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The Australian Mathematical Society

Gazette

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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 42(4), 42(5) and 43(1) of the *Gazette* are 1 August and 1 October 2015, and 1 February 2016.

Volume 42 Number 3 2015

Editorial

David and I welcome you to the July issue of the *Gazette*. The period since the last issue has been an eventful one. The Federal Budget impacted on science and mathematics. According to the Australian Academy of Science:

> The Australian Government's 2015 Budget in May brought relief from the deep cuts to science funding of the previous two budgets. Some areas received a funding boost while others experienced moderate cuts (cuts which will be delayed in most cases until 2016–17), with the result being what many viewed as a 'status-quo' outcome for science. Significant announcements made during the budget include:
>
> - two years continued funding for the National Collaborative Research Infrastructure Strategy (NCRIS)
>   - a further cut to support for university research block grants in the out-years (commencing in 2016–17)
>   - additional funding for the Australian Nuclear Science and Technology Organisation (ANSTO)
>   - a reduction in funding for the Cooperative Research Centre (CRC) program
> - continued development of the Medical Research Future Fund, with an expectation of significant funding for research over the next four years.
>
> Following the budget, the Government also committed to a round of 50 Australian Research Council (ARC) Future Fellowships to be offered in July 2015, and full rounds of 100 Fellowships to follow conditional on passage of the higher education reforms.

John Forbes Nash Jr. and Louis Nirenberg received the Abel Prize from the Norwegian King, His Majesty King Harald V, at an award ceremony at the University Aula in Oslo on 19 May 2015 'for striking and seminal contributions to the theory of nonlinear partial differential equations and its applications to geometric analysis.' A mere four days later John Nash and his wife Alicia died in a car accident in New Jersey. John Nash shared a Nobel Prize for Economics in 1994. His struggles with his illness and his recovery became the basis for Sylvia Nasar's biography, *A Beautiful Mind*, as well as a film of the same name. This film certainly brought to the attention of the public, the importance and relevance of mathematics.

Talking about bringing to the attention of the public the importance and relevance of mathematics, I must mention the AMSI article by Janine McIntosh in this issue in which she reports (as reported in our last issue) that AMSI has secured funding from the BHP Billiton Foundation to engage 13 new staff to work on a program designed to entice more girls and young women into mathematics. This is a wonderful achievement by AMSI in this vitally important area and we wish

the program great success. I refer readers also to the annual 'Girls Do the Maths' workshop item in News.

And while on wonderful achievements, we were delighted that in the Queen's Birthday Honours, Emeritus Professor Peter Taylor was made an Officer of the Order of Australia for distinguished service to education, and to youth, particularly through the development of mathematical competitions and challenges for students, as an academic, and to professional learning associations.

On 25 May 2015 the Australian Academy of Science announced the election of 21 new Fellows for their outstanding contributions to science and scientific research. Amongst them were three practitioners of mathematics. Our congratulations go to Professor Peter Bartlett FAA (Queensland University of Technology), Professor Geoffrey McLachlan FAA (The University of Queensland) and Professor Malcolm Sambridge FAA (Australian National University).

Three members of the Society have recently been awarded Laureate Fellowships by the Australian Research Council. They are: Professor Ben Andrews (Australian National University), Professor Kerrie Mengersen (Queensland University of Technology) and Professor Trevor McDougall (University of New South Wales).

One of the features of each issue of the *Gazette* in recent years has been Puzzle Corner prepared so brilliantly by Ivan Guo. Ivan has indicated that he would like to step down from this role, or at least have a break, from the end of 2015. So we seek expressions of interest from anyone interested in preparing Puzzle Corner from 2016. As Ivan is a very hard act to follow, we would certainly be happy to have expressions of interest from a group of people who would like jointly to prepare Puzzle Corner for 2016 issues of the *Gazette*.

This year, in the International Mathematics Olympiad, Australia achieved its highest-ever placing of 6th (ahead of Russia, Canada, Singapore, France, UK, Germany ...), and the team members won two gold medals and four silver medals. Congratulations to the team. For more details, see
http://www.imo-official.org/year_country_r.aspx?year=2015.

In his President's Column, Tim Marchant observes "Currently the AustMS publishes three journals, with the support of Cambridge University Press. These comprise the Bulletin and the Journal of the AustMS, which focus on pure mathematics and the ANZIAM Journal, which has an applied focus. Journals via editorial policy and their editorial panels have the opportunity to influence research directions, both in Australia and overseas." Tim goes on to say "I believe there is capacity within the Society to support the launch of an additional journal. I encourage AustMS members to discuss the idea of forming a new journal and what disciplinary focus would be most suitable." It is certainly timely for Tim to raise this issue as the Society is increasing the number of its Divisions and Special Interest Groups.

In the News section in this issue we read about the desire of Deb King and Joann Cattlin to build on the growing interest in mathematics education to form a new Special Interest Group of AustMS on Mathematics Education. If you would like to nominate to join this SIG, please contact Joann at joann.cattlin@unimelb.edu.au.

Nalini Joshi, Chair of the National Committee for Mathematical Sciences (NCMS), in this issue says there is a nationwide obsession with the Australian Tertiary Admission Rank (ATAR) and it appears that the flame of mathematics education may be flickering because of our fixation on maximising every student's ATAR. She asks what we can do to manage this distorting influence.

This issue contains reports on several conferences and workshops supported by the AustMS and/or AMSI. There is also an article by Professor Philip Broadbridge on the recent establishment of the Australian Branch of Institute of Mathematics for Industry, Kyushu University.

Finally I mention that we include in this issue four interesting book reviews.

Sid Morris, Adjunct Professor, La Trobe University;
Emeritus Professor, Federation University Australia.
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Sid Morris retired after 40 years as an academic. He received BSc (Hons) from UQ in 1969 and PhD from Flinders in 1970. He held positions of Professor, Department Head, Dean, Deputy Vice-Chancellor, CAO and CEO. He was employed by the universities: Adelaide, Ballarat, Flinders, Florida, La Trobe, UNE, UNSW, UQ, UniSA, Tel-Aviv, Tulane, Wales, and Wollongong. He was Editor of *Bull. AustMS* and *J. Research and Practice in IT*, and founding Editor-in-Chief of *AustMS Lecture Series*. He was on the Council of AustMS for 20 years and its Vice-President. He received the Lester R. Ford Award from the Math. Assoc. America. He has published 150 journal papers and 4 books for undergrads, postgrads and researchers, plus an online book, supplemented by YouTube and Youku videos, and translated into 6 languages. The third edition of the 900-page book *The Structure of Compact Groups* by Karl H. Hofmann and Sid was published in 2013 by Water De Gruyter GmbH, Berlin/Boston.

President's Column

Tim Marchant*

A bid committee comprising representatives from the Mathematics Education Research Group of Australasia, Australian Association of Mathematics Teachers, the Australian Mathematical Society, The Statistical Society of Australia and the Australian Mathematical Sciences Institute submitted a bid earlier this year to host the 14th International Congress on Mathematical Education (ICME-14). This major conference attracts 3000 delegates from across the world. The bid committee together with the support of Business Events Sydney spared no effort in submitting a highly competitive bid. Unfortunately we were unsuccessful, with Shanghai being awarded the hosting rights. My commiserations go to Professor Merrilyn Goos, the proposed conference convenor and the rest of the bid team. However there are some positives to take from the experience; the teamwork and cooperation across a range of organisations supporting the broad range of mathematical sciences in Australia was first class. This bodes well for future cooperative activities between our sister societies.

Currently the AustMS publishes three journals, with the support of Cambridge University Press. These comprise the Bulletin and the Journal of the AustMS, which focus on pure mathematics and the ANZIAM Journal, which has an applied focus. Journals via editorial policy and their editorial panels have the opportunity to influence research directions, both in Australia and overseas. A survey of sister organisations overseas shows that many societies support a much bigger range of journals. In the UK, for example, the London Mathematical Society and Institute for Mathematics and its Applications publish twenty different journals in total. A quick look at Scopus shows that authors based in Australia published over 500 journal articles in 2014, whilst the AustMS stable of journals published around 250 articles. Hence our influence over journal publishing activities is much lower than our publishing activities. Moreover the income the AustMS derives from its publishing activities forms a substantial part of our annual budget and is used to support a wide range of activities for our members. I believe there is capacity within the Society to support the launch of an additional journal. I encourage AustMS members to discuss the idea of forming a new journal and what disciplinary focus would be most suitable.

Recently I have received some emails from concerned members regarding the impact on the mathematical sciences from the Defence Trade Controls Bill, recently passed by the Australian Parliament. The Act restricts the supply of military and dual use technologies and will impact the university research sector. The dual use technologies cover a wide range of engineering and technology disciplines. In

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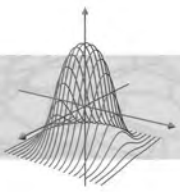
particular there is a supply offence, related to the transmission of information from Australia to overseas. This offence includes all physical and electronic forms except verbal means of communication. Clearly this places restrictions on the operation of research groups with international partners and is likely to impact Australia's research efforts and further burden us with red tape. However, the mathematical sciences are fortunate as most of their research activities fall outside the scope of the new Bill.

Tim Marchant received his Doctorate from Adelaide University in 1989. After graduation he joined Wollongong University where he is currently Dean of Research and Professor of Applied Mathematics. His research areas include nonlinear optics, nonlinear waves and combustion theory. Tim is a Fellow of the Australian Mathematical Society, a Member of the Endeavour Awards selection panel and on the editorial board of *Applied Mathematical Modelling*. His other interests include playing bridge and learning Mandarin.



Puzzle Corner

Ivan Guo*

Welcome to the Australian Mathematical Society *Gazette*'s Puzzle Corner number 43. 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, Faculty of Science and Technology, Federation University Australia, PO Box 663, Ballarat, Victoria 3353, Australia.

The deadline for submission of solutions for Puzzle Corner 43 is 15 September 2015. The solutions to Puzzle Corner 43 will appear in Puzzle Corner 45 in the November 2015 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.

Floating fedora

Sammy dives from a bridge into a river and swims upstream for one hour at constant speed. She then turns around and swims downstream at the same speed. As Sammy passes under the original bridge, a bystander tells her that her hat fell into the river the moment she dived into the water. In order to retrieve her hat, Sammy continues to swim downstream at the same speed. She finally catches up to her hat when she is exactly one kilometre away from the bridge. Assuming it is constant, what is the speed of current?

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Social network

There is a group of 300 Twitter users, such that each one is following exactly one other person in the group. Prove that it is possible to find a smaller group of 100 in which no one is following anyone else.

Digit divisibility

A number is said to be *elegant* if its digit sum is divisible by eleven. How many elegant numbers are there in the set $\{0, 1, 2, \ldots, 10^{11} - 1\}$?

Square solitaire

Four pegs are initially placed on the ground so that they form a square. At each move, you may take an existing peg from some point P and move it to a new point P', as long as there is another peg at the midpoint of PP'. Is it possible to form a larger square using the four pegs after a finite number of moves?

Rational coordinates

Does there exist a sphere (i.e. the surface of a ball) in $\mathbb{R}^3$, such that exactly one point on it has only rational coordinates?

Solutions to Puzzle Corner 41

Many thanks to everyone who submitted. The $50 book voucher for the best submission to Puzzle Corner 41 is awarded to Jensen Lai. Congratulations!

Improbable product

Is it possible for the product of four consecutive positive integers to be equal to the product of two consecutive positive integers?

Solution by Martin Bunder: Denote the four consecutive positive integers by $n-1$, n, $n+1$ and $n+2$, and the two consecutive positive integers by m and $m+1$. If their products are equal, then we have the equation:

$$(n-1)n(n+1)(n+2) = (n^2+n)(n^2+n-2) = m(m+1).$$

Since $n-1$ and m are positive integers, it is clear that every term in the equation above is positive. There are two possible cases:

- If $n^2+n \leq m+1$, then $n^2+n-2 < m$ and the left side is strictly smaller.
- If $n^2+n > m+1$, then $n^2+n-2 \geq m$ and the left side is strictly larger.

In both cases, we have reached contradictions. Therefore the answer is no, it is not possible for the product of four consecutive positive integers to be equal to the product of two consecutive positive integers.

