{otherwise.} \end{cases}$$

If C is a convex set then δ_C is a convex function. The indicator function helps us to to talk interchangeably about convex sets and convex functions. Another important concept is the idea of a cone. Cones are used to define order relationships. A set $K \subset E$ is said to be a cone if $tK \subset K$ for every $t \geq 0$. In particular $\mathbb{R}_+ = [0, +\infty)$ is the nonnegative cone in $\mathbb{R}$. Carefully selected definitions, key properties and important theorems are introduced without proof but with copious references to later chapters where proofs and detailed discussions can be found. Some mathematical applications are also presented to provide context and motivation. Well-chosen mathematical applications include the Birkhoff theorem *that each doubly stochastic matrix is a convex combination of permutation matrices*, an example of a continuous but nowhere differentiable function and a discussion of the Gauss theorem *that roots of the derivative of a polynomial lie inside the convex hull of the zeros*. There are also applied examples. A first intriguing example concerns *hidden convexity* in the classic Brachistochrone problem. A later example challenges readers to prove that the mapping

$$p \mapsto \sqrt{p} \int_0^\infty \left| \frac{\sin x}{x} \right|^p \mathrm{d}x$$

can be expressed as the difference of two convex mappings for $p \in (1, \infty)$. And there is more — from the famous von Neumann minimax result in game theory to the inevitable discussion of *entropy*. To my way of thinking this chapter is an excellent introduction which can be summed up best by once again returning to the text for illustration.

> The function f is *Fréchet differentiable* at $\overline{x} \in \operatorname{dom} f$ with Fréchet derivative $f'(x)$ if
>
> $$\lim_{t \to 0} \frac{f(\overline{x} + th) - f(\overline{x})}{t} = \langle f'(\overline{x}), h\rangle$$
>
> exists uniformly for all h in the unit sphere. If the limit exists only pointwise, f is *Gâteaux differentiable*.

I had to think about this for a while but soon realised it was an economic and elegant expression of the usual definition of Fréchet differentiability — that for each $\epsilon > 0$ there exists $\delta > 0$ so that

$$\left\| \frac{f(\overline{x} + th) - f(\overline{x})}{t} - \langle f'(\overline{x}), h\rangle \right\| \leq \epsilon \|h\|$$

for all h and all t with $0 < |t| < \delta$. It can be seen here that a little prior knowledge is needed to gain the full benefit of the exposition — but perhaps that is how it should be.

Chapter 2 looks at convex functions on Euclidean spaces. There are no real surprises here but the treatment is crisp and complete. We begin with continuity and subdifferentials and move on to differentiability, conjugate functions and Fenchel duality, second order differentiability and finally support functions and extremal structures. The *Fenchel conjugate* of a function $f\colon E \to [-\infty, +\infty]$ is the function $f^*\colon E \to [-\infty, +\infty]$ defined by

$$f^*(\phi) := \sup_{x \in E}\{\langle \phi, x\rangle - f(x)\}$$

from which one may deduce the important *Fenchel–Young* inequality

$$f^*(\phi) + f(x) \geq \langle \phi, x\rangle$$

for all $\phi \in E$ and $x \in \operatorname{dom} f$ provided $f\colon E \to (-\infty, +\infty]$. The basic properties of convex functions are discussed in depth and there are numerous informed examples and problems — some straightforward and some challenging. The approach is clear and concise but also recognizes the later need for a more general view. Thus, for instance, we have — early on — the definition of a *balanced* set and a preliminary discussion about the broader significance of norms in Banach space. The *Minkowski functional* is introduced too and there is a Euclidean space version of the Hahn–Banach theorem. The Fenchel–Young inequality and the Fenchel duality theorem are perhaps the main focus while other key results such as the Fan minimax theorem and proof are presented (with some hints from the authors and some serious thinking required by the reader) in the many exercises. There are exercises on a classical maximum entropy problem and the generalized Steiner problem. There is an in-depth discussion of conjugate functions and Fenchel duality leading on to a Sandwich theorem and various other separation theorems. Differentiation of convex functions is investigated exhaustively and culminates in a famous Alexandrov theorem *that every convex function $f\colon \mathbb{R}^n \to \mathbb{R}$ has a second-order Taylor expansion almost everywhere.*

Chapter 3 studies the finer structure of Euclidean spaces. The first topic embraces polyhedral convex sets and functions. The definitions come thick and fast here and we quickly arrive at the key theorem of polyhedrality *that a convex set or function is polyhedral if and only if it is finitely generated.* The algebra of polyhedral functions under linear transformation is outlined and the fundamental theorems on Fenchel duality are adapted to polyhedral functions. Another theme is the study of functions of eigenvalues. I need to outline some definitions to impart a sense of what this is all about. Define $\mathbb{R}^n_+ = [0, +\infty)^n$ and $\mathbb{R}^n_{++} = (0, +\infty)^n$. Let S^n denote the set of real $n \times n$ symmetric matrices with subsets S^n_+ and S^n_{++} of positive semidefinite and positive definite matrices respectively. There is a partial order on S^n written as $X \preceq Y$ if $X, Y \in S^n$ and $Y - X \in S^n_+$. The mapping $\lambda\colon S^n \to \mathbb{R}^n$ is defined by the vector $\lambda(A) \in \mathbb{R}^n$ whose components are the eigenvalues of A in nonincreasing order. The space S^n becomes a Euclidean space with the definition $\langle X, Y\rangle = \mathrm{tr}(XY)$ where $\mathrm{tr}(A)$ denotes the trace of A. The key to this study of functions of eigenvalues is Fan's theorem that *all real symmetric matrices* $X, Y \in S^n$ *satisfy the inequality*

$$\mathrm{tr}(XY) \le \lambda(X)^T \lambda(Y) \Leftrightarrow \langle X, Y\rangle \le \langle \lambda(X), \lambda(Y)\rangle$$

with equality if and only if there is a simultaneous ordered spectral decomposition defined by an orthogonal matrix U *such that* $X = U^T[\mathrm{diag}\,\lambda(X)]U$ *and* $Y = U^T[\mathrm{diag}\,\lambda(Y)]U$. A special case yields the classical inequality $x^T y \le [x]^T[y]$ where $x, y \in \mathbb{R}^n$ and $[x]$ denotes the vector obtained from x by rearranging the components into nonincreasing order. Now we can say that $f\colon \mathbb{R}^n \to \mathbb{R}$ is *symmetric* if $f(x) = f([x])$. These definitions enable the authors to state some beautiful and fascinating results. First is a result about barriers. *The functions* $lb\colon \mathbb{R}^n \to (-\infty, +\infty]$ *and* $ld\colon S^n \to (-\infty, +\infty]$ *defined by*

$$lb(x) := \begin{cases} -\sum_{i=1}^n \log x_i & \text{if } x \in \mathbb{R}^n_{++} \\ +\infty & \text{otherwise} \end{cases}$$

and

$$ld(X) := \begin{cases} -\log\det X & \text{if } X \in S^n_{++} \\ +\infty & \text{otherwise} \end{cases}$$

are essentially smooth and strictly convex on their domains and they satisfy the conjugacy relations $lb^*(x) = lb(-x) - n$ *for all* $x \in \mathbb{R}^n_+$ *and* $ld^*(X) = ld(-X) - n$ *for all* $X \in S^n_+$. The vector and matrix examples can be related through the identities

$$\delta_{S^n_+} = \delta_{\mathbb{R}^n_+} \circ \lambda \quad \text{and} \quad ld = lb \circ \lambda.$$

Second is a theorem about spectral conjugacy. *If* $f\colon \mathbb{R}^n \to [-\infty, +\infty]$ *is a symmetric function it satisfies the formula* $(f \circ \lambda)^* = f^* \circ \lambda$. Next are a sequence of interesting corollaries on spectral functions, symmetry and convexity.