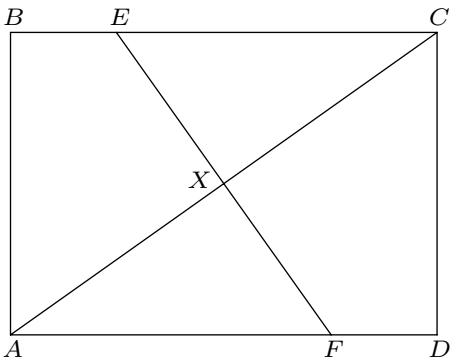
Many folds

Submitted by Andrew Kepert

(i) *An A4 paper has the length to width ratio of* $\sqrt{2} : 1$*. How many folds are needed to locate a point on the longer edge that divides the edge into the ratio of* $1 : 3$*?*

(ii) *Start with a rectangular piece of paper, choose an edge and mark a point somewhere along it. Now there are two 'far' corners which do not belong to the chosen edge. Make a fold so that one of these far corners coincides with the marked point, then unfold. Make another fold so that the other far corner coincides with the marked point, then unfold again. Prove that the intersection point of the two creases has equal distance to two opposite edges of the paper.*

Solution by Alan Jones: (i) The $1 : 3$ ratio is achievable with a single fold. Refer to the following diagram:



Let the rectangular A4 paper be $ABCD$ and denote its centre by X. Without loss of generality, let $AB = 1$ and $BC = \sqrt{2}$. Make a single fold so that the corner A coincides with the diametrically opposite corner C. Let the resulting fold line be EF as shown. We claim that E has the required property, or $BE : EC = 1 : 3$.

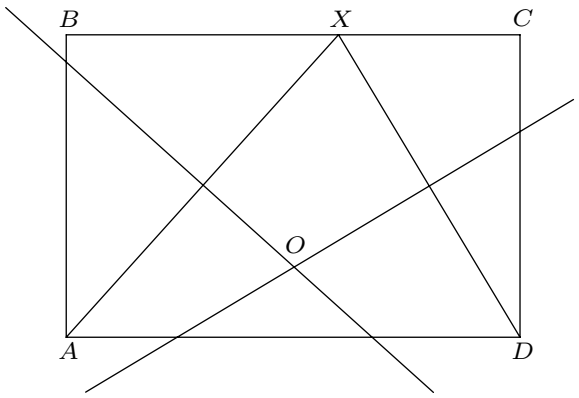
By our folding construction, EF is the perpendicular bisector of AC. So triangles ABC and EXC are similar. Hence

$$\frac{EC}{XC} = \frac{AC}{BC} \quad \Longrightarrow \quad \frac{EC}{BC} = \frac{AC^2}{2BC^2} = \frac{1^2 + \sqrt{2}^2}{2\sqrt{2}^2} = \frac{3}{4},$$

completing the solution.

Note that it is also possible to obtain the point E by making a single fold along the diagonal AC.

(ii) Refer to the diagram below:



Again let the rectangle be $ABCD$. Denote the arbitrary point along BC by X and the intersection of the creases by O. By definition, the two creases are the perpendicular bisectors of AX and DX. Since every point on a perpendicular bisector is equidistant from the two end points of the interval, we must have $AO = OX = OD$. Therefore O also lies on the perpendicular bisector of AD, so it must be equidistant from the sides AB and CD, as required. The point O is in fact the circumcentre of triangle AXD.

Rabbit season

(i) *Rachel and Fran are playing a game. Rachel controls three 'rabbit' pieces, while Fran controls a single 'fox' piece. Initially, all four pieces are placed somewhere along a straight line. They take turns making moves, with Rachel going first. Each move, a player is allowed to move one of her pieces a distance of at most one unit along the straight line. Fran wins if her fox piece can catch one of the rabbit pieces. Can Fran always win?*

(ii) *The same game is now played on a two-dimensional plane instead of a straight line. The rules are the same, except now Rachel has 20 'rabbit' pieces. Can Fran always win?*

Solution: (i) Yes, Fran can always win. Since there are three rabbits in total, two of them must lie on the same side of the fox. Fran's strategy is to move the fox 1 unit towards the two rabbits every turn until a rabbit is caught.

To see why this works, denote the fox by F and the two rabbits (which are on the same side of F) by R_1 and R_2. Consider the sum $S = FR_1 + FR_2$. Every move Fran makes will decrease S by 2, unless a rabbit is caught. But every move Rachel makes can only increase S by at most 1. Eventually, S must be no greater than 2 after Rachel's move, which means at least one of the rabbit is within 1 unit of the fox. Then Fran can win on the next move by catching that rabbit.

(ii) No, Fran cannot always win the two-dimensional version. Place the 20 rabbits on the 20 horizontal lines described by

$$y = 0, \quad y = 3, \quad y = 6, \quad \ldots, \quad y = 57.$$

Place the fox so that it is initially more than 1 unit away from all of the rabbits. For each line $y = 3i$, define its *trigger zone* to be the region that is within 1 unit of the line, or $\{3i - 1 \leq y \leq 3i + 1\}$. It is not possible to reach the line without being in its trigger zone in the previous turn. Also it is clear that the 20 trigger zones are pairwise disjoint.

Rachel's strategy is as follows: whenever the fox enters a trigger zone, move the corresponding rabbit along its horizontal line by 1 unit away from the fox. Since the fox cannot catch the rabbit the moment it enters the trigger zone, and it certainly cannot outrun the rabbit in a one-on-one chase, the fox will never be able to catch any of the rabbits.

Lighthouse logic

There are 18 fixed lighthouses in the plane, each has the ability to illuminate an angle of $20°$*. Prove that, by carefully selecting the directions in which the lighthouses are operating, it is always possible to illuminate the whole plane.*

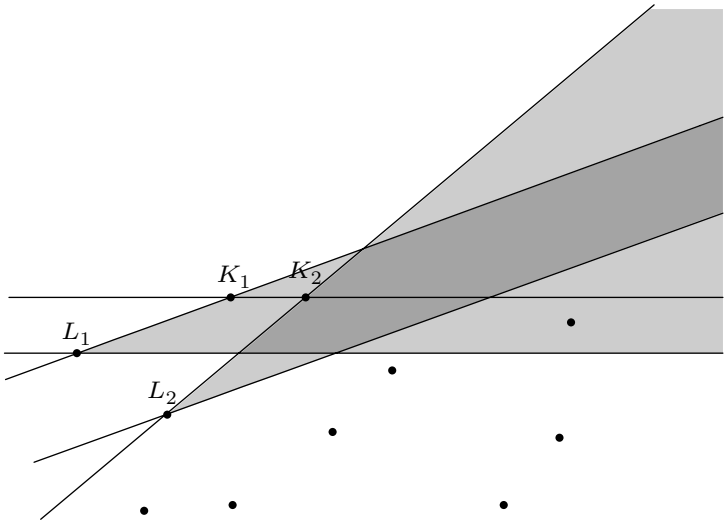
Solution by Jensen Lai: Yes, it is always possible to illuminate the whole plane. For convenience, we shall assume that the 18 lighthouses are at distinct points in the plane. (The following proof still works even if two or more lighthouses are on the same point.) Also, all angles are measured anti-clockwise with respect to the positive direction of the x-axis.

First of all, let us divide the plane into two half planes, so that each half plane contains exactly 9 lighthouses. This is possible by starting with a line and shifting it sideways until there are exactly 9 lighthouses on each side. Without loss of generality, let there be exactly 9 lighthouses in the half plane $\{y \leq 0\}$. It suffices to prove that these 9 lighthouses can illuminate the other half plane $\{y \geq 0\}$.

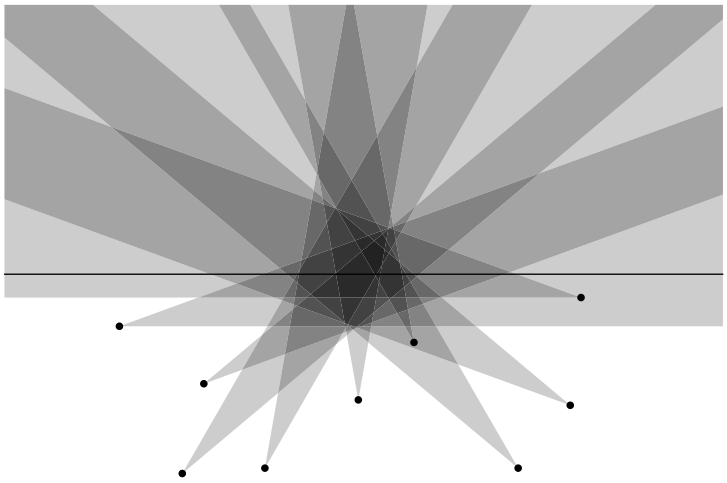
Draw a line through each lighthouse at an angle of $20°$. These 9 lines create 9 intersection points with the x-axis. Let the lighthouse with the leftmost intersection point be L_1 and its intersection point be K_1. Use L_1 to illuminate the angles in the range of $[0°, 20°]$. In particular, the cone with centre K_1 covering $[0°, 20°]$ is now illuminated by L_1.

Now there are 8 lighthouses remaining, all positioned to the right of the line L_1K_1. Draw a line through each of these lighthouses at an angle of $40°$, and let the 8 lines create 8 intersection points with the x-axis. Let the lighthouse with the leftmost intersection point be L_2 and its intersection point be K_2. Use L_2 to illuminate $[20°, 40°]$. Regardless of whether K_2 is on the left side or the right side of K_1, the

cone with centre K_2 covering $[0°, 40°]$ is now illuminated by the combined efforts of L_1 and L_2.



Continue the same process inductively. In the ith iteration, we draw lines at an angle of $20i°$ from the unused lighthouses and let them intersect the x-axis. Let L_i be the lighthouse with the leftmost intersection point K_i and use it to illuminate $[20(i-1)°, 20i°]$. As a result, the cone with centre K_i covering $[0°, 20i°]$ is now completely illuminated by the combination of $L_1, L_2, \ldots, L_i$.



When all 9 lighthouses are lit, we have successfully illuminated the entire half plane $\{y \geq 0\}$. Repeating the same argument for the opposite half plane completes the solution.

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.

Order of Australia for Peter Taylor

Emeritus Professor Peter Taylor was awarded an Order of Australia in the Queen's Birthday Honours on Monday 8 June.

Peter became an officer (AO) in the general division for 'distinguished service to education, and to youth, particularly through the development of mathematical competitions and challenges for students, as an academic, and to professional learning associations'.

Peter studied at the University of Adelaide for eight years, completing a PhD under the supervision of Ernie Tuck. His thesis involved some modelling of shallow water ship hydrodynamics, solving singular integral equations and matching asymptotic expansions. This later had some applications, for example at the Bougainville mines, where large ore carriers had to be moored in exposed positions.

On graduation, he obtained a job as an Assistant Lecturer at the Canberra College of Advanced Education (CCAE), now the University of Canberra, where he remained for 41 years. In the early days, CCAE was a rapidly growing teaching-only institution. Peter was kept busy, developing lecture materials. This led him to the Open University in 1978, where he worked with Oliver Penrose (brother of Sir Roger), developing materials for the Applied Mathematics courses, with a heavy accent on mathematical modelling. He co-authored with Oliver the first book on Differential Equations for this new course and was later contracted to write the book on Linear Programming. He also recorded the audiotape for the Differential Equations section. This relationship with the Open University continued until the early 1980s, by which time another interest had taken over.

Peter O'Halloran from CCAE had discussed with him in 1972 the mathematics competitions he had seen in Canada and the US, and how he would like to try the idea in Australia. Many students who don't necessarily go so well in the classroom, can discover talent by taking part in local enrichment activities. Although maths was not always a popular subject, it could be one that many excelled in, and competitions have helped many young people to realise this.