The authors move on to talk about linear and semidefinite programming duality and to present some results concerning selection and fixed point theorems. The chapter concludes with a section that looks *into the infinite.* The idea is to present the Euclidean space *avatars* of some important results from later chapters that are usually stated in more general settings — locally convex spaces, normed spaces, Banach spaces and Hilbert spaces. These include the Ekeland variational principle and some well-known results about convex functions as well as a brief introduction to the remarkable *Fitzpatrick function* $\mathcal{F}_T\colon E \times E \to \mathbb{R}$ defined for a multifunction T by the formula

$$\mathcal{F}_T(x, x^*) := \sup\{\langle x, y^*\rangle + \langle x^*, y\rangle - \langle y, y^*\rangle \mid y^* \in T(y)\}.$$

As a final note the authors provide a guide on *how to browse in the rest of the book.*

I will not describe the rest of the book in detail. The essence of the story has already been told. Suffice it to say that what remains — and there is a vast amount that does remain — is as much a reference library as it is a story, with a plethora of extensions, intricacies and exceptions. The chapter titles are *Convex functions on Banach spaces* where my old favourite Conditonal Value-at-Risk (CVaR) makes a guest appearance in Problem 4.4.24; *Duality between smoothness and strict convexity*; *Further analytic topics* which includes sections on multifunctions and monotone operators, an introduction to epigraphical convergence, convex integral functions, strongly rotund functions, trace class convex spectral functions, deeper support structures, and convex functions on normed lattices; *Barriers and Legendre functions*; *Convex functions and classifications of Banach spaces*; *Monotone operators and the Fitzpatrick function*; and lastly some *Further remarks and notes* where the authors examine the role of finite dimensionality and ponder the essential differences between convex functions on Euclidean, Hilbert and Banach spaces. More information with additional notes, some solutions and errata can be found at http://carma.newcastle.edu.au/ConvexFunctions/.

This is a comprehensive reference book from two experts in the field. Those parts that I have read in detail are concisely written and informative but also interesting and challenging. I cannot easily imagine a better book on this topic. It should become an indispensable reference work for both experts on convex functions and those of us who simply wish to apply and briefly understand these remarkable results from time to time.

Phil Howlett
Division of Information Technology, Engineering and the Environment, University of South Australia, Mawson Lakes Blvd, Mawson Lakes, SA 5095. Email: Phil.Howlett@unisa.edu.au

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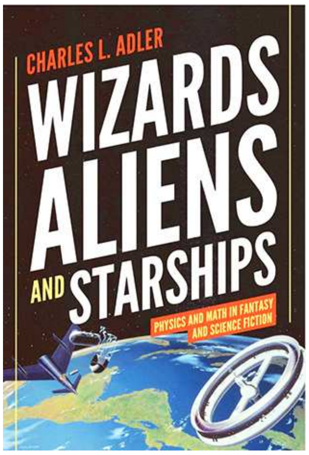
Wizards, Aliens and Starships

Charles L. Adler
Princeton University Press, 2014, ISBN 978-0-691-14715-4
Also available in eBook (ISBN 978-1-400-84836-2)

Adler states that his purpose is to give a scientific critique of science fiction, focussing on the physics and mathematics. This book delivers on part of its promise: it does indeed discuss the physics and science of some science fiction and even fantasy standards. As far as maths goes, it is just the basic algebra needed to apply some physics formulae — occasionally the calculus behind it is discussed.

The choice of physics topics captures the main themes from science fiction, and throws in a few from fantasy as well, largely drawn from the Harry Potter books. While specifically staying away from movies and television, he does mention several, such as Star Trek and Star Wars.

The book starts with a discussion of the physics behind the Potter books, which gets the book rolling with its basic technique: check the energy requirements. Shape-changing is limited by conservation of mass (at least), dragons can't reasonably fly (metabolic rate versus power requirements), time travel causes no ends of trouble, and so on. The chapter ends, oddly enough, with a long discussion about the dimness of candles compared to daylight and electric bulbs.



The book then settles down to science fiction proper. Topics covered are space travel, living and building in space, other habitable planets, aliens, the future of the Earth, humanity, and even the universe. This is good solid stuff, and the physics is discussed in enough detail to enjoy the borderlines of the plausible (space elevators and the Orion project) and the wildly unlikely flights of fancy (Ringworld).

The examples are drawn, almost exclusively, from the Golden Age of science fiction (1940–1960 or so, Asimov, Niven, Clarke, Heinlein, . . .) and a few books of the early twentieth century (mostly Stapledon). A couple of references to William Gibson and Greg Bear (and J.K. Rowling!) are the only exceptions. The focus on the Golden Age creates notable omissions, such as Frank Herbert and Iain Banks.

The book, and the extra problems available at the website, provide easy access to discussions of the rocket equation, twin paradox, wormholes and so on. Due to the format, these discussions will all require some effort to supplement, which is good. The equations are tested on real world numbers, often with much changing of units: tedious, but honest physics. The book skips from topic to topic quite quickly, which makes it much better to dip into than to read through. The editing is very uneven.

The main problem with this text for teaching physics is that the Golden Age of science fiction is now 50 years ago, and the examples almost certainly lack resonance for our students, though the topics still stand up. Even worse, these days much of the best science fiction is not even in books: movies, television and increasingly games like Halo and Destiny are where people pick up their science fiction.

Overall, I think this book is a handy reference for those interested in the science of science fiction. The good fun ideas are in the science fiction, with the science deployed to analyse it very workmanlike and a bit repetitive. The advantage is that the maths required and used is minimal, so that much of the text is accessible for first year physics students — nothing here for the maths students though.

Adam Rennie
School of Mathematics and Applied Statistics, University of Wollongong, Wollongong, NSW 2522.
Email address: renniea@uow.edu.au

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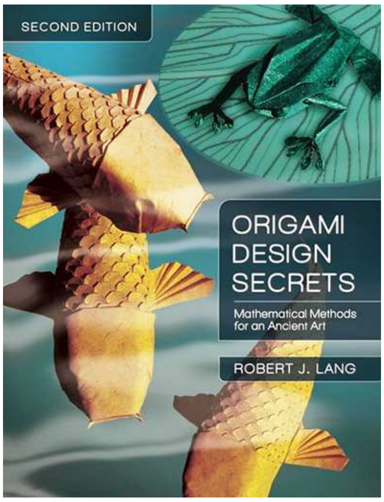
Origami Design Secrets

Robert J. Lang
A.K Peters, 2011, ISBN 978-1-568-81436-0

Introduction: Origami then and now

We may all recall folding little figures out of paper when we were younger: simple representations of animals and plants; maybe a few geometric shapes. The art of origami (the word comes from the Japanese for 'paper folding') has a long and honourable history in Japan (although it seems to have originated in China), mainly as a folk art. There are different traditions of origami, some allowing for cutting and pasting, or for non-square shapes of paper, but what we might call 'classical origami' uses a single uncut square.

Origami was long constrained by the fact that a square has four vertices. This meant that any figure crafted using origami principles would only have four 'points'. A bird, for example, may have a head and tail and two legs, or a head and tail and two wings, but never head, tail, wings and legs together, as that would require six points. A quadruped — a horse for example — might be designed with only a single back leg, and some sort of rough squeezing about the head to indicate ears. Even with these constraints, folds could be used to great effect to indicate the shape of an animal, or some aspect of its behaviour. Precise verisimilitude was seen as unnecessary, and even by some as being inimical to the art.



However, concurrently with simple folding there was an undercurrent of a more serious formal approach, led in Japan by the great origami master Akira Yoshizawa (1911–2005). In his long career Yoshizawa created many thousands of models, from the simple to the enormously intricate, developing along the way techniques which made it possible to move beyond the simple four points to a greater representational exactness. Yoshizawa inspired other folders around the world, especially in the UK and the USA, and from the 1970s onwards there was a huge outpouring of origami models, with folders outdoing each other in the complexity of their designs.

Insects and other arthropods, long considered impossible as origami subjects due to their many legs, antennae, and other various pointy bits, have become favorites as models, and now there is a vast origami entomological bestiary, with models having the requisite number of legs (six), antennae (two), and any other points required by the species. Some insects, as well as legs and antennae, have (double) wings. Birds now have two legs (often with individual claws), sweeping tails, heads, and even in at least one example, wings with separate feathers. Quadrupeds have all their legs, and tails, heads with ears, and anything else. Elephants have always been popular origami subjects, owing to the fact that their shape and bulk makes them easily recognizable. No modern folders worth their salt would dare to produce an elephant now with any less than four legs, a tail, a trunk, large flaps for ears, and tusks. And of course folders scorn the use of cutting, pasting, or using more than one sheet of paper. A model must start from a single square.

Possibly the most complex model in existence is a dragon by the Japanese artist Satoshi Kamiya, which includes a body covered with scales, four legs (all with long curving claws), a multi-horned head (with an open mouth and tongue), all folded from one (very large) uncut square, and which took several hundred hours to complete.

However, remarkable and astonishing as modern creations may be, origami is more than folding animals, and finding new ways to conjure points out of nowhere. It has become a serious applicable discipline, with applications including the folding and deployment of car air-bags; the folding and deployment of solar sails or telescopes on satellites; the folding of DNA molecules in order to provide transport of drugs to particular cells (for example cancerous cells, while leaving non-cancerous cells alone); the folding of arterial stents for easier delivery and use — the list goes on.