Together they decided to conduct a mathematics competition in Canberra in 1976. Over time, this expanded nationally. The questions in the Australian Mathematics

Competition were always moderated to ensure that as much as possible the mathematics needed in order to solve a problem was within the classroom curriculum, but the problems might be set in contexts which were quite new to the student, and designed to test the student's ability to adapt to that situation, as we all have to in everyday life. So an event like the AMC might identify different students than those who stand out in the confines of normal testing, and include those who might have greater creative ability and who may develop positively given the right circumstances. The AMC, despite careful checking of formal syllabus content, is a true competition rather than a test, in that it can be a major part of classroom preparation beforehand, and provide rich material for classroom discussion, on the judgement of the teacher, in the weeks following. This process is also commonly referred to as mathematical enrichment, and it is expected that the opportunity to participate in the AMC will provide a maturity which helps in later tertiary study or is useful in employment. Likewise the Olympiad programs give students who have demonstrated higher ability, or who wish to participate further on their own initiative, the opportunity to greatly broaden their mathematical knowledge beyond the syllabus without needing to go to a higher class to avoid boredom.

In 1992, the Australian Mathematics Trust was formally started as a merger between the Australian Mathematics Foundation Limited and the Australian Mathematical Olympiad Committee. Peter remained its executive director for 18 years. The AMC, AMOC, Tournament of Towns, and the activities of the Trust increasingly dominated his working life.

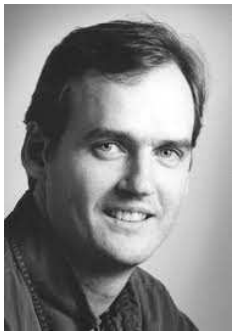
In 2002, together with Ed Barbeau of the University of Toronto, Peter was appointed co-editor of the International Commission on Mathematical Instruction's 16th Study, entitled Challenging Mathematics in and beyond the Classroom. It was initially designed to study the inter-relation between competitions and the normal education system, but ICMI gave it quite wide terms of reference to include any type of challenge, including for example exhibitions, mathematics days, maths camps, publications, etc. The study was completed in 2009, and consists of eight papers by 45 authors.

The Trust and its predecessors were founded explicitly in response to a need to add value to the school learning experience, not to replicate it nor write texts nor provide instruction within the curriculum. Nevertheless, Peter also has a longstanding interest in curriculum development. He chaired AMSI's Education Advisory Committee from its inception and was deeply involved in the planning and execution of the seminal workshops on 'Teacher Content Knowledge and Materials for Schools'. Peter guided this work and other early initiatives such as the first edition of the ICE-EM Mathematics books. He has also overseen AMSI's response to the Australian Curriculum; the creation of the teacher resource modules; the launch of the 'Maths: Make your career count' campaign; the collaboration with CSIRO to produce 'Maths by Email'; and the 'Mathematicians in Schools' program.

In short, he has been instrumental in developing enrichment activities and in helping thousands of students recognise their own talent for mathematics.

Australian Academy of Science Fellows

On 25 May 25, the Australian Academy of Science announced the election of 21 new Fellows for their outstanding contributions to science and scientific research. Amongst them were three practitioners of mathematics. Our congratulations to all of them! Visit https://www.science.org.au/fellows-elected-2015 to see interviews with the new Fellows.



Professor Peter Bartlett FAA (Professor in Mathematics, Faculty of Science and Engineering, Queensland University of Technology)

Peter Bartlett is a pioneer in statistical learning theory, which is at the interface of computer science and statistics, and is focused on the science behind large, complex statistical decision problems. He has created the theoretical foundations for many key advances in statistical machine learning. Peter's contributions include analysing large margin classifiers (a successful family of computationally efficient methods for classifying patterns), developing and analysing statistical learning methods based on convex optimisation, and developing new techniques for analysing the performance of prediction methods.

Professor Geoffrey McLachlan FAA (Vice-Chancellor's Senior Research Fellow, Department of Mathematics, The University of Queensland)

Mixture models play a central role in statistical science, and Geoffrey McLachlan's pioneering work in this field has been especially influential. His research on mixture models for inference and clustering is of particular note, as is his work on applications of the EM algorithm, especially to complex multivariate problems. Geoffrey has also made major contributions to error-rate estimation for classifiers and to new techniques in analysing gene expression data, including techniques for clustering tissue samples containing thousands of genes, and for controlling the false discovery rate.

Professor Malcolm Sambridge FAA (Head of Seismology and Mathematical Geophysics, Research School of Earth Sciences, The Australian National University)

Malcolm Sambridge has made lasting fundamental contributions to the understanding of the Earth and its internal processes through new mathematical approaches to analysing complex geophysical datasets. His robust approaches to modelling diverse observational data — including statistically meaningful estimates of uncertainty — has had wide-ranging impact in geoscientific research. Malcolm's work has changed the way in which we analyse seismic waves for the structure of the Earth's interior, model landscape evolution, understand populations of mineral ages from isotopic microanalysis, and interpret infrared absorption spectra associated with hydrous crystal defects in silicate minerals.

Australian Laureate Fellowships

Three members of the Society, listed below, have recently been awarded Laureate Fellowships by the Australian Research Council.

The Australian Laureate Fellowships scheme reflects the Commonwealth's commitment to support excellence in research by attracting world-class researchers and research leaders to key positions, and creating new rewards and incentives for the application of their talents in Australia. The scheme encourages proposals involving Australian or international researchers by providing eligible Australian Laureate Fellows with Project Funding in addition to a salary supplement and salary-related (on-cost) support. For details of all 15 new recipients of Australian Laureate Fellowships, see http://arc.gov.au/media/releases/Minister_FL23June15.htm. Our congratulations to all of them!

Professor Ben Andrews (Mathematical Sciences Institute, Australian National University)

Geometric analysis of eigenvalues and heat flows

This fellowship project aims to build on Australia's leading position in the areas of nonlinear partial differential equations and geometric analysis to exploit new and highly innovative mathematical methods. It is expected that the methods will affect a range of related fields including stochastic modelling and finance, image processing, and the basic sciences. The project seeks to serve as a focal point for a developing community of Australian researchers in this field, providing a training ground for young researchers and students at the forefront of a vigorous and internationally active area of research, and bringing top international researchers to Australia to interact with the local research community.

Professor Kerrie Mengersen (Mathematical Sciences School, Queensland University of Technology)

Bayesian learning for decision making in the big data era

This fellowship project aims to develop new techniques in evidence-based learning and decision-making in the big data era. Big data has arrived, and with it a huge global demand for statistical knowledge and skills to analyse these data for improved learning and decision-making. This project will seek to address this need by creating a step-change in knowledge in Bayesian statistics and translating this knowledge to real-world challenges in industry, environment and health. The new big data statistical analysts trained through the project could also create much needed capacity at national and international levels.

Professor Trevor McDougall (Department of Applied Mathematics, University of New South Wales)

Ocean mixing processes and innovation in oceanographic models

This fellowship project aims to develop new oceanographic tools and thermodynamic variables to support a new generation of accurate ocean models more suitable for the prediction of changes in a warming world. The ocean's role in the climate system is predominantly to store and to transport heat and carbon dioxide, and the ocean's ability to do this is sensitive to the strength of mixing processes, which are quite uncertain. This project hopes to distinguish the vital role of vertical mixing from that of horizontal mixing by (i) developing algorithms to construct neutral density surfaces in climate models, (ii) formulating new inverse techniques to deduce the amount of vertical mixing in various ocean regions, and (iii) incorporating new approaches to ocean mixing processes and thermodynamics into ocean models.

Australian Branch of Institute of Mathematics for Industry Kyushu University

Phil Broadbridge*

In 2013, the Institute of Mathematics for Industry[1], based at Kyushu University, was selected for federal funding under the national Joint Use Institutes Program. This is the second Joint Use Institute in mathematics, after the RIMS Kyoto, which has been funded by the national government for 48 years. Kyushu University is one of the original four Imperial Universities, and it now has the largest mathematics department in Japan.

IMI has established an Australian Branch, based at La Trobe University.

Honourable Adem Somyurek, Professor Wakayama and Professor Keith Nugent, 12 March

IMI was conceived by Professor Masato Wakayama, the founding Director, who is now the university's Executive Vice-President (Research). Japan produces many more PhDs in mathematics than there will be academic positions in the future, as the nation's student population is decreasing. Therefore, these highly trained

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[1]URL of home page of IMI-Kyushu-U: http://www.imi.kyushu-u.ac.jp/eng/pages/about.html

graduates in mathematics should better understand the possibilities of applying their skills to add a competitive edge to industry.

For the IMI to produce industry-attuned graduates, it has required a change in mindset of the university's mathematicians, something that has been achieved in just two years. Note the use of preposition 'for' rather than 'in', in the title. Most members of IMI are accomplished in fundamental mathematics. They still conduct curiosity-driven basic research but they also manage to apply their knowledge to a range of interesting industry problems, including automated combinations of facial images for the movie industry, location of the free phase boundaries during fabrication of steel, cryptographic systems for computer security, optimising surface shapes in engineering design, and predicting energy levels of atomic-scale devices that may be used as qubits in quantum computers.

Among the divisions of IMI, there is the Division of Fujitsu Social Mathematics. IMI collaborates with a range of major Japanese companies, some of whom host student interns. It runs an annual Forum for Mathematics in Industry (FMI) as well as a regular industry Study Group Workshop (SGW), and it produces a sequence of books that is published by Springer. Invited speakers at FMI have included Bob Anderssen, Frank de Hoog, John Hearne, Murray Cameron, Graeme Wake, Robert McKibbin, Winston Sweatman, Kerry Landman, Troy Farrell, Reinout Quispel, Robert Norman and myself. It is a pleasure to visit Fukuoka, a medium-sized city with a reputation for good food, hospitality, sports and good climate.

IMI has a strong international outlook, generating regular collaborations around the Asia-Pacific region, as well as with Europe and the Americas. It has quickly established the reputation of being a regional leader in mathematics for industry, helping to form the Asia-Pacific Consortium for Mathematics-for-Industry, under the guidance of Bob Anderssen, the late Professor Geoff Mercer of ANU as founding consortium president as well as Graeme Wake, Robert McKibbin and Winston Sweatman of Massey University. The inaugural APCfMI committee wrote about this earlier in the *Gazette*.[2] Part of the Japanese interest in our region stems from our good track record in hosting successful events such as the Mathematics in Industy Study Group.[3] One of the problem presenters at SGW2014 was the Melbourne Brain Institute's Dr Paul Abbott, who had previously presented a problem at MISG. This year in late July, one of the presenters at SGW 2015 will be Dr Jeff Hawkins of Pivot Maritime, a Hobart company that specialises in ship motion simulators.

On 12–13 March in 2015, the Australian Branch held a very successful kick-off event, a workshop, 'Mathematics Bridge over the Pacific for Competitive Edge in Industry'. Over 30 Kyushu staff and students made the trip south. Invited speakers included Yasuhide Fukumoto (Director of IMI), Peter Van der Kamp, Monique Chyba, Stan Miklavcic, Yoshihiro Mizoguchi, Robert McLachlan, Hirokazu Anai,

[2]Inaugural APCMfI Committee, 'The Asia Pacific Consortium of Mathematics for Industry', *Gazette* of the Australian Mathematical Society 41(2), 85–86, May 2014.

[3]URL of MISG special interest group of ANZIAM:
http://www.anziam.org.au/Mathematics+in+Industry+Study+Group.

Marcel Jackson, Kate Smith-Miles, Zainal Abdul Aziz, Osamu Maruyama, Mary Myerscough and Graham Weir. As well as the talks and student poster session, the social program included an Aussie barbecue in the La Trobe Wildlife Reserve.

Participants at Mathematics Bridge over the Pacific for Competitive Edge in Industry

On the afternoon of 12 March, there was a ceremony in the Victorian Government's showcase room, the Sir Redmond Barry Room in Collins Street. The Australian Branch of IMI was formally opened by the then Minister for Small Business, Innovation and Trade, the Honourable Adem Somyurek. Other speakers included Professor Masato Wakayama (Executive Vice President Research at Kyushu University), Professor Keith Nugent (Deputy Vice Chancellor Research at La Trobe University) and Ms Keiko Haneda (Consul-General of Japan in Melbourne). Others in attendance included Professor Reiko Aoki (Executive Vice-President International Relations, IP and Gender Equality, Kyushu University), Professor Geoff Prince (Director Australian Mathematical Sciences Institute), Professor Tim Marchant (President Australian Mathematical Society), Ms Alexandra Hogan (Hon Secretary APCMfI) and Professor Larry Forbes (President Australia New Zealand Industrial and Applied Mathematics). Guests enjoyed spectacular views of Melbourne and Port Phillip Bay from the panoramic windows.