The third aspect of origami is its theory, to which its main contributor is Erik Demaine at MIT (who is the youngest ever professor to be appointed there), and who has raised the theory of origami to very respectable mathematical heights. In a mathematical sense origami theory may be considered a part of computational geometry, but like all theories, it has a character uniquely its own. Theorists concern themselves with considering, for example, if paper is folded, what constructions are possible? General angle trisections are almost trivial, as is the construction of non-euclidean lengths such as $\sqrt[3]{2}$. There is a collection of axioms: the Huzita–Hatori–Justin axioms, which precisely characterise the allowable folds: a point onto another point, a line onto a line, and so on. Quadratic, cubic and quartic equations with rational coefficients can be solved by origami constructions. There are also other questions: what are the conditions for folds to lie flat? What are the principles which allow a certain shape to be made? One of Demaine's earliest results is the 'fold and cut theorem', which says that any collection of straight line cuts in a piece of paper can be made by appropriately folding the paper first, and then cutting the folded paper with one straight cut.

Origami has evolved from its humble folk beginnings into a subtle art, an important area of applications, and with an impressive theory.

The book

Robert Lang has been at the forefront of both the art and its theory now for several decades, and is recognized internationally as a master folder. He has worked as an academic physicist, but now spends all his time working as an origami artist and consultant. He is one of the people involved in the car air-bags study mentioned above.

This is the second edition of a book initially published in 2003, and which differs from the first edition in having some more models, and one chapter removed. This chapter, which is available on Lang's website, contains only mathematics, and while its removal may be a disappointment to the readers of the AustMS *Gazette*, Lang claims that 'most people would not be interested in big, hairy equations'.

The book is primarily about the theory which makes the design of complex models possible. Clearly models of the complexity of an insect, or of Kamiya's dragon, can't be created by simply fiddlin' with a bit of paper and hoping for the best. Such models must be carefully designed first, and this book is an exploration of various methods which can be used to realize a particular shape starting with a single square. This design-oriented approach to origami is known in Japan as 'origami sekkei'; that is: 'technical origami'. This name is possibly a misnomer, as 'technical' sounds somewhat dry and pedantic, and yet the models produced are often of astonishing beauty.

The book starts and ends with elephants: first a page showing a 'herd' of 32 different origami elephants, from the very simple four-point variety (with a single rear leg) to some highly detailed modern examples, including one of Lang's own. The book ends with the folding instructions for Lang's elephant. Lang delightfully points out that in fact anatomical precision is not necessary for an origami model, and gives as an example a sort of 'zen' elephant in which the animal's likeness has been reduced to an extreme simplicity of form — with just one fold!

Although the book does not contain much formal mathematics in the sense of equations, theorems, and proofs (although there are some equations), the sense of the book is very mathematical, and much of terminology has mathematical antecedents.

The first few chapters discuss basic origami: the notation and symbols used for diagrams (developed by Yoshizawa, extended by other folders, and now universal), and the use of simple 'bases'. In origami, a 'base' is the result of several folds into a form which can be used to create different models. Bases are named after their most famous models, thus the 'bird base', 'frog base' and so on. Bases were fundamental to much classical origami, and they have a new lease of life in this book. Chapter 4 uses the standard bases in highly non-standard ways to produce some remarkable models, for which full folding instructions are given: a stealth fighter, a snail (with a lovely shell), a valentine (heart with arrow through it), a ruby-throated hummingbird (in which the colours on the different sides of the paper are cleverly used), and a sitting baby.

Chapters 5–14 introduce the techniques of origami sekkei: Splitting Points, Grafting, Pattern Grafting, Tiling, Circle Packing, Molecules, Tree Theory, Box Pleating, Uniaxial Box Pleating, and Polygon Packing. The book finishes with Chapter 15: Hybrid Bases, in which Lang discusses the design of models which don't have masses of points but which may include large flat areas, such as butterfly wings. Each chapter begins with an essay describing the technique and its uses, then gives some simple examples (with numerous diagrams), showing how it might be used in practice, and then finishes off with the folding instructions for various models illustrating the technique. As to be expected, in this book the models are mostly complex, although there are a few which are within the purview of the intermediate folder. One such model, in Chapter 9, Circle Packing — is an emu!

As example chapters, take Chapters 9 and 10: Circle Packing, and Molecules. Points in a model, if not folded from the square's corners, must come from the middle somewhere. When the model is unfolded, the resulting pattern of creases on the paper, known not surprisingly as a 'crease pattern', will show a local radial symmetry about the positions of the model's points. A model may therefore be designed by first placing circles of the right size on the square: the centres of the circles will end up as points in the model; the lengths of radii indicating the lengths of those points. For efficiency it will be necessary to align the circles so that they are mutually tangential; this is in fact a difficult computational procedure (see the Addendum below), and Lang provides a neat method of doing this with 'jigs' (cardboard circles with upturned drawing pins through their centres), and two L-shaped rulers to make the square. It would be interesting to see if Lang's jig method could be realized with dynamic geometry software or a computer algebra system, but this seems to be an area as yet unexplored. The emu is given as an example of offsetting the centre of the bird base so as to obtain a longer neck.

Chapter 10 again has lots of circles — and in passing one of the book's many excellent aspects is the manner on which chapters build on previous material — but in this chapter Lang looks at how folds can be made so that their edges line up. With a triangle this is trivial, for a convex quadrilateral Lang shows that such a fold is possible if and only if the sums of opposite sides are equal. Although this could be stated and proved as a formal theorem, it is not given as such, as this text is not designed for mathematicians, but for origami artists and designers. Such elements of a fold are called 'molecules' (and so named by another folder, the Japanese Toshiyuki Meguro, who is a biochemist). Lang claims that: 'By enumerating and identifying the molecules of origami, we will develop the building blocks of origami life'. Lang then enumerates different molecules, and describes how molecules can be used in that part of a design between the circles: places Lang refers to as 'rivers'. The combination of circles and rivers can be used to create extraordinarily complex models, in particular arthropods, and one of this chapter's two models is a silverfish, with six legs, two antennae, two palps (appendages next to the antennae which are used for tasting and manipulating food), three long tail segments (which are formally called 'cerci') plus two other rear appendages, as well as a tapering scaly body. That's fifteen points!

Some of the books most complex models are not given as a sequence of folding instructions, but as crease patterns, which illustrate the design elements introduced earlier in the book. These models are all insects and arachnids, and as you would expect, contain points galore. One insect, a 'Euthysanius Beetle', as well as having two tarsal claws on each leg, has combed antennae. The result is a tour-de-force of origami. (And so are all the others.)

Who is this book for?

Although this is not a formal mathematics book as such, it has immense mathematical appeal. The intricacy of the diagrams and models alone, along with the careful theory which underlies their design, make for an enticing book. Even if you never make any of the models, you can admire them. If you have played around with some simple origami and would like to advance your skills — both as a folder and designer — this book is a cornucopia of good things. You may not necessarily become a virtuoso folder like Lang, any more than reading through a book of music theory will turn you into Mozart, but you will certainly advance both your folding and design skills, and maybe create some lovely models of your own. And in doing so, you may be quietly entering the enticing world that is origami sekkei.

Addendum

Because this book is not a mathematics text, it does not mention a remarkable result proved in 2010 by Lang, Demaine, and Sándor Fekete: that the design of a crease pattern, in particular the placing of circles into a square, is NP-hard. So not only is origami difficult to do, it is computationally intractable!

Alasdair McAndrew
College of Engineering and Science, Victoria University, PO Box 14428, Melbourne, VIC 8001.
Email address: Alasdair.McAndrew@vu.edu.au

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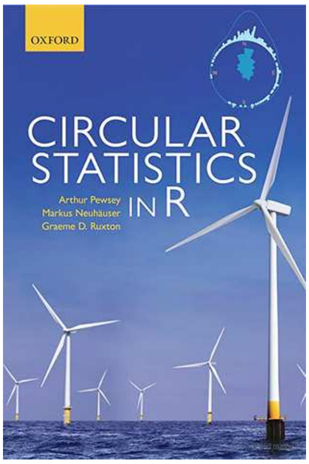
Circular statistics in R

Arthur Pewsey, Markus Neuhäuser and Graeme D. Ruxton
Oxford University Press, 2013, ISBN 978-0-19-967113-7

Directional, and in particular circular, statistics date back to Fisher and von Mises who were the first ones to develop ideas for such data. Applications of such methods can be found especially in ecology, geology and seismology, or earth sciences as a whole.

I was glad to read a book in circular statistics, which focuses on real data examples and it contains R functions. N.I. Fisher's *Statistical Analysis of Circular Data*, E. Batschelet's *Circular Statistics in Biology* and *Topics in Circular Statistics* by S.R. Jammalamadaka and A. SenGupta are three other books specifically focused on circular statistics but they either lack or have very few examples with statistical software within the book.