There have recently been two joint appointments made. These are Dr Dimetre Triadis (Level B Research Fellow) and Dr Pierluigi Cesana (Level C Senior Research Fellow). IMI set out to appoint English-speaking academics who can later work in Kyushu after fixed-term appointments at La Trobe. This will be not only a home for the new appointees, but will become a base for visiting Kyushu professors and students. This has required good will and support from all levels of our governments and universities' administrations.

Readers will see from the list of Australians and New Zealanders who have already been involved with IMI, that this is much more than a relationship between two universities. We hope to facilitate the mutually beneficial involvement of many more from our region. For example, there is a special Joint Institute funding scheme for short working groups and workshops on a mathematical topic of general interest to an industry collaborator or partner. AustMS members are encouraged to contact me if you have ideas of that type.

Interactions Between Operator Algebras and Dynamical Systems[1]

30 June – 4 July 2014
University of Wollongong

Murray Elder[2], Adam P.W. Sørensen[3], Samuel Webster[3] and Michael Whittaker[3]

Organising Committee

- Dr Murray Elder (University of Newcastle)
- Dr Adam P.W. Sørensen (University of Wollongong)
- Dr Samuel Webster (University of Wollongong)
- Dr Michael Whittaker (University of Wollongong)

Sponsors

We had sponsorships from the Australian Mathematical Sciences Institute, the Australian Mathematical Society, the Institute for Mathematics and its Applications (University of Wollongong), the School of Mathematics and Applied Statistics (University of Wollongong), and The Danish Council for Independent Research | Natural Sciences.

Topics covered

Professor Søren Eilers (University of Copenhagen) gave the lecture series on operator algebras. The running theme of the series was the mutually beneficial connection between symbolic dynamics and C*-algebras. The focus was on C*-algebras associated to shift spaces and how C*-algebraic invariants can be used to distinguish various shift spaces. The first two lectures gave a historical introduction to the subject and provided key examples for understanding the theory. The third lecture described the recent result of Matsumoto and Matui that completely characterizes flow-equivalence of irreducible shifts of finite type in terms of their associated C*-algebras. The final lecture was an overview of important open problems in the area.

The lecture series on dynamics was given by Professor Douglas Lind (University of Washington). Lind is one of the world's leading experts on symbolic dynamics, in fact, he literally wrote the book on symbolic dynamics. His textbook *An Introduction to Symbolic Dynamics and Coding* holds a place on virtually every

[1]Visit http://eis.uow.edu.au/smas/operator-algebra-dynamic-systems/index.html

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dynamicist's bookshelf. The series began with a discussion of various equivalence relations of shifts of finite types, and the invariants used to distinguish between them. From there on the series progressed naturally to more complicated shift spaces, such as spaces with commuting shift maps, algebraic shifts, and algebraic actions of non-commutative groups. The final lecture discussed the connection between von Neumann algebras, a class of operator algebras, and algebraic actions of non-commutative groups. Throughout the lecture series, interesting open problems were pointed out and discussed.

In addition to the lecture series and an introductory talk by Sims (University of Wollongong), there were 13 specialist talks where researchers presented their new results in their own area, but always kept the mixed audience in mind. A few highlights were Froyland's (University of Sydney) discussion of the use of dynamics of transfer operators to study ocean movements; an Huef (University of Otago) describing the equilibrium states of certain C*-dynamical systems; Deeley's (Université Blaise Pascal, Clermont-Ferrand) overview of the homology of Smale spaces; and Carlsen's (Norwegian University of Science and Technology) report on a possible generalization of the Matsumoto–Matui theorem.

Report and feedback

The workshop brought together international and domestic experts in the fields of dynamical systems and operator algebras, thus creating exciting new collaborations across disciplines and providing an introduction to each field for students and postdocs alike.

> The AMSI workshop in operator algebra brought together world-class mathematicians from all four corners of the world. It gave me an opportunity to see how topics in apparently different disciplines fit together and thus make a powerful tool to study analysis and dynamics.
>
> Roozbeh Hazrat (University of Western Sydney)

Dynamical systems were introduced as a mathematical framework for analysing time-dependent physical systems. Operator algebras stem from the quantisation of classical mechanics, and provide an algebraic structure for studying dynamical systems. This deep connection between traditionally separate fields has inspired a highly successful, emerging area of research. The workshop focused on this interplay, and provided a forum to foster new collaborations among domestic and international researchers in each field.

> [The workshop] has led to two new research collaborations/directions for me personally with people I had not met before the workshop.
>
> Aidan Sims (University of Wollongong)

Organisers' opinion of success

The workshop was a resounding success. It introduced young researchers to open problems, created new collaborations for established researchers, and provided new research directions for both groups. With a strong international focus the workshop helped to cement Australia as a world leader in pure mathematics.

The workshop managed to bring together operator algebraists and dynamicists and showcase the interconnectedness of the two fields. The size of the workshop allowed for good mingling in the breaks, which led to many interesting discussions. All the speakers made sure to keep the mixed audience in mind when presenting, something that seems trivial but is not always the case.

IMS-FPS-2014 (IMS-Finance, Probability and Statistics)

3–5 July 2014

University of Technology, Sydney

Alex Novikov*

Organising Committee

- Professor Philip Protter (Columbia University), co-chairman
- Professor Alex Novikov (UTS), co-chairman
- Professor Xin Guo (University of California, Berkeley)
- Professor Steven Kou (Columbia University and NUS)
- Professor Kostya Borovkov (Melbourne University)
- Professor Ben Goldys (Sydney University)
- Associate Professor Juri Hinz (UTS)
- Professor Erik Shlogl (QFRC, UTS)
- Adjunct Professor Pavel Shevchenko (UTS and CSIRO, Sydney)
- Adjunct Professor Volf Frishling (UTS and National Australian Bank)

Topics covered

High frequency trading, retirement products and insurance, options pricing, stochastic optimal control, risk management and regulation, stochastic analysis, energy markets, Monte Carlo methods and empirical properties of financial markets.

Special presenters

- Rene Carmona (Paul M. Wythes '55 Professor of Engineering and Finance, Princeton University): 'Equilibrium analysis of large population dynamics'.
- Xunyu Zhou (Nomura Chair of Mathematical Finance and Director of the Nomura Centre for Mathematical Finance, University of Oxford): 'Rank dependent utility and risk taking'.
- Tze Lai (Professor of Statistics, Stanford University): 'Adaptive particle filters: theory and financial applications'.
- Dilip Madan (Professor of Finance at the Robert H. Smith School of Business, University of Maryland): 'Modelling and monitoring risk acceptability in markets: the case of the credit default swap'.

This was the fourth workshop for the special interest group 'Finance, Probability and Statistics' (FPS), recently formed under the auspices of the Institute for Mathematical Statistics (IMS). The event was a satellite of the joint Australian

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MathSciNet Classification: 91G80, 91G70, 91G80.

Fields of Research (FOR) code: 010205, 010404, 010405.

Statistical Conference/IMS Annual meeting, held 7–10 July 2014 in Sydney. The first IMS-FPS workshops were held in 2011 at Columbia University, in 2012 at the University of California at Berkeley and in 2013 at the National University of Singapore, respectively. By bringing together leading academic experts, practitioners and junior researchers, the workshop highlighted important contributions to mathematical finance made through the use of statistics and probability, and identified emerging directions where statistics and probability will play an essential role in the future.

On 2 July at the pre-workshop 'High Frequency Trading' Professors Philip Protter (Columbia University), Rene Carmona (Princeton) and Xin Guo (UC, Berkley) presented their research on new models for analysing trading strategies. Indisputably, this is one of the hottest areas of research in mathematical finance and applications. Other main topics of the workshop were: analytical and numerical methods for pricing financial contracts, retirement products and insurance, stochastic optimal control, risk management and regulation, stochastic analysis, energy markets, Monte Carlo methods and empirical properties of financial markets.

The workshop lasted for four days, with 13 plenary talks and 45 invited talks in two or three parallel sessions. The program of the workshop and abstracts of talks can be viewed at http://www.qfrc.uts.edu.au/IMS-FPS-2014/. It was a great opportunity to mix with people from academia and industry.

The session 'Australian practitioners' organised by Dr Volf Frishling, Head of Market Risk Quantitative Support at National Australia Bank (NAB) attracted a lot of interest. In this session Dr John Jarratt, Head of Operational Risk Quantitative Analysis (NAB) presented a plenary talk on 'Developments in operational risk modelling'. Dr Alan Brace, one of the founders of the famous LIBOR market model (known as the BGM Model), discussed some open problems in the area of interest rate modelling.

Thanks to AMSI and AustMS sponsorship we were able to provide partial support for the following scholars: Professor Dilip Madan (Cornell U), Xunyu Zhou (Oxford and Hong Kong U), Masaaki Kijima (Tokyo Metropolitan U), Tze Lai (Stanford U) and Rong Chen (Rutgers U). Furthermore, AMSI contribution allowed the setting of very reasonable registration fees and, as a result, among the 79 participants there were 26 postgraduate students.

Selected papers will be published in a Special Issue of the *ANZIAM Journal* devoted to recent advances in Financial Mathematics and Applied Stochastic Analysis.

Organisers' opinion of success

Our opinion is that the workshop was a great success. We were able to assemble talks from a wide variety of topics and in particular we were very happy to have fantastic talks from esteemed international speakers. There were robust discussions and questions answered following many of the talks and all participants (students, academics and practitioners alike) benefited by attending this event.

AMSI/AustMS Conference on Geometric Analysis and Stochastic Methods in Geometry

21–25 July 2014

Glen Wheeler*

Geometric analysis is a modern and vibrant area of mathematics. In the recent past, it has achieved remarkable results and found numerous applications, several of which we mention below. The conference focused on three key subfields of geometric analysis: heat kernels, equations involving Ricci curvature, and the Willmore functional. The participants of the conference explored these subfields using traditional techniques, as well as probabilistic ones. This represented the achievement of one of the goals of the conference: to showcase the application of probabilistic methods in the analysis of problems from differential geometry and partial differential equations.

In particular, Professors Elton Hsu, Anton Thalmaier, and Bruce Driver contributed presentations tailor-made as "User's Guides" to probabilistic methods in geometric analysis, detailing for example the connection between Hamilton's classical gradient estimate and Brownian motion. This alternative point of view enables the observation that Hamilton's gradient estimate is the limiting case of an entire family of gradient estimates.

The conference enjoyed contributions from established experts in the area as well as new stars. Professor Rick Schoen (Stanford U, UC Irvine) opened the conference, with a fundamental new contribution on an application of localisation in cones to the analysis of the rigidity of asymptotically flat space-times. A vast survey was contributed by Professor K.-T. Sturm (Hausdorff Center), and Professor Gerard Besson (Fourier Institute) presented startling facts on how weird and wonderful 3-manifolds may be. Leading Australian mathematicians were well-represented, with a deep application of interior ball curvature presented by Professor Ben Andrews (ANU) and Laureate Professor Xu-Jia Wang (ANU) detailing recent developments on the p-Minkowski problem.

Distinguished presentations from young mathematicians included that of Dr Yann Bernard (ETH), speaking on energy quantisation for the Willmore functional, work that recently appeared in the Annals of Mathematics, and Dr Richard Bamler (UC Berkeley), who found new insights in Perelman's work on the Ricci flow, enabling him to drastically improve on previous results. Given the level of activity in Ricci flow and in particular the level of interest in Perelman's work, this is an astonishing achievement.

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Report on AMSI/AustMS Workshop: Geometric and Asymptotic Group Theory with Applications 8

21–25 July 2014
The University of Newcastle

Murray Elder[1], **Lawrence Reeves**[2], **Simon Smith**[3] **and Anne Thomas**[4]

Reason for workshop and target audience

GAGTA has become a key international meeting held annually in Europe and North America since 2006, and for the first time in the southern hemisphere in Newcastle in 2014.

The meeting put a spotlight on the Australian group theory community, bringing strong international researchers to our shores and temporarily keeping them here to collaborate and present lectures and short courses.

The purpose was to bring together people working in the area of geometric group theory, asymptotic group theory, and group based cryptography, as well as nearby areas, to communicate new cutting edge advances in the field, to expose students and early-career researchers to the leading directions in the field.

Australian based researchers, including students, benefited from exposure to material presented by experts in the field, as well as being able to network with both Australian and international researchers.

Organising committee

- Dr Murray Elder, The University of Newcastle
- Dr Lawrence Reeves, The University of Melbourne
- Dr Simon Smith, City Tech, CUNY
- Dr Anne Thomas, The University of Sydney

Topics covered

A variety of areas in geometric and combinatorial group theory, including asymptotic and probabilistic methods, as well as algorithmic and computational topics involving groups. In particular, areas of interest include group actions, isoperimetric functions, growth, asymptotic invariants, random walks, algebraic geometry

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[4]School of Mathematics and Statistics F07, University of Sydney, NSW 2006.

over groups, algorithmic problems and their complexity, generic properties and generic complexity, and applications to non-commutative cryptography.

Invited presenters

- Yago Antolin Pichel, Vanderbilt
- Oleg Bogopolski, Dusseldorf
- Inna Bumagin, Carleton
- Laura Ciobanu, Neuchâtel
- Volker Diekert, Stuttgart
- Susan Hermiller, Nebraska
- Kate Juschenko, Northwestern
- John Meakin, Nebraska
- Alexei Miasnikov, Stevens
- Masato Mimura, Tohoku
- Eamonn O'Brien, Auckland
- Adam Piggott, Bucknell
- Sarah Rees, Newcastle (UK)
- Simon Smith, UWA/CUNY
- Enric Ventura, Catalunya
- Pascal Weil, Bordeaux

Summary of participants

Total number of participants: 55
Total number of AustMS members: 22

Country	
Australia:	21
Canada:	1
France:	1
Germany:	3
India:	1
Israel:	1
Japan:	1
New Zealand:	1
Spain:	2
Switzerland:	2
UK:	4
USA:	17

Institution	
Univeristy of Melbourne:	3
Univeristy of Newcastle (Aus):	8
Univeristy of Sydney:	4
Univeristy of Western Sydney:	2
Univeristy of Western Sydney:	1
Univeristy of Wollongong:	3

Number of ERCs	
Students:	14
Postdocs:	10

Financial support

The meeting was generously supported by the following organisations:

- The National Science Foundation (USA)
- The Priority Research Centre in Computer Assisted Mathematics and Applications (CARMA), The University of Newcastle
- The Faculty of Science and Information Technology, The University of Newcastle
- The Office of the Deputy Vice Chancellor Research, The University of Newcastle
- The Australian Mathematical Sciences Institute
- The Australian Mathematical Society

Stereographic conference photo by Cameron Rogers.

Organisers opinion of success

The meeting was highly successful. Almost all participants remarked that the pace of the schedule, high quality of the research talks and informal discussions, catering, location, recreational activity on Wednesday afternoon and conference dinner on Thursday night all contributed to making this an outstanding event.

More information, including slides for some of the talks presented, can be found at the workshop webpage: https://sites.google.com/site/gagta8/.

We thank the AustMS sincerely for their generous support of this event.

2014 Workshop in Harmonic Analysis and its Applications

21–25 July 2014
Macquarie University, Sydney

Xuan Duong*

The purpose of the workshop was to bring together leading international and Australian researchers as well as early-career researchers and PhD students, in Harmonic Analysis and related areas, for the dissemination of the most recent developments in the field, and for discussions on future directions.

It was organised by Xuan Duong (Macquarie), Chris Meaney (Macquarie) and Lesley Ward (University of South Australia). It was sponsored by the Australian Mathematical Sciences Institute, the Australian Mathematical Society, the Centre for Industrial and Applied Mathematics (CIAM), School of Information Technology and Mathematical Sciences, University of South Australia, and the Department of Mathematics, Macquarie University.

We had 52 participants from 7 countries, including 13 female and 15 from overseas. There were 31 academics (20 are based at Australian institutions and 11 at overseas institutions), 19 students (15 at Australian institutions and 4 at overseas institutions), 1 participant employed by an Australian company, and 1 unemployed. There were 13 AustMS members

There were 26 talks, comprising twenty 45-minute talks, and six 25-minute short talks for ECRs, postdocs and PhD students. They addressed many topics in harmonic analysis and related areas.

The four principal speakers were

- Leonardo Colzani, Universita di Milano-Bicocca, Italy,
- Michael Lacey, Georgia Institute of Technology, USA
- Carlos Perez, Universidad de Sevilla, Spain
- Jill Pipher, Institute for Computational and Experimental Research in Mathematics (ICERM) and Brown University, USA.

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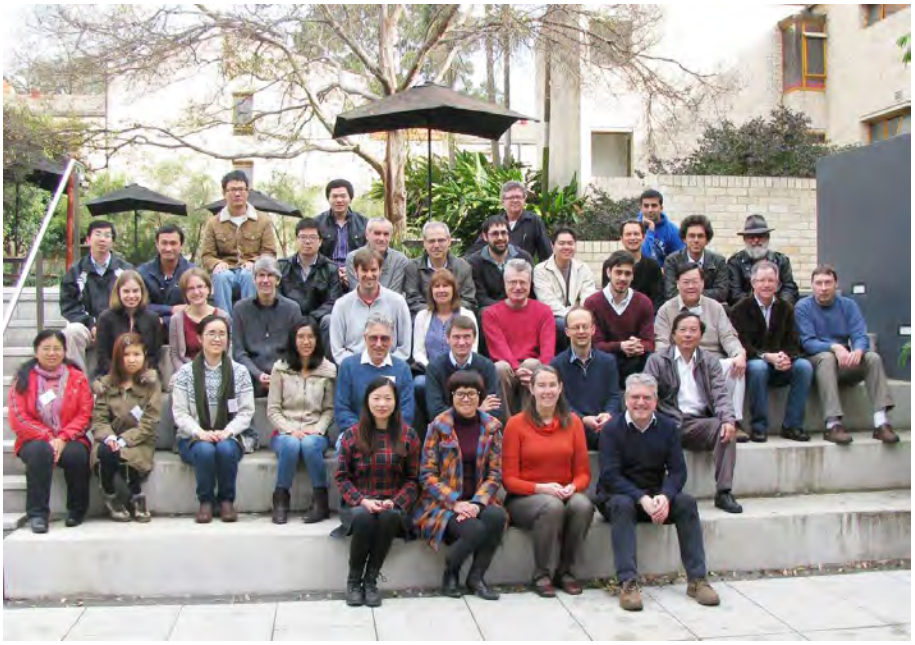
MathSciNet Classification: 2 or 3-digit classification code: 42B, 35A, 47A
5-digit codes in descending order of relevance: 4 2-B-37, 42-B-20, 35-J-45
Fields of Research (FOR) code: 6-digit codes in descending order of relevance: 01-01-06, 01-01-10, 01-01-08

Topics covered in the talks included:

- Harmonic Analysis: Estimates on singular integrals, holomorphic functional calculi, Carleson measures, harmonic analysis on product spaces.
- Partial differential equations: Elliptic and parabolic systems, homogenization of elliptic equations, heat kernel estimates, eigenfunctions expansion, Strichartz estimates on manifolds.
- Applied harmonic analysis: Image visualization, prolate shifts and sampling.



The talks gave quite a few recent important results at the frontier of the research topics. All the talks were well attended In the organisers' opinion the workshop was highly successful as reflected by comments from the participants in a survey carried out near the end of the workshop. This survey attracted 16 responses, which were overwhelmingly positive.

One of the highlights of the workshop was the lecture on The Two Weight Inequality for the Cauchy Transform given by Michael Lacey which verifies a conjecture of Nazarov–Treil–Volberg.

Social events: In addition to the conference dinner, we organised two further social events. We held a women's lunch on the second day, attended by about 10 women mathematicians. Participants included senior and mid-career mathematicians, as well as ECRs and PhD students, from several countries. The third afternoon had no scheduled talks; some participants took the opportunity for research discussions while others joined our excursion by train and ferry for a walk around Bradley's Head, near Taronga Zoo.

New Directions in Fractal Geometry

23–28 November 2014
The Australian National University and its Coastal Campus at Kioloa

Michael Barnsley*

Fractal geometry is a fast growing and dynamic area of mathematics and this meeting's goal was to bring together pure and applied researchers working on the cutting-edge of fractal geometry to stimulate research and collaboration between theory and applications. There was also an extra effort made to attract female researchers. In particular, there was a special women's luncheon with a talk by Professor Sue Wilson (ANU, UNSW) on her life-experiences as a woman in science. Having this event early in the conference provided a great opportunity for all the women to get to know each other and there was strong feedback that this was very worthwhile.

New Directions attendees at Kioloa.

On the Monday on the ANU campus there were fascinating research talks including presentations from leading international figures Valerie Berthé (CNRS) on the links between fractals and Kronecker dynamics, Doug Hardin (Vanderbilt) on discrete minimum energy problems and Jun Kigami (Kyoto) on self-similar sets as quotients of shifts. Konstantin Igudesmann (Kasan State) spoke on applications to fractal antennas. In the evening Michel Lapidus (UCal) gave a public lecture entitled 'An Invitation to Fractal Geometry and Its Applications' to an appreciative audience.

The talks on Tuesday morning continued to be of a very high standard with contributions from Jörg Thuswaldner (Leoben) on the topology of self-affine tiles, Jeff

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Geronimo (GTech) on a separation condition for fractal attractors, Irmina Herburt (Warsaw) on fractal star bodies and Mike Whittaker (Wollongong) on fractal substitution tilings.

After lunch on Tuesday all participants boarded the bus for the NSW South Coast. After a short sightseeing stop at Braidwood, the bus made its precipitous way down through the mountains and arrived at the ANU Coastal Campus at Kioloa.

Meeting the neighbours.

During the next three days there were intensive sessions of talks in the mornings but the afternoons were all 'free' to encourage interaction between the participants. This led to many fruitful discussions, sometimes between early career researchers and established experts, sometimes between people from different specialisms finding interesting common ground and sometimes between theory and applications. Key talks were given by Michel Lapidus (UCal) on links between fractals and noncommutative geometry, Károly Simon (Budapest) on multi-fractal analysis of traffic on the internet, Christoph Bandt (Greifswald) on fractal morphisms, Jon Borwein (Newcastle) on short walks, Markus Hegland (ANU) on connections between numerics and fractals, Christian Gentil (Bourgogne) on applications of fractals in computer-aided design, and Andrei Tetenov (Gorno-Altaisk) on self-similar Jordan arcs.

In summary, to quote one overseas visitor:

> ... this was a high level conference that gathered together specialists, researchers of all generations. The discussions were very stimulating. The organization was excellent, as well as the general atmosphere. I have access though this conference to results I was not aware of and which will be undoubtedly very useful in a near future for my research.

Friendly Rainbow Lorikeets visit Jörg Thuswaldner at the Kioloa mess hall.

There was a strong groundswell that this conference should be the starting point of a series and another conference, organised on similar lines should be planned for 2016.

This conference was supported by AMSI, AustMS, CARMA, ANU, Fractal Antenna Inc. and ACEMS.

Visit http://maths.anu.edu.au/events/new-directions-fractal-geometry for further details.

Workshop on Algebraic, Number Theoretic and Graph Theoretic Aspects of Dynamical Systems

2–6 February 2015
University of New South Wales

Brendan McKay[1], Alina Ostafe[2], John A.G. Roberts[3] and Igor E. Shparlinski[4]

Arithmetical dynamical systems, that is, dynamical systems generated by iterations of rational functions over fields of number-theoretic interest, have seen a significant explosion of work in recent years but still many algebraic, number theoretic and graph theoretic problems remain wide open. The interest in such dynamical systems comes also from connections that have been forged with many different areas of pure and applied mathematics. The purpose of this workshop was to further explore the complex algebraic and number theoretic behaviour, as well as to gain a better understanding of the structure of functional graphs of arithmetical dynamical systems.

Topics covered

- Algebraic dynamical systems
- Dynamical systems of number theoretic origins
- Graph theory
- Number theory

Special presenters

- Professor Alex Gamburd (City University of New York): expert in number theory and expander graphs
- Tony Guttmann (University of Melbourne): expert in random matrices, lattices, random walks
- Cheryl Praeger (University of Western Australia): expert in graph theory and group theory

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5-digit codes in descending order of relevance: 11T06, 37P05, 05C20.
Fields of Research (FOR) code: 6-digit codes in descending order of relevance: 010101, 010104, 010109.