The book is suitable for postgraduate students in statistics or mathematics or related fields (with knowledge in statistics). This book is a useful companion for Fisher's book (*Statistical Analysis of Circular Data*). It is not a very introductory book for circular statistics though (it does not start from scratch, or contain a lot of theory to begin with), but on the other hand the fact that it's not very technical and it contains a lot of R functions is what makes it suitable for practitioners as well. So I would say there is a good balance between mathematics and R functions.



The first chapter contains a long introduction, which is nicely written and informative. The next two chapters describe graphs and descriptive statistics for circular data, with not many technicalities. Chapter 4 contains a list of circular distributions but again with not many details, even though this could be a drawback, since in some cases the mean direction and the circular variance are not provided. The remaining chapters go deeper into the field but again with not too many technicalities: hypothesis testing, model fitting, correlation and regression are discussed.

In most cases, an R library is used extensively, but in many cases the authors provide some of their own R functions. This is a good feature of the book. The interested reader may try to write his own functions and compare the results with the available ones. The practitioner who wants to analyse some circular data without having to write his own functions or search on the internet for functions, is good to go. The authors have made all their programs available online. The data however are not, and perhaps they could upload them also, at some point. To be honest it took me some time to understand how the front page relates to circular data, wind mills generating electric energy. Wind speed is measured in degrees, so here you are, circular data. A drawback of the book I found is that the fonts are too small. My sight is not the best, so I needed some time for my eyes to get used to these fonts. The book consists of only 172 pages in total and this is an attractive feature and the examples used to illustrate the analyses come from real life. It's like a short manual for circular data analysis. I would like to see a similar book for spherical data as well.

Michail Tsagris
School of Mathematical Sciences, University of Nottingham, UK.
Email: michail.tsagris@nottingham.ac.uk

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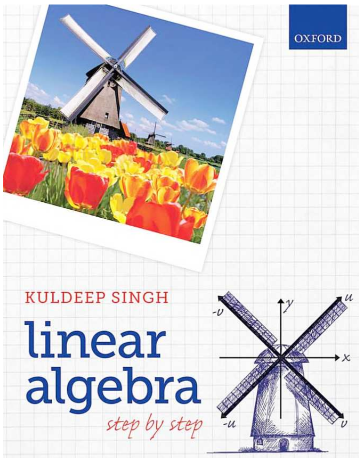
Linear Algebra: Step by Step

Kuldeep Singh
Oxford University Press, 2013, ISBN 978-0-199-65444-4 (paperback)

Linear algebra is an important subject not only to mathematicians but also to an ever widening range of disciplines. Time and time again authors note, typically in their text's preface, that in the old days only mathematics and physics majors would be in a foundation linear algebra course. Now, however, due to the wonders of the computing age, various aspects of linear algebra have found application in diverse areas which in turn means that the neophytes of other departments can be seen attending linear algebra 101.

The effect of the broader audience is reinforced by the trend of lower levels of mathematical preparedness students have after finishing high school. It is with today's 'average' student that Kuldeep Singh, senior lecturer in mathematics at the University of Hertfordshire, has written his undergraduate text *Linear Algebra: Step by Step* (LASBS). Singh's goal is to assume only a limited mathematical background while still covering difficult material and to present it in such a way that students are able to learn on their own without the constant support of lecturer or tutor.



Like many texts in linear algebra, this one begins with systems of linear equations and uses that as an obvious vehicle to introduce matrices and Gaussian elimination. Matrix algebra, elementary matrices, and inverses follow. Vectors in $\mathbb{R}^2$ and $\mathbb{R}^3$ form the topic of the next chapter together with linear independence, basis and spanning sets. General vector spaces are delayed until the third chapter where many early concepts are revisited. Inner products are covered in Chapter 4 followed by linear transformations. The text is rounded out with chapters on determinants and eigenvalues/vectors finished with sections on LU decomposition and singular value decomposition respectively. Between chapters is an interview with an academic or industrial scientist who uses linear algebra in their research. Scattered throughout the text are biographical notes on famous mathematicians who had an impact on linear algebra.

LASBS is an aesthetically pleasing and relatively cheap textbook (under $55) of 608 pages. It is a much more inviting read than Singh's earlier *Engineering Mathematics Through Applications* and the more challenging content isn't infected with a rash of Greek symbols or dense prose which can put off anyone let alone Singh's target audience of so-called 'average' students. The usual exercise style of questions end sections with brief solutions contained in the book. (The student can go on-line to the LASBS website for full worked solutions and additional material.) More challenging questions are taken from the exam papers from various universities around the world with the idea of extending the student and building their confidence. The idea being that if they can solve an exam question from 'insert name of famous institution here' then they are making progress.

Importantly, throughout the text questions are posed to the student in blue font which are then promptly answered. While many authors pose the question 'why?' after some statement to encourage thought on the topic at hand it appears to me that Singh is more concerned with making questions like 'What does this definition mean?', 'How could we prove this statement?', 'Can the statement be generalised?', 'When is this valid?' common place and showing the 'average' student that they should be asking these questions and how they might answer the questions for themselves. Questioning the content is important but quite a rare activity amongst students in my experience who seem to focus more on calculation and getting an 'answer'.

With LASBS I believe Singh succeeds starting off with a low expected background and building in abstract topics such as vector spaces and generalised inner products. I'm somewhat sceptical of Singh's claim that students will be able to take all this in on their own. Perhaps a better than average student with an interest in mathematics could but the target students, particularly if maths is not their primary focus, are going to be less inclined to read on their own and more inclined to jumping straight to this week's assignment questions. Getting such students reading and thinking about the text in blue font is where the instructors come in.

There are no chapters on numerical methods or on common packages such as MATLAB which some may see as bad. I'm inclined to see it as a positive as LASBS keeps the focus on understanding the mathematics rather than calculating. Depending on the scope of your course or time constraints you may wish to drop the harder material — at least the first time round — and LASBS allows this by having chapters mainly self-contained.

If you don't already have you own set of notes or a favourite text to set students LASBS is definitely worth considering, particularly if you are wanting to ease students towards more abstract topics.

Isaac Towers
School of Physical, Environmental and Mathematical Sciences, UNSW Canberra at the Australian Defence Force Academy, PO Box 7916, Canberra, ACT 2610.
Email: i.towers@adfa.edu.au

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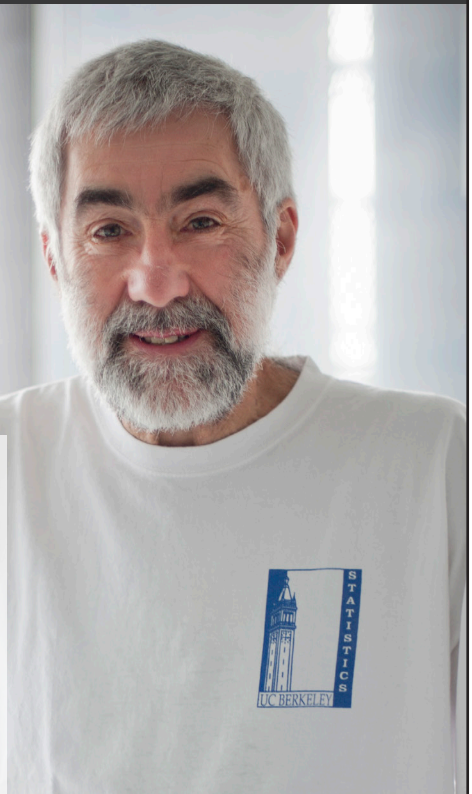
Research & Higher Education
Australian Mathematical Sciences Institute

2014
AMSI-SSAI Lecturer

Professor Terry Speed



Touring Australia between August & October 2014

Professor Terry Speed, winner of the 2013 Prime Minister's Prize for Science will be touring Australia between August and October to deliver a range of public lectures and specialised seminars to the general public and the wider research community.

"Terry has a truly remarkable track record. It extends beyond extraordinary personal research achievement as one of the world's most cited mathematicians to visionary leadership of an entire research endeavour. He is also terrific in front of an audience and so we are delighted that he will be the 2014 AMSI-SSAI Lecturer."

- Geoff Prince, AMSI Director

The AMSI Lecture tour, held in biannual partnership with the Statistical Society of Australia (SSAI) and Australia and New Zealand Industrial and Applied Mathematics (ANZIAM), gives the research community and the general public an opportunity to hear top academics in the fields of both pure and applied mathematics speak about their research.