- Klaus Schmidt (University of Vienna): expert in algebraic dynamics
- Joe Silverman (Brown University): expert in arithmetic dynamics and number theory
- Franco Vivaldi (Queen Mary University of London): expert in algebraic dynamics and number theory
- Thomas Ward (Durham University): expert in ergodic theory and algebraic dynamics
- Nick Wormald (Monash University): expert in graph theory and combinatorics

Report

The ADS_NT_GT Workshop brought together researchers in dynamical systems, graph theory and number theory who were interested in learning about the latest advances in these fields, as well as expanding their own research areas. The choice of the invited speakers, who all had very broad research interests, reflected the goal of the workshop: finding new connections between the above areas. In fact each invited talk was covering several different topics. For example, Professor Cheryl Praeger was talking about problems of graph theory, which are related to dynamical systems on graphs (e.g. mixing) and also to such 'hot' areas of number theory as additive combinatorics. The workshop was very 'dynamic' not only by its name but also by its nature: one of the invited speakers, Professor Tony Guttmann, influenced by some discussions at the workshop, changed the topic of his previously planned talk to another one to reflect these discussions and new developments.

The structure of the workshop, which allocated plenty of time for informal interaction (with appropriate logistical support: dedicated class rooms, internet, coffee, etc.), greatly stimulated such discussions and interactions. New contacts have been made and new collaborative links have been established. A number of participants provided positive feedback. It is expected that these links will mature to long-term collaborative projects with publications in high ranked outlets.

A very successful and well-attended outreach event embedded in the program and aimed at the general public and high school students was the public lecture on Tuesday evening by Professor Franco Vivaldi entitled 'The Arithmetic of Chaos'.

Visit http://web.maths.unsw.edu.au/~jagr/ADS_NT_GT.html for more details and slides of presented lectures and contributed talks.

Summary of participants

There were 47 participants in total: 28 from Australia and 19 from overseas. Of the 47 participants, there were 9 student participants, 1 from overseas. There were 8 female participants within the total. The total number of participants was close to the expected number. However, we had fewer than expected Australian participants and more than expected international participants. The lower than expected number of Australian participants can be explained by an unavoidable overlap with the dates of the ANZIAM 2015 Conference: 1–5 February, Gold Coast, Queensland. In particular, many potential participants from the University of Newcastle and ANU, who initially expressed high interest in the ADS_NT_GT Workshop, attended the ANZIAM Conference instead.

Organisers' opinion of success

We were very pleased with all aspects of the workshop: logistically, scientifically and socially. People mixed and discussed really well and we felt that they learnt from each other, in line with our aims to bring people from different areas together. Subsequent feedback also supports this. As an example, we report the recent appearance on arXiv of *Somos-4 and Somos-5 are arithmetic divisibility sequences* by Peter van der Kamp, one of the participants. It relates the work described in his contributed talk but mentions discussions at our workshop in the acknowledgements as a source of additional knowledge.

As mentioned above, 8 of the 47 participants were female, a little under 20%. As agreed with the AMSI Director prior to confirmation of the AMSI funding, we took several steps to increase female participation. Firstly, we individually approached female academics in Australia working in the conference topic areas. Secondly, we contacted the Secretary of the Women in Mathematics Special Interest Group of the Australian Mathematical Society to ask if we could have their membership list and research interests.

Increasingly, it is being recognised that the under-representation of females in mathematics needs to be addressed at the school level. Accordingly, we arranged a public lecture in the workshop program which we advertised extensively, in particular to the schools we deal with through our *Girls do the Maths* network. The lecture by Professor Franco Vivaldi (University of London) was a great success and, hopefully, an inspiration for those young and old who attended.

Some specific feedback from the public lecture via two unsolicited emails from high school teachers accompanying their students to the lecture:

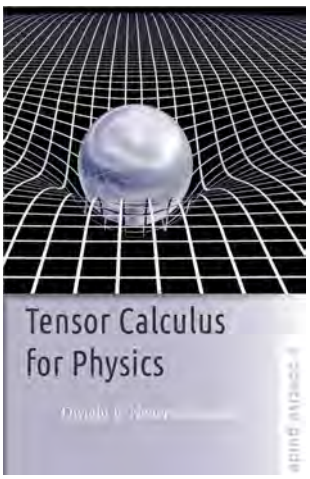
> I am a teacher at North Sydney Girls High School and attended the lecture yesterday. I am wondering if we could go on your mailing list to be advised of future public lectures. We could then promote it at our school.
>
> It was fantastic to have such an erudite speaker talk so passionately about important research in mathematics whilst making it accessible to a school audience at the same time. I'd love to be able to promote future lectures to our students as a means of raising the profile of mathematics in their minds as they consider their future study and careers. Based on the feedback from colleagues from the school who attended, these lectures are also a great opportunity to reach out to school teachers. Let me know if I can assist in any way.

Book Reviews

Tensor Calculus for Physics

Dwight E. Neuenschwander
John Hopkins University Press, 2015, ISBN 978-1-4214-1565-9

Neuenschwander's opening section is titled, 'Why aren't tensors defined by what they *are*', echoing many a student's plaintive cry. Along with the blurb and preface this made me wonder if Neuenschwander was attempting to disprove the old joke known as The Tensor Uncertainty Principle: you can understand tensors, or work with them, but not both. To a certain degree he is, and he makes a fair fist of it. His approach is to build up to tensors from ideas that students reading this book should know: vectors in 3-space, vector fields and the inertia tensor. He states up front exactly the key point that a tensor is something independent of how it is described in terms of coordinates, even if they are primarily used in a particular coordinate system.



This idea does lead to some idiosyncrasies in both presentation and notation. I like the idea of using the Dirac bra and ket for row and column vectors, and the idea that while a tangent vector is a displacement divided by a scalar, a gradient is a scalar divided by a displacement. I am less sure of his heavy use of the concept of a dual vector. Maybe I'm just set in my ways, but I expect a vector-like object with one index downstairs to be a covector (1-form), i.e. a linear map on (tangent) vectors. We first meet dual vectors properly in Section 3.3, but in the midst of a discussion of the metric, when duals appear as the index lowered version of tensors, and so the 1 index ones are actually vectors (not 1-forms, despite how they transform). This is technically correct of course, and fits in with his approach, but leaves Neuenschwander searching for something that naturally transforms like a dual vector when there is no metric. He finds it in the gradient, which is in fact a covector. I wonder if students reading this book will feel he has left the question of what dual vectors actually are hanging.

Unfortunately, in the midst of so much good material, with interesting discussion questions as well as more traditional questions, there are a number of errors in the mathematics.

Chapter 1 is a good introduction and recap of vectors, setting up Neuenschwander's ideas, and we meet tensors in Chapter 2, in the form of specific types that students

ought to have met. I felt there was some haziness over index positioning here, which could have easily been sorted out at the end of Section 3.3.

Chapter 3 begins with a good discussion on the difference between coordinate displacement and distance, an idea that is also useful in general relativity when the factors of c are replaced: it is great to see this consistently stressed. Unfortunately, this section is spoiled by an egregious error in the definition of a Riemannian metric as it is usually understood. The components of a positive definite metric do not have to be all non-negative (e.g. $dx^2 - 2dxdy + 3dy^2$) and a pseudo-Riemannian metric can have all non-negative components (e.g. $2dudv$). This error does not actually make any impact on the rest of the book, fortunately. Later on (and in Chapter 4) a good discussion is given on how the 'ordinary' vector components are to be related to the contra/co- variant components of vectors, and how these differ in non-cartesian coordinates: this is very useful material.

The affine connection is introduced in Chapter 4, using the local equivalence principle (in free fall special relativity is locally valid). This is a nice approach, but does mean there is no real indication of what a connection is, and why it has that name. The covariant constancy of the metric is an exercise, leaving me to wonder where Neuenschwander had sneaked in the equivalent requirement, and the familiar Christoffel symbols appear out of nowhere.

We meet curvature in Chapter 5, which Neuenschwander chooses to introduce through the concept of holonomy (although he avoids that term). Namely, parallel transport an arbitrary vector around an arbitrary loop in flat space and it returns unchanged; a space is curved if this does not happen. Neuenschwander makes an unfortunate logical error in stating the negative, but gets it right when he later uses the concept to prove that his definition does lead to the Riemann tensor, which he has by then introduced in the usual way by commuting covariant derivatives. He closes the chapter with an attempt to prove that the Riemann tensor is the only tensor linear in second derivatives of the metric. This is surely false without more restrictions (such as vanishing divergence). His proof does not hold up at least: nowhere in his argument does Neuenschwander introduce a general tensor linear in 2nd derivatives of the metric.

Chapter 6 is on applications, and 6.1 is a useful look at electromagnetism in tensor notation. However, Section 6.2 on general relativity skates over almost all the issues Einstein actually faced in his quest for a covariant theory of gravitation. It almost works as a post hoc derivation, but as history it is very inaccurate, see Pais [1].

In Chapter 7 Neuenschwander outlines the mathematics of manifolds, tying them in to his approach. He makes the same error about Riemannian metrics as in Chapter 3, and I had the same issue with the meaning of dual vectors: they are defined on a manifold in Section 7.3 but again under the assumption of a metric on the tangent space, so are tangent vectors, not covectors. His derivation of the covariant derivative for dual basis vectors in Section 7.4 follows the usual definition from surface theory, which to me misses the whole point of a connection. His account also begins by claiming that an n-manifold can always be (isometrically) embedded in an $(n+1)$-manifold, which is false. He does give a nice derivation for the Christoffel symbols from the completeness relation for the metric.

Chapter 8 is brief overview of differential forms. Neuenschwander uses idea of a 1-form as 'parallel planes' to illustrate the difference between vectors and 1-forms. This is all fairly standard but modified to fit his overall approach. There are several mistakes in this chapter too. Neuenschwander twice confuses linear dependence with collinearity; defines an inner product of a p-form and a q-form that only works if $p = q$; uses continuity rather than smoothness to swap the order of partial derivatives and refers to the converse of the Poincaré Lemma as a corollary of it.

Most of the errors are easily fixed, and I trust will be in a second edition. However, I cannot recommend this edition as suitable for independent reading by students. It does address a need though, so with suitable guidance would be useful for students trying to get to grips with the fundamental ideas of tensors, what they mean and how they are used.

References

[1] Pais, A. (1982). *Subtle is the Lord . . . . The Science and Life of Albert Einstein*. The Clarendon Press, Oxford University Press, New York.

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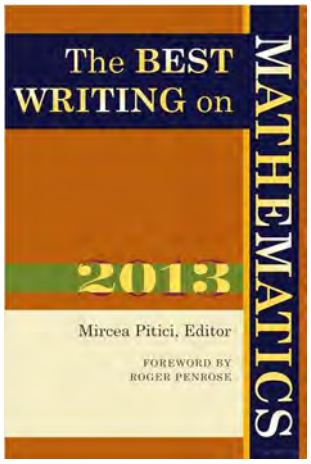
The Best Writing on Mathematics 2013 and **The Best Writing on Mathematics 2014**

Mircea Pitici (Editor)
Princeton University Press, 2013 and 2014,
ISBN 978-0-691-16041-2 and 978-0-691-16417-5

These two volumes are the fourth and fifth of an annual series edited by Mircea Pitici, who teaches maths and writing at Cornell University. I had the pleasure of reviewing earlier volumes in this *Gazette*, Vol. 39, No. 4, 2012 and Vol. 40, No. 4, 2013. The stated aim of the editor is to present to mathematicians and the general public accessible but non-trivial perspectives on pure and applied mathematics, historical and philosophical issues related to mathematics and its teaching, and social and institutional aspects.

Selecting examples of 'best writing' from the plethora which is published every year is a difficult task. Pitici takes the course of reading widely, selecting around 150 candidates which fit into his chosen format and present no copyright problems, and presenting a short list of a few dozen which his publisher asks independent referees to rate.