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Maths of Planet Earth

www.amsi.org.au/speed

NCMS News

Nalini Joshi*

On Tuesday 25 March 2014, the Academy held a meeting of Chairs of all National Committees for Science. You probably think I am odd, but I found it an uplifting exercise. Since mathematics does not exist in isolation from the sciences, I wanted to describe some of the issues from this meeting, as well as the ensuing strategies and proposed actions that inspired me.

The Academy did well not only in bringing Chairs of the 22 National Committees together, but making sure that the challenges and ideas arising from each discipline area were heard by all. The meeting of all Chairs used to be an annual affair but this one was held over for three years until the recent review of National Committees was finished. So there was a lot to say and to hear.

It was interesting to note that seven committee chairs stated an interest in developing a new decadal plan: (i) Agriculture, Fisheries and Food, (ii) Astronomy (this will be their third one), (iii) Chemistry, (iv) Earth Sciences, (v) Geographical Science, (vi) Information and Communication Sciences and (vii) Materials Science. Of the two that completed a decadal plan recently, Space & Radio Science intends to carry out a mid-term review and Physics is developing an implementation plan.

I heard for the first time about other promising initiatives based on individual characteristics of each scientific area. Agriculture, Fisheries and Food is working on a white paper on Australia's agricultural competitiveness. Antarctic Research is planning a major cultural event in 2015 called 'Pure Antarctic' to improve awareness of Australian Antarctic Science. Biomedical Sciences is promoting education through CUBEnet — a network of biomedical science educators and advocacy to government agencies. Brain and Mind intends to develop a website to facilitate information exchange between brain imaging centres in Australasia. Cellular and Developmental Biology is considering a position paper on stem cell research and applications along with a possible Q&A booklet to reach the public. Chemistry is concerned about the accreditation process for chemistry teachers and weighing up different options. Crystallography is celebrating the International Year of Crystallography by facilitating photography and art exhibitions and crystal growing competitions, as well as organising commemorative Australian postage stamps of the first five Australian Nobel Laureates. Data in Science plans to develop a policy paper to help realise a culture of open data in Australian science. History and Philosophy of Science focuses on communication through biennial essay competitions and a workshop on current issues. Mechanical and Engineering Sciences has established the John Booker medal for Engineering Sciences. Nutrition undertakes public and scientific awareness campaigns focusing on one or two crucial issues per

*Chair, National Committee for Mathematical Sciences, School of Mathematics and Statistics F07, The University of Sydney, NSW 2006, Australia. Email: nalini.joshi@sydney.edu.au

year. Physics will be participating in outreach activities for the International Year of Light in 2015.

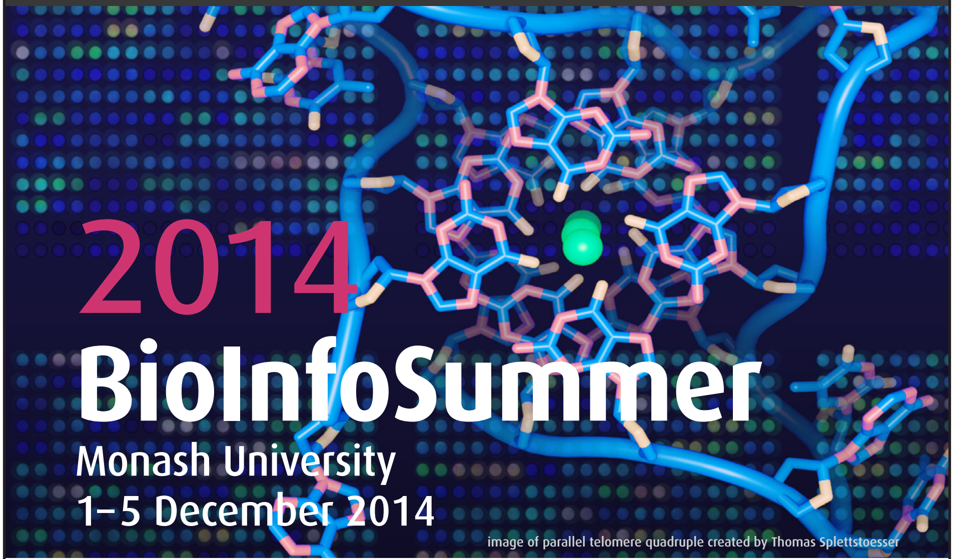
Imagine doing all of this for the mathematical sciences. First, how are we doing on postage stamps? It seems the golden decade of Australian mathematical stamps occurred in the 1970s. To the best of my knowledge, Australia issued five postage stamps that feature mathematics: abacus, 1972; best fit curve, 1976; golden section, 1972; graphs, 1974; metric system, 1973. But alas, no postage stamp was issued to celebrate Terry Tao's Fields medal.

Second, in 2013, generous support by AMSI enabled a year-long celebration of the Mathematics of Planet Earth program in Australia. But in general, our public campaigns to raise awareness about mathematics have focused on low achievements in international tests, the scarcity of teachers qualified in mathematics and poor funding levels for mathematics departments in universities. It would be good to reflect on why our efforts in the media do not tend to focus on more positive, enjoyable and affirming aspects of mathematical sciences in a way that is accessible to the general public.

At the Chairs of National Committees meeting, we also heard from the Academy's Early- and Mid-Career Researchers (EMCR) Forum. This spectacularly energetic group with over 3000 members publishes a regular newsletter called 'Early Days', and holds national meetings called 'Science Pathways'. While it has so far tended to attract members in the medical and engineering sciences, it is keen to involve EMCRs from a wider range of disciplines. An EMCR participates as an intern on many of the National Committees. We recently enlarged the group of observers on the National Committee for Mathematical Sciences to include an earlier-career researcher and are about to appoint a new EMCR as an observer. Please encourage keen early- and mid-career mathematical researchers to sign up at http://www.sciencearchive.org.au/ecr/ecrlist.html.

Nalini Joshi is an ARC Georgina Sweet Laureate Fellow and the Chair of Applied Mathematics at The University of Sydney. She was the President of the Australian Mathematical Society during 2008–2010, elected a Fellow of the Australian Academy of Science in 2008, became the Chair of the National Committee of Mathematical Sciences in 2011, and was elected to the Council of the Australian Academy of Science in 2012.

Research & Higher Education
Australian Mathematical Sciences Institute



2014 BioInfoSummer

Monash University
1–5 December 2014

image of parallel telomere quadruple created by Thomas Splettstoesser

Bioinformatics is an exciting, fast-moving area analysing and simulating the structures and processes of biological systems. BioInfoSummer introduces students, researchers and others working in related areas to the discipline.

The program features:

- Introduction to molecular biosciences and bioinformatics
- Next-generation DNA sequencing and sequence evolution
- High-throughput technology and omics data analysis
- Methods in bioinformatics
- Systems biology

Speakers include:

Prof. Gordon Smyth
Walter and Eliza Hall Institute

Prof. Mark Ragan
Institute for Molecular Bioscience

Prof. Kate Smith-Miles
MAXIMA

Register your interest for BioInfoSummer 2014

AMSI Australian Mathematical Sciences Institute
Australian Government Department of Education
Monash University
EMBL Australia
Bioplatforms Australia
AMSIIntern
maxima maximising impact through mathematics
Maths of Planet Earth
Australian Bioinformatics Network

Register www.amsi.org.au/BIS

AMSI News

Geoff Prince*

2014 Discipline Profile and Policy Brief released

This year's AMSI Discipline Profile of the Mathematical Sciences got off to a flying start with two very good pieces in the *Australian Financial Review* by Joanna Mather around gender and out-of-field teaching. So good in fact that I did four radio interviews on 10 June after stepping off a plane from Brussels.

The headline trends in the Profile are as follows.

- Regional and socio-economic inequality in the mathematical performance of school students is worsening.
- Australia's international position in school mathematics performance has declined sharply.
- Year 12 advanced maths enrolments have dropped by 22% from 2000 to 2012 and by 34% from 1995 to 2012.
- 40% of Year 7–10 maths classes are without a qualified mathematics teacher, roughly three times the international average and roughly twice the estimated rate for Year 7–10 science classes.
- 54% of Australian adults have only basic numeracy skills at best, below the OECD average.
- Undergraduate and postgraduate enrolments in mathematics and statistics have been stagnant for the last three years.
- Females make up only 30% of undergraduate and postgraduate enrolments in mathematics.
- International students make up around 35% of all PhD enrolments in the mathematical sciences, with domestic enrolments in decline.
- Australia's graduates PhDs in the mathematical sciences at one of the lowest rates in the OECD and at half the OECD average.
- The mathematical sciences are one of Australia's most successful research disciplines with an international performance comparable to medical research.
- The mathematical sciences has a higher sustained success rate for research grants from the Australian Research Council than any other discipline.

*Australian Mathematical Sciences Institute, Building 161, c/- The University of Melbourne, VIC 3010, Australia. Email: director@amsi.org.au

AMSI's policy brief 'Dealing with Australia's Mathematical Deficit' identifies three key priorities for urgent and sustained action by the various stakeholders, as follows.

Priority A

Train the unqualified teachers of school mathematics and secure the supply of future maths teachers.

Priority B

Reverse the decline in intermediate and advanced maths enrolments at Year 12.

Priority C

Increase the number of girls studying maths and women employed in the quantitative professions.

There should be no doubt about the serious and structural nature of these problems. About 10 years ago, the Deans of Engineering were brought face to face with the decline in Year 12 advanced maths enrolments and made the mistake of dropping prerequisites. Will our university maths and stats departments make a similar mistake and just be reactive? The Group of Eight may now have enough students with advanced and intermediate maths to maintain their third year numbers and they may not have felt the decline in the school situation, but surely we know a straight line when we see one! We all of us have to recognise that we can't be insulated from the appalling situation in so many secondary schools and that female adult numeracy runs so far behind that of males. As I've said so many times 'mathematical illiteracy is disabling'.

At the moment governments and the press are listening, so please join the chorus of voices speaking out about the nation's mathematical deficit.

The documents are at http://www.amsi.org.au/index.php/news/87-news/general-and-outreach-news/1290-discipline-profile-of-the-mathematical-sciences-2014.

I was a Monash undergraduate and took out a La Trobe PhD in 1981 in geometric mechanics and Lie groups. This was followed by a postdoc at the Institute for Advanced Study in Dublin. I've enjoyed teaching at RMIT, UNE and La Trobe. My research interests lie mainly in differential equations, differential geometry and the calculus of variations. I'm a proud Fellow of the Society, currently a Council and Steering Committee Member. I became AMSI director in September 2009.

Research & Higher Education

Australian Mathematical Sciences Institute

2015 Summer School

AMSI Summer School
in the Mathematical Sciences

3–29 January 2015

The University of Newcastle

7 Reasons to Attend:

- **Learn** from Australia's leading mathematicians and statisticians
- **Choose** from a wide range of courses to suit your specialty
- **Gain** credit towards your degree
- **Meet** future employers at the Careers Afternoon
- **Build** your networks at dinners, BBQs and special events
- **Broaden** and deepen your knowledge base with advanced coursework
- **Discover** the latest subjects in your discipline

Full travel and accommodation scholarships available!

AMSI Australian Mathematical Sciences Institute · The University of Newcastle Australia · Australian Government Department of Education · AustMS Australian Mathematical Society · ANZIAM · Maths of Planet Earth

Apply today: www.amsi.org.au/SS

News

General News

Heidelberg Laureate Forum

PhD students Alex Amenta from ANU, Murray Smith from La Trobe, and Michael Brand and Marsha Minchenko from Monash, have been selected to participate in the second Heidelberg Laureate Forum in September 2014. There are just 100 spaces available worldwide for PhD students and early-career researchers in each discipline of mathematics and computer science, so they deserve our congratulations.

The annual Heidelberg Laureate Forum brings together 38 laureates, all winners of either the Abel Prize, the Fields Medal, the Turing Award or the Nevanlinna Prize, for an inspiring week of scientific, social and outreach activities in Heidelberg.

Further details are available at http://www.heidelberg-laureate-forum.org/.

Lift-Off Fellowships

The Australian Mathematical Society Lift-off Fellowships are designed to help recent PhD graduates in Mathematics and Statistics jump-start their career by giving them financial support after they submit their PhD thesis, but before they take up their first postdoctoral position. The Fellowships can be used for living expenses, to attend conferences, for travel and to fund the visits of collaborators. The Lift-off Fellowships are awarded on the basis of academic merit. Applications for the AustMS List-Off Fellowship can be made at any time. To be eligible to apply, applicants must have submitted their PhD thesis for examination within the previous three months. Applications for, and enquiries about, this Fellowship should be sent to Lift-Off@austms.org.au. Full details about the award and the applications process can be found on the AustMS website at http://www.austms.org.au/Lift-Off+Fellowship+information.

Completed PhDs

Australian National University

- Dr Qi-Rui Li, *Regularity of Monge–Ampère type equations arising in optimal transportation*, supervisor: Xu-Jia Wang.
- Dr Griffith Ware, *Uniqueness of norm properties of Calkin algebras*, supervisor: Rick Loy.

Monash

- Dr Marsha Elizabeth Minchenko, *Counting subgraphs of regular graphs using spectral moments*, supervisor: Ian Wanless.

Swinburne University

- Dr Sergio De Luca, *Nanoscale pumping of polar fluids with rotating electric fields*, supervisors: Billy Todd (Swinburne), Peter Daivis (RMIT) and Jesper Hansen (Roskilde University, Denmark),

University of Sydney

- Dr Ivan Guo, *Competitive multi-player stochastic games with applications to multi-person financial contracts*, supervisors: Marek Rutkowski and Christian Ewald.
- Dr Erwin Lobo, *Modelling the role of interclonal cooperativity during early carcinogenesis*, supervisors: Mary Myerscough and James Guy Lyons.
- Dr Ellis Patrick, *Statistical methods for the analysis and interpretation of RNA-Seq data*, supervisors: Jean Yang, Michael Buchley and Uri Keich.

University of Wollongong

- Dr Ahmed Hussein Msmali, *The effect of incomplete mixing in biological and chemical reactors*, supervisors: Mark Nelson and Maureen Edwards.

Awards and other achievements

La Trobe University

- Ms Lucy Ham (Honours in Mathematics) received the 2013 D.M. Myers (University) Medal at her recent graduation.

University of New England

- OLT extension grant: Acquiring and applying a shared meaning of quantitative skills (QS) across core first year science units with a focus on distance education. Jackie Reid, Janelle Wilkes, Trevor Brown and Geoff Hinch. Name of original project: Quantitative Skills (QS) in Science: Curriculum models for the future (2010) Reference ID PP10-1640.

University of New South Wales

- Ian Sloan was elected a Fellow of the newly reinvigorated Royal Society of New South Wales.

University of Newcastle

- Dr Mike Meylan has had an article published in *Nature*. The article 'Storm-induced sea-ice breakup and the implications for ice extent' by A.L. Kohout, M.J.M. Williams, S.M. Dean and M.H. Meylan was published online. The authors show that the propagation of large waves through sea-ice around Antarctica extends much further than previously thought, and demonstrate the relationship between the location of the sea-ice edge and wave height over more than a decade. Congratulations on a fine paper!
- Dr Judy-anne Osborn gave a talk in the Australian Academy of Science 'Science stars of tomorrow' series on 'Tipping the balance towards scientific thinking, via Zombies and Maths'.

University of Wollongong

- On 28 May at the inaugural induction of inductees to the Wollongong Academy of Tertiary Teaching and Learning Excellence (WATTLE), Associate Professor Anne Porter was inducted as a Senior Fellow. Dr Caz Sandison was inducted as a 2014 Octal (Outstanding contribution to teaching and learning) recipient.

Appointments, departures and promotions

Australian National University

MSI staff departures

- Dr Julie Clutterbuck will depart ANU in June to take up a position at Monash. She was working with Professor Ben Andrews.
- Dr Paul Leopardi (was working with Dr Conrad Burden).
- Dr Tarje Bargheer (was working with Dr Vigleik Angeltveit).
- Dr Jian Lu (was working with Prof Xu-Jia Wang).
- Dr Zihua Guo (was working with Prof Thierry Coulhon).

MSI staff arrivals

- Dr Shibing Chen is joining Professor Xu-Jia Wang.
- Dr Qi-Rui Li is joining Professor Xu-Jia Wang.
- Dr Garth Tarr is joining Professor Alan Welsh.
- Dr Feida Jiang is joining Professor Neil Trudinger.

MSI promotions

- Dr Vigleik Angeltveit from B to C.
- Dr Qinian Jin from B to C.
- Dr David Smyth from B to C.
- Prof Ben Andrews from D to E.
- Prof Alex Isaev from D to E.

Emeritus

- Professor John Hutchinson
- Professor Neil Trudinger

La Trobe University

- On 1 July, Dr Luke Prendergast became Head of the Department of Mathematics and Statistics, replacing Associate Professor Grant Cairns who has capably served as acting Head of Department for over a year.

Macquarie University

- Vladimir Gaitsgory was appointed Professor of Mathematics in the Macquarie University Department of Mathematics, commencing 28 March 2014. Vladimir was Strategic Research Professor in Mathematics at Flinders University. His research interests include the study of optimal control of dynamical systems. He has a distinguished track record of publications and ARC grants including a currently held DORA.