The essays in the current volumes, which were originally published in generalist journals such as *American Scientist* and *Plus* magazine, or in specialist mathematics, statistics, history, philosophy or education journals or simply in blog posts, are about ten pages in length and eschew calculations and technical details. Thus the level of mathematics presented is a step below that of expository papers in *The Mathematical Intelligencer* or the *Notices* and *Bulletin* of the American Mathematical Society. To this biased reviewer, the result is a mixed bag, so I will limit my comments to those which I found most enjoyable.



At the top end of the spectrum, the 2013 volume contains extracts from Terry Tao's blog on Complexity and Universality and Kevin Hartnett describes recent work on the ABC Conjecture, which is apparently still (in June 2015) open. The 2014 volume contains a vivid account, written only a few weeks after the result was announced, of Zhang's result on bounded gaps between successive primes, and John H. Conway describes recent work on the Collatz $3x+1$ conjecture and explains why it may well be unsettleable; that is, neither the conjecture nor its negation is provable in ordinary set theory.

At the lower end, there are fascinating articles on creative people who make no claim to be mathematicians, but who are inspired by mathematical ideas. For example, the artist Fiona Ross, assisted by her partner mathematician William T. Ross, and motivated by diagrams illustrating the Jordan Curve Theorem and space filling curves, creates striking unicursal ink drawings which are largely abstract but contain haunting figurative images. Kelly Delp describes how sketches illustrating Thurston's 3-dimensional geometries, or rather the singular sets in the orbifolds representing these geometries, were used by the fashion designer Dai Fujiwara to design scarves and other elements of Issey Miyaki's 2010 Paris Fashion Week presentation.

Architecture is a discipline which demands equal parts of mathematics and aesthetics. Renan Gross uses Bézier curves to analyse Spanish architect Santiago Calatrava's beautiful Jerusalem Chords Bridge, a suspension bridge whose span is supported by steel cables from a single inclined tower. The cables emanate from different levels of the tower, the lower ones being attached to more distant points on the deck so that their envelope forms a parabola with inclined axis.

Among the historical offerings, Ian Stewart describes Alan Turing's early work on morphogenesis; Daniel Silver discusses Dürer's work on projections of the conic sections, and his use of them in his paintings; John Pavlus recounts Gödel's early recognition of computational complexity and his exchanges with Von Neumann on the subject and David Lloyd describes the Scottish Neolithic stone balls which resemble the Platonic solids. Michael J. Barany discusses Cauchy's discoveries in analysis, particularly the Intermediate Value Theorem and Prakash Gorroochurn has collected errors in statements about probability in the works of Cardano,

Leibniz, Pascal, Bernouilli, D'Alembert and Laplace. Many of our students are indeed in distinguished company!

Philosophical entries address the contribution of mathematics to the 'good life', the inexorable rise of Big Data, non-linear scaling in human perception, and speculation concerning the shape of the universe.

A useful feature of both volumes is Pitici's annotated bibliography of recently published works of the same genre. His work fills a gap between expository mathematics and popular explanation. It is a welcome contribution to improving public perception of our discipline.

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Introduction to Probability and Statistics for Engineers and Scientists (5th edn)

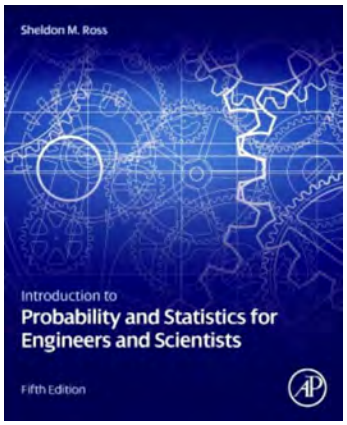
Sheldon M. Ross
Academic Press, 2014
ISBN 978-0-123-94811-3

I jumped at the opportunity to review this textbook, with a motive. I'm not a statistician, but I have been teaching a one-semester second-year subject *Probability Models* to a class of both computer systems engineers and scientists for several years now. In the first year, we referred to a text chosen by a previous lecturer, but few students bought it, having been forewarned by the class of the year before. Second time around, there was no specified reference text, but I would consider setting one in future, should I find one that I thought would be acceptable. While I am not an expert on probability and statistics, I am a very experienced educator, and I know what I am looking for in a textbook.

Although textbooks are written by expert authors, and chosen by lecturers, it is the students who need to get the most from them. So *acceptable* should not mean 'a book written exactly the way I would' or 'a book that I want to refer to' (even though as a non-expert I have needed several of those!). The students have to find it approachable, get what they need from it, and not be made too unhappy. Choosing a textbook is somewhat akin to the decision a parent makes when serving peas (but not peppermint ice-cream) rather than Brussels sprouts as a green, and it is from this perspective of being conscious of student needs and reaction that I approach this book review.

But what tempts students to open the covers of a book? And what do they dislike?

My students complain about cost, particularly if we cover only a small portion of a massive tome with a correspondingly large price. They are intolerant, not unreasonably, of errors. They like answers in the back of the book. And they need to be able to find the information and key facts clearly set out. They also like relevance, a book that seems to be for them. They would not like this book.



This is the fifth edition of a book first published in 1987. The first edition ran to around 500 pages, in 12 chapters, and included a disk which had to be used in a PC to solve some of the examples and exercises. A review of this first edition[1] commented that this feature distinguished it at that time from similar texts. The fifth edition, which adds only four further subsections to the fourth, has 15 chapters and some 670 pages, though none of these are devoted to answers to exercises. This is the first edition *not* to have an accompanying disk; in one sentence in the preface, it is mentioned that the software useful for solving problems is accessible at the publisher's website. However, as a result of non-existent proof-reading, the chapters and exercises themselves constantly refer students to the non-existent 'text disk'.

In fact, solutions to certain examples say things like 'by running Program M.N.n we obtain ...'. The software is not just 'useful'; it is the only way offered to tackle these problems. To enhance the relevance for students, standard twenty-first century software, such as they will use in employment, could have been adopted.

The preface states that the book is intended for an introductory course, and assumes elementary calculus. The publisher's blurb more appropriately describes it as being for upper-undergraduate level; it requires multi-variable calculus and a fluency in reading symbolically-dense expressions. However, the book was intended for a year-long course when first published, and is now about 25% longer, so unless one is able to agree with others in one's department to use this book across a number of subjects, students would be paying for material they would not cover in a one-semester unit should one adopt it. (In my current subject, we would use about four chapters.)

This book has an overwhelmingly north American flavo(u)r to it. For example, the exercises refer to heights and weights of adults in inches and pounds, gallons of petrol consumed per mile, the amount of salt available for snow-covered roads, and NFL statistics. One exercise starts: 'Use the results of a Sunday's worth of major league baseball scores to test the hypothesis that ...'. On the plus side so far as I am concerned, there are no examples that assume knowledge of a 'standard deck of playing cards' and not too many where one is required to draw imaginary coloured balls from an urn. The tables of data provided in many of the exercises would seem foreign to my students, the past being as distant a country as the

[1]Review by Marion R. Reynolds Jr., *Technometrics* 1988, Vol. 30, No. 4, accessed via JSTOR

US. For other tables of supposedly real-data, no source is given, which gives the impression that they are constructed for the purpose of the question.

Student reviews of the fourth edition (for example on Amazon[2]) were scathing about the number of errors in the exercises, not unreasonably expecting that a fourth edition should be largely error free. Correction of such errors is not explicitly mentioned as one of the amendments made in the fifth edition, but as the publisher maintained an errata list for the previous edition, one might expect this has been dealt with. Student users commented that the important facts and definitions were hard to locate in the fourth edition, often being swamped with text or indistinguishable from examples, and comparing this new edition with sample pages of the fourth on-line[3], that has not changed. I am inclined to place responsibility for the layout of pages and the typesetting at the feet of the editorial staff, rather than the author. In modern typesetting, changing the relative prominence of elements such as headings, subheadings, definitions etc. and incorporating highlighting such as spacing or coloured boxes should not be insurmountably difficult. The book would look less dated if the fonts used in the figures matched the font in the text body (e.g. x doesn't match x).

The book has made it to its fifth edition and been around for nearly 30 years, and I have no doubt that it covers adequately its theoretical content. But, while my students would probably be briefly amused if I chose a textbook with an author called Sheldon from California, my search for a text for my Australian students will go on.

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Zombies & Calculus

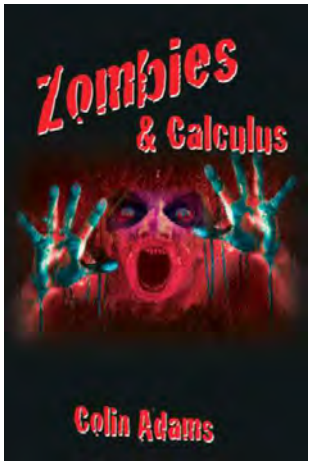
Colin Adams
Princeton University Press, 2014, ISBN 978-0-6911-6190-7

Shaun of the Dead, World War Z, Zombieland, The Walking Dead . . . the zombie has crossed the road, not to eat the chicken, from being a staple of the B movie to a staple of popular culture.

[2] http://www.amazon.com/Introduction-Probability-Statistics-Engineers-Scientists/dp/0123704839

[3] http://store.elsevier.com/Introduction-to-Probability-and-Statistics-for-Engineers-and-Scientists/Sheldon-Ross/isbn-9780080919379/

Evidentially most characters that appear in zombie movies have not watched zombie movies. If they had, they would have a greater chance of surviving by avoiding the 'traps' that catch the unwary. However, it is easy to be wise from the comfort of the sofa. You may believe that your pre-existing knowledge of zombies will give you a cutting edge. You may also believe that your intellect will aid you in surviving. Let's be honest. The average academic is going to become zombie fodder pretty quickly. Whilst it may be appealing to fantasize about which of your colleagues will be eaten first, the sad reality is that soon afterwards they will be coming for you. Yes, your intellect, your braaaiiinnnsss will be in demand.



Colin Adams has constructed an entertaining story of a zombie outbreak at a small liberal arts college in New England. The story starts at 'hour 6', when the first zombies arrive on campus, and finishes at 'hour 24', with a small band of survivors heading for the Canadian border. An epilogue summarises developments over the next three months. Against expectations, not only does Professor Craig Williams survive the zombie apocalypse but he finds that his knowledge of calculus aids in his survival.

During the course of those first eighteen hours Professor Williams finds a number of opportunities to explain to his companions how calculus can explain what's happening. The index contains 51 scientific terms, mostly drawn from calculus with a small amount of statistics and a few scientific terms, mostly connected to viruses. However, whilst he explains why the number of zombies is initially going to grow exponentially the secretary shows more sense and discovers that the security guard has been bitten! Professor, save the exposition for later. The ease with which academics can be distracted from the task at hand by providing them with an opportunity to discuss the importance of their subject, this is one reason why I anticipate a high mortality rate amongst them. Still, it suggests that in the case of a zombie outbreak a good survival strategy will be to include a brace of academics in your survival party — better them than you should the need arise . . . .

Anyone interested in zombies or the combination of mathematics and fiction will enjoy this book. The book illustrates how some standard calculus examples can be recast using zombie cladding. Three examples that I particularly enjoyed concern the classic 'pursuit problem', taking into account that zombies head towards where the target is now and not where they are heading towards. The first time we are introduced to this problem, the Dean of the Faculty is heading for Sleason Hall. The 'real-life' solution to this problem illustrates that when applying a mathematical solution we must always consider possible limitations due to assumptions made. It is a good approximation to model the Dean and the zombie as points. However, the Dean is caught by the zombie not because their points coincide but because the Dean becomes within the reach of the zombie's arm. (The Dean escapes, but there were zombies in Sleason Hall!) A few pages later, one of the survivors is on a bicycle pedalling around a walkway that encircles the interior of a quad. In this

case the pursuing zombies settle into a circular path on a slightly smaller radius than the one being cycled. The third time we encounter the pursuit problem the survivors are at the top of an auditorium while the zombies are at the bottom. Instead of following the survivors' path, the zombies can only move in a straight line towards where the survivors are: climbing straight over the seats.

Does it work as a piece of fiction? To use mathematics as a plot device slows down the pacing. Furthermore, most readers will either already know the mathematics or have no interest in the mathematics. Thus the readership that will benefit from the exposition, except perhaps for lecturers wanting to use specific examples in their teaching, is rather limited.

Calculus, good against zombies in a fictional work. That is one thing. Good against the living dead in the next zombie apocalypse? That's something else.

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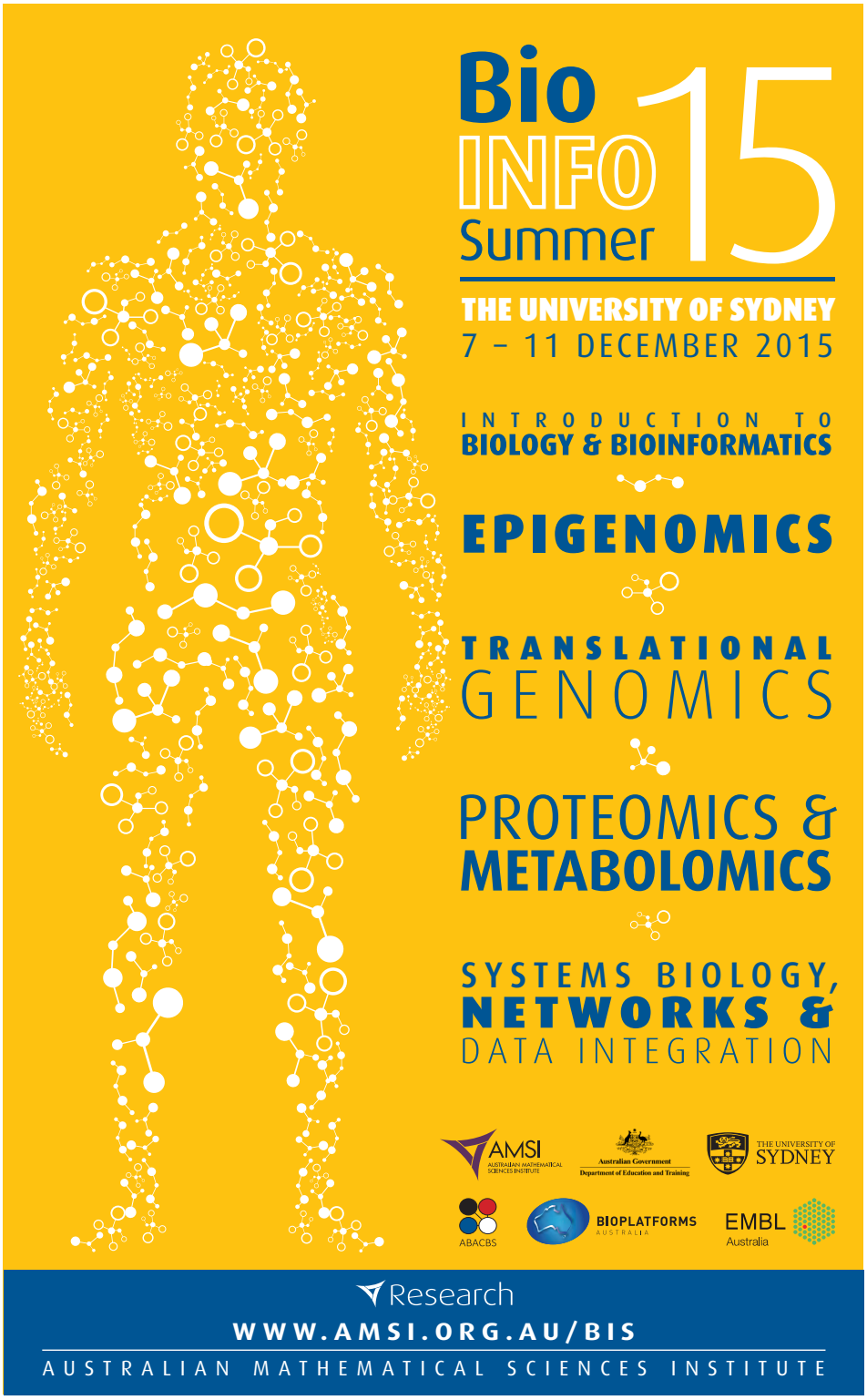
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Nalini Joshi*

Opinions abound on the ATAR

Socrates was reported to have said 'Education is the kindling of a flame, not the filling of a vessel.' At its recent meeting, the National Committee for Mathematical Sciences discussed an issue close to the heart of each of us: mathematics education. The galvanising topic was the nationwide obsession with the Australian Tertiary Admission Rank (ATAR). It appears that, in Australia, the flame of mathematics education may be flickering because of our fixation on maximising every student's ATAR.

The discussion was stimulated by two reports (see [1], [2]) highlighted at the NCMS meeting by the President of the Australian Association of Mathematics Teachers, Dr Mary Coupland. These reports focused on the situation in NSW[1], but the outcomes are of national interest.

The points highlighted in our discussion, and in this column, concern the mathematical education of the broader cohort of our future society, not just the high flyers. While the number of students undertaking the top-level mathematical courses (the combination of Higher School Certificate (HSC) Mathematics Extension 1 and 2 courses) has remained relatively small and stable, the number taking the calculus based mathematics course is declining in favour of the non-calculus general mathematics course. The reports [1], [2] point out a startling reason for this decline: the award of higher scaled scores in the ATAR to students studying the General Mathematics course.

The earlier report [1] by the Mathematical Association of NSW (MANSW) describes the results of a survey of teachers and analysis of students' mathematics subject preferences in 2013. One of its many worrisome conclusions is that students are electing to undertake the non-calculus General Mathematics course in

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[1]It may be useful for overseas and out-of-state readers to know that in NSW there are four senior (Years 11 and 12) high school mathematics courses, which can be taken for the Higher School Certificate (HSC): General Mathematics (2 unit), Mathematics (2 unit), Mathematics Extension 1 (3 unit) and Mathematics Extension 2 (4 unit). General mathematics is the sole one that does not include any calculus topics. The HSC Mathematics (2 unit) course is designed for those who have been able to achieve most of the Year 7 to 10 mathematics outcomes as measured by the Year 10 School Certificate (SC) Mathematics test. The ATAR is a single figure between 0 and 99.95 with increments of 0.05 that is intended to measure performance in Year 12 relative to other students.

preference to the calculus based 2 unit Mathematics course due to a perception that the former choice leads to a higher ATAR score for less effort.

The more recent report [2] highlighted by Dr Coupland explores detailed empirical data to back up this conclusion. It compares the results for a cohort of students undertaking the 2011 School Certificate (SC) mathematics exam and estimates the scaled marks for their 2013 HSC mathematics exam. It shows that students with similar ability measured by SC exam can expect an advantage in scaling results arising from their choice of the General Mathematics course. We quote from p. 12 of the report 'it is clear that the relative performance of students ... improves about twice as often for students who take HSC general mathematics than for those who take HSC mathematics.'

The overall findings of both reports are very worrying:

- The number of students taking the Mathematics (2 unit) course declined by 18% between 2001 and 2013, while the combined numbers in the extension courses has remained stable. This leads to a decline in the total number of students undertaking calculus-based mathematics courses.
- The most frequent reason given for choosing a mathematics course below the capability of a student is 'a desire to optimise HSC and ATAR results' ([1, p. 10]).
- In 2013, a General Mathematics student on the 90th percentile scored a higher ATAR contribution than the median Mathematics (2 unit) student ([1, p. 13]).
- The results of a comparison between the relative performance of students in the Year 10 SC Mathematics test in 2011 and their estimated scaled examination results in the HSC General Mathematics or HSC Mathematics (2 unit) course in 2013 show that 'on average, the study of HSC general mathematics leads to materially higher scaled scores, relative to the performance on the SC mathematics test, than does the study of HSC mathematics' ([2, p. 16]).

There are also sharp differences in outcomes between metropolitan and regional schools: '49% of Year 12 students in metropolitan Sydney and 24% in NSW regional schools are enrolled in a calculus course' ([1, p. 2]). Why should this matter? The MANSW report answers ([1, p. 4]): 'Lower student numbers in the calculus courses will have short and long term negative impact on the teaching population and Australia's global competitiveness.'

How can we respond to these findings? What should we do to manage the distorting influence of gaming the ATAR? Should we reintroduce prerequisites for entry into University mathematics courses? Should Universities introduce their own entrance examinations? What do you think? I look forward to hearing from you.

References

[1] Report on the MANSW 2013 Secondary Mathematics Teacher Survey. http://www.mansw.nsw.edu.au/resources/public-resources/2013-secondary-mathematics-teacher-survey-report. Accessed 2 June 2015.

[2] Pitt, D.G.W. (2015). On the scaling of NSW HSC marks in mathematics and encouraging higher participation in calculus based courses. *Australian Journal of Education* 0004944115571943.

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 is a member of the Commonwealth Science Council of Australia.

AMSI-ANZIAM
2015 LECTURE TOUR

PROFESSOR

MICHAEL SHELLEY

NEW YORK UNIVERSITY

27-28	JULY	SYDNEY
30-31	JULY	PERTH
3-4	AUG	ADELAIDE
5-6	AUG	MELBOURNE
10-11	AUG	BRISBANE
12	AUG	NEWCASTLE

Research

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AUSTRALIAN MATHEMATICAL SCIENCES INSTITUTE

AMSI News

Janine McIntosh*

For some time concerns have been raised about Australia's ability to satisfy the demand for mathematically capable professionals. AMSI is well known for its advocacy in this space, and for the programs we deliver to address the issues. Across the pipeline, from the earliest years of primary school, through junior secondary and Years 11 and 12, and then into undergraduate and postgraduate study the motivation for students to 'stick with maths' seems to be diminishing.

The decision for a student to choose maths comes from having sufficient information and motivation about the need to do so. Information about the types of work that mathematicians and statisticians do and motivation to understand that any effort made to complete a secondary school mathematics subject will have benefits. As things stand, both the information and motivation are in short supply. Especially for girls and young women — too few of them take mathematics in the senior years of secondary school and in undergraduate years of university. The reasons for this are many and varied, and attempts to address them will require a multi-dimensional approach.

AMSI has secured funding from the BHP Billiton Foundation to address just these issues with strategies across the mathematics pipeline to be implemented over the next five years. The funding allows AMSI to engage 13 new staff to work on a program designed to entice more girls and young women into mathematics. In each of the four components, explained below, there will be opportunities for AMSI members to collaborate with us in the delivery of *Choose Maths*.

Component A — Mathematics-Ready Teacher PD

A professional development program will be delivered on-the-ground in 120 Australian schools throughout the life of the *Choose Maths* program. The program will be based on AMSI's existing highly successful cluster arrangement where a secondary school and up to three of its feeder primary schools are formed into a professional development group working with an AMSI Specialist to focus on enhancing content knowledge. The cluster provides a support network for teachers and creates a ripple effect in the region as teachers share their experiences with other teachers in their area.

Component B — Women in Mathematics Career Awareness Campaign

A national public-awareness campaign will be launched to help students (especially female students), their teachers, parents, and the general public, see that

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rewarding and interesting careers exist for people who 'stick with maths'. Elements will be designed to refute the stereotype that science, technology, engineering and mathematics (STEM) subjects are predominantly male domains. The means of communication may include videos, posters, radio, print and social media, regular stakeholder newsletters, online advertisements and a website.

Component C — Inspiring Women in Mathematics Initiative

We aim to establish a community of high-achieving women and men passionate about sharing their professional journey and wisdom with the young women of Australia. We need to establish a community of 'passionate professionals' who are good role models for their achievement in STEM and also possess the ability to translate their experience for the audience. Activity in this component includes shadowing opportunities, careers events, scholarships to attend AMSI events and a Maths and Biology Initiative — where the interdisciplinary connections between mathematics and biology will be made explicit.

Component D — The BHP Billiton Awards for Excellence in the Teaching and Learning of Mathematics

As professionals, teachers are highly motivated and committed to successive generations of students. Teachers however tend to celebrate their students' achievements and are seldom celebrated for their own. The *Choose Maths* program will address this lack of recognition for teachers of maths by initiating the Annual BHP Billiton Foundation Awards for Excellence in the Teaching of Mathematics.

I am the Program Manager for AMSI Schools where I lead a professional development and schools visit program for teachers across the country. From 2015, I will lead the *Choose Maths* project as Program Director. Through clusters of schools supported by industry and government partners, my