Monash University

- Dr Sarada Herke commenced as Research Fellow. Sarada's research interests are graph theory and combinatorial design theory. In particular, graph decompositions, Steiner triple systems and mutually orthogonal Latin squares.
- Dr Daniel Harvey commenced as Research Fellow. Daniel's research interests are in graph structure theory, specifically treewidth, graph minors, graph colouring; graph algorithms.
- Dr Nevena Francetic commenced as Research Fellow. Nevena's research interests are in combinatorial design theory: generalization of covering arrays, graph decompositions, application of probabilistic methods in combinatorial design and applications of designs.
- Dr Carla Ewels commenced as Research Fellow. Carla's main research interests are in Bayesian methods. These include Bayesian modelling, model comparisons, classification, clustering, statistical genetics, data analysis of high-throughput data and Markov chain Monte Carlo methods. Her applied interests are in the field of genetics, health, agriculture and fishery.
- Dr Maria Lugaro, Senior Lecturer in Astrophysics resigned on 30 April 2014 to travel and to take on a new academic position in Europe.

Queensland University of Technology

Recent appointments at QUT are:

- Eleftherios Kirkinis: Lecturer in Applied Mathematics.
- Robyn Araujo: Lecturer in Applied Mathematics.
- Associate Professor Steven Stern: Statistics.

We apologise for incorrectly listing these in the previous issue.

University of Adelaide

- Sarthok Sircar has joined as lecturer in Applied Mathematics.
- Richard Larkang will be working as a research associate with Finnur Larusson.

UNSW Canberra

- Dr Jason Sharples has been promoted to Associate Professor.

University of Newcastle

- Dr Paul Vbrick will be joining the University of Newcastle as a postdoctoral fellow.
- Professor Natashia Boland is leaving the University of Newcastle for a position at Georgia Institute of Technology.
- Professor Martin Savelsburgh is leaving the University of Newcastle for a position at Georgia Institute of Technology.

Conferences and Courses

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

2014 AMSI Winter School on Contemporary Aspects of Cryptography

Date: 7–18 July 2014
Venue: University of Queensland
Web: http://amsi.org.au/WS

Registration is now open for the 2014 AMSI Winter School on Contemporary Aspects of Cryptography. The speaker line-up includes: Professor Alexei Miasnikov (Stevens Institute of Technology) and Professor Tanja Lange (Technische Universiteit Eindhoven).

Workshop on Optimization, Nonlinear Analysis, Randomness and Risk

Date: Saturday 12 July 2014
Venue: CARMA, The University of Newcastle
Web: http://carma.newcastle.edu.au/meetings/risk2014/

GAGTA8: Geometric and Asymptotic Group Theory with Applications

Date: 21–25 July 2014
Venue: Newcastle, Australia
Web: https://sites.google.com/site/gagta8/

For more information, see the website, or *Gazette* 40(5), pp. 353-354.

Workshop in Harmonic Analysis and its Applications

Date: 21–25 July 2014
Venue: Macquarie University
Web: http://rutherglen.science.mq.edu.au/ha2014/

For further details, see the website, or *Gazette* 40(5), p. 354.

Geometric Analysis and Probabilistic Methods in Geometry

Date: 21–25 July 2014
Venue: University of Queensland
Web: http://www.smp.uq.edu.au/GASMG-2014

For further details, see the website, or *Gazette* 41(2), p. 134.

International Congress of Mathematicians

Date: 13–21 August 2014
Venue: Seoul, Korea
Website: http://www.icm2014.org/

For further details, see the website, or *Gazette* 41(1), p. 64.

Robust Statistics and Extremes

Date: 8–11 September 2014
Venue: ANU
Web: http://maths.anu.edu.au/events/robust-statistics-and-extremes

Statistics today is faced with many challenges, especially relating to such topical issues as the analysis of 'big data' through to understanding the complexities of climate change — and many others. Floods, fires, variations in temperature on local through to global scales, etc., have provided impetus for recent vigorous redevelopments of extreme value analysis. Extremely large data sets and high dimensional data now becoming available in genetics, finance, physics, astronomy, and many other areas, have spurred exponential advances in statistical theory and practice with special emphasis on robustness issues, in recent years. The need to analyse large, linked, data sets in health, crime, agriculture, surveys, and industry, just to name a few, has revolutionised our profession. It's an exciting time to be a statistician.

The aim of the Robust Statistics and Extremes (RS&E) conference is to provide an opportunity for researchers to present up-to-date accounts of the present state of the art in the topics of Robust Statistics and Extremes. A number of distinguished speakers, both international and Australian, will give keynote addresses in their areas of interest. Special provision will be made for student participation.

Distinguished invited speakers

- Professor Peter Hall (University of Melbourne)
- Professor Aurore Delaigle (University of Melbourne)
- Professor Debbie Dupuis (Montreal)

- Professor Manuel Febrero-Bande (University De Santiago de Compostela)
- Professor Ana Ferreira (Lisbon, Portugal)
- Dr Luke Prendergast (Latrobe University)
- Professor Elvezio Ronchetti (University of Geneva)
- Professor Matias Salibian-Barrera (University of British Columbia, Canada)

For more information on Robust Statistics and Extremes, see the website, or contact us by email (Admin.research.msi@anu.edu.au) or telephone (02) 6125 2897.

EViMS 2: Effective use of Visualisation in the Mathematical Sciences workshop

Date: 21–23 November 2014
Venue: ANU
Web: http://maths.anu.edu.au/events/effective-use-visualisation-mathematical-sciences-evims-2

New Directions in Fractal Geometry workshop

Date: 24–28 November 2014
Venue: ANU
Web: http://maths.anu.edu.au/events/new-directions-fractal-geometry

CTAC 2014

Date: 1–3 December 2014
Venue: ANU
Web: http://maths.anu.edu.au/events/ctac-2014

CTAC is organised by the special-interest group in computational techniques and applications of ANZIAM, the Australian and New Zealand Industrial and Applied Mathematics Division of the Australian Mathematical Society. The meetings provide an interactive forum for researchers interested in the development and use of computational methods applied to engineering, scientific and other problems. Our aim is to conduct a high-quality conference on computational mathematics; scientific, technical, and industrial applications; and high performance computing. The special themes for the meeting will include:

- Computational fluid dynamics
- Data assimilation
- Optimisation
- Inverse problems

For more information about CTAC 2014 go to the website, or phone/email us on:
E: CTAC2014@anu.edu.au; T: (02) 6125 2897.

BioInfoSummer 2014

Date: 1–5 December 2014
Venue: Monash University (Caulfield Campus), Melbourne
Web: http://www.amsi.org.au/index.php/higher-education/bioinfosummer

Bioinformatics is an exciting, fast-moving area analysing and simulating the structures and processes of biological systems. BioInfoSummer introduces students, researchers and others working in related areas to the discipline.

The program features:

- Introduction to molecular biosciences and bioinformatics
- Next-generation DNA sequencing and sequence evolution
- High-throughput technology and omics data analysis
- Methods in bioinformatics
- Systems biology

38th Australasian Conference on Combinatorial Mathematics and Combinatorial Computing

Date: 1–5 December 2014
Venue: Victoria University of Wellington, New Zealand
Web: http://msor.victoria.ac.nz/Events/38ACCMC

Contributed talks to the 38th ACCMCC will be sought from all areas of discrete and combinatorial mathematics and related areas of computer science. The invited speakers are:

- Mike Atkinson (University of Otago),
- Simeon Ball (Universitat Politécnica de Catalunya),
- Alice Devillers (University of Western Australia),
- Jaroslav Nesetril (Charles University),
- Sergey Norin (McGill University),
- James Oxley (Louisiana State University),
- Andrew Thomason (University of Cambridge),
- Mark Wilson (University of Auckland),
- Stefan van Zwam (Princeton University).

At this stage, the website contains only basic information. Information will be added as we get closer to the start date — so bookmark the page now. A further announcement will be made when registration opens. Queries should be sent to the head of the organising committee, Dillon Mayhew (dillon.mayhew@msor.vuw.ac.nz).

International mathematical conference at the University of Goroka, PNG

Date: 1–5 December 2014
Venue: University of Goroka, PNG
Web: http://icpam-goroka2014.blogspot.com/

The Society has been asked by Samuel Kopamu, President of the PNG Mathematical Society, to help to promote an international mathematical conference at the University of Goroka, which is being hosted by the PNGMS.

Details of the conference and a registration form can be found at
http://icpam-goroka2014.blogspot.com.au/.

The conference is being supported by American Mathematical Society (AMS), European Mathematical Society (EMS) and the African Mathematical Union (AMU) and is advertised at the following sites of AMS, EMS and UOG:
http://www.ams.org/meetings/calendar/2014_nov24-28_papua.html
http://www.euro-math-soc.eu/node/4640
http://icpam-goroka2014.blogspot.com/

8th Australia–New Zealand Mathematics Convention

Date: 8–12 December 2014
Venue: University of Melbourne
Web: http://www.austms2014.ms.unimelb.edu.au/

The combined meeting of the Australian and New Zealand mathematical societies is held every six years, and will next be held at Melbourne University from 8–12 December 2014. It will incorporate the 3rd annual meeting of ANZAMP (the Australian and New Zealand Association of Mathematical Physics).

Confirmed plenary speakers:

- Rosalind Archer (University of Auckland, NZ)
- Mark Gross (University of California, San Diego, USA)
- John Hearn (RMIT, Australia), ANZIAM Lecturer
- Nicolas Monod (École Polytechnique, Switzerland)
- Robert Penner (Caltech, USA and Aarhus, Denmark)
- Jill Pipher (Brown University, USA)
- Nicolai Reshetikhin (University of California, Berkeley, USA)
- Hyam Rubinstein (University of Melbourne, Australia)
- Nina Snaith (University of Bristol, UK), Hanna Neumann lecturer
- Mariel Vazquez (San Francisco State University, USA)

The following Special Sessions are planned as part of the conference:

- Algebra/Combinatorics
- Algebraic Geometry
- Applied Dynamical Systems
- Geometry and Topology
- Groups and Dynamics
- Harmonic Analysis and PDE
- Mathematical Biology
- Mathematics Education
- ANZAMP/Mathematical Physics
- Number Theory
- Operator Algebras/Functional Analysis
- Probability
- Representation Theory

We invite further suggestions from people willing to organise a session. Each registered participant is restricted to talk in at most one special session unless one of the sessions is Mathematics Education. There will be a poster session, continuing a tradition of the NZMS, which may help those who would like to present more than once.

2015 AMSI Summer School

Date: 2–28 January 2015
Venue: University of Newcastle
Web: http://www.amsi.org.au/index.php/higher-education/summer-school

Planning for Summer School 2015 is well underway. You can register for updates via the Summer School website.

ICIAM mini-symposium

Date: 10–14 August 2015
Venue: Beijing, China
Web: http://www.iciam2015.cn/

We encourage you to think about taking part in ICIAM 2015. Arguably, the best way to participate is to be part of a minisymposium, and one way to ensure this is to propose one yourself. The call for minisymposia is now live. A miniysymposium should have at least four speakers, and ideally should be international in scope and speaker locations.

See http://www.iciam2015.cn/Submissions.html for more information.

Visiting mathematicians

Visitors are listed in alphabetical order and details of each visitor are presented in the following format: name of visitor; home institution; dates of visit; principal field of interest; principal host institution; contact for enquiries.

Mogens Bladt; IIMAS-UNAM; 1–15 November 2014; applied probability; SMP at UQ; Leonardo Rojas-Nandayapa

José Blanchet; Columbia University; January 2015; applied probability; SMP at UQ; Leonardo Rojas-Nandayapa

A/Prof Xiyou Cheng; Lanzhou University, China; February 2014 to February 2015; nonlinear analysis; UNE; Yihong Du

Dr Pavel Chigansky; The Hebrew University, Israel; 1 October 2013 to 30 September 2014; probability, stochastic processes, nonlinear filtering, control and stability; MNU; Kais Hamza

Mr Romain Couvreur; École Normale Supérieure, France; 1 February to 1 August 2014; UMB; Paul Pearce

A/Prof Anto Dzhamay; University of Northern Colorado; 22 July to 7 August 2014; applied; USN; Nalini Joshi

Dr Lance Fiondella; University of Massachusetts, USA; April to August 2014; computer science; RMIT; P. Zeephongsekul

Prof Vyacheslav Futorny; University of São Paulo; 30 October to 30 November 2014; pure; USN; Alexander Molev

Dr Ganes Ganesalingam; Massey University, NZ; 1 July 2014 to 30 June 2015; statistics; USN; Shelton Peiris

Dr Nhan Bao Ho; La Trobe University; March to August 2014; combinatorial games and complexity; MNU; Graham Farr

Prof Satoshi Koike; Hyogo University, Japan; 8–23 September 2014; pure; USN; Laurentiu Paunescu

Dr Uwe Leck; University of Wisconsin, USA; July; school level enrichment activities and Extremal Set Theory; CDU; Ian Roberts

Dr Claire Lemarchand; Roskilde University, Denmark; 3.5 weeks starting on 17 June 2014; non-equilibirum molecular dynamics applications; SUT

Prof Weidong Liu; Shanghai Jiao Tong University, China; 6 July to 2 August 2014; statistics; USN; Qiying Wang

Dr Frank Lubeck; RWTH, Aachen; 30 May to 30 June 2014; UWA; Alice Niemeyer and Stephen Glasby

Hou Lvlin; National University of Defense Technology, PR China; 11 November 2013 to 11 November 2014; UWA; Michael Small

Prof Vladimir Matveev; University of Jena, Germany; 23 April to 3 May 2014; differential geometry; LTU; Yuri Nikolayevsky

A/Prof Si Mei; Shanghai Jiaotong University, China; 9 August 2014 to 8 August 15; pure; USN; Andrew Mathas

Kassem Mustapha; King Fahd University of Petroleum and Minerals, Dhahran, Saudi Arabia; 14 June to 14 July 2014; UNSW; Dr Bill Mclean

Andrew Oster; Eastern Washington University, USA; mathematical biology and computational cell biology; UAD; Edward Green

Prof Joon Park; Indiana University, USA; 5–13 July 2014; stats; USN; Qiying Wang

Prof Jessica Purcell; Brigham Young University; 21 December 2013 to 20 August 20 2014; UMB; Craig Hodgson

Prof Aixia Qian; Qufu Normal University, China; December 2013 to December 2014; nonlinear analysis; UNE; Yihong Du

Mr Fazli Rabbi; 31 January to 31 July 2014; stats; USN; Samuel Mueller

Iain Raeburn; 16 June to 2 July; UOW

Dr Csaba Schneider; Federal University of Minas Gerais, Brazil; 6–20 July 2014; UWA; Cheryl Praeger

Ms Thidaporn Seangwattana; Naresuan University, Thailand; 20 September to 20 December 2014; optimisation; FedUni; Alex Kruger

Dr Ratana Srithus; Silpakorn University, Nakhon Pathom, Thailand; 21 May to 17 June 2014; universal algebra and clone theory; LTU; Brian Davey

Tim Steger; 16 June to 17 July 2014; UOW

Dr Anne Thomas; University of Glasgow, UK; 28 July to 8 August 2014; UWA; Michael Giudici

Dr Qian Wang; University of Oxford; 1 March to 31 December 2014; ANU; Markus Hegland

Prof Rabian Wangkeeree; Naresuan University, Thailand; 20–26 September 2014; optimisation; FedUni; Alex Kruger

A/Prof Lei Wei; Jiangsu Normal University, China; February 2014 to February 2015; nonlinear partial differential equations; UNE; Yihong Du

A/Prof Dongsheng Wu; University of Alabama, USA; 17 August to 15 November 2014; stats; USN; Qiying Wang

A/Prof Yuezhu Wu; Changsu Institute of Technology; 1 October 2013 to 30 September 2014; Lie superalgebras; USN; Ruibin Zhang

Mr Panu Yimmuang; Naresuan University, Thailand; 20 September to 20 December 2014; optimisation; FedUni; Alex Kruger

Prof Hechun Zhang; Tsinghua University, China; 20 July to 13 September 2014; pure; USN; Ruibin Zhang

Assoc Prof Jin-Xin Zhou; Beijing Jiaotong University; 16 November 2013 to 16 November 2014; UWA; Cai Heng Li

Prof Wu Ziku; Qingdao Agricultural University, China; 1 October 2014 to 1 March 2015; applied; UNS; Georg Gottwald

The Australian Mathematical Society

President:	Professor P.J. Forrester	Department of Mathematics and Statistics University of Melbourne Vic 3010, Australia. p.forrester@ms.unimelb.edu.au
Secretary:	Dr P. Stacey	Department of Mathematics and Statistics La Trobe University Bundoora, VIC 3086, Australia. P.Stacey@latrobe.edu.au
Treasurer:	Dr A. Howe	Department of Mathematics Australian National University ACT 0200, Australia. algy.howe@maths.anu.edu.au
Business Manager:	Ms May Truong	Department of Mathematics Australian National University ACT 0200, Australia. office@austms.org.au

Membership and Correspondence

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

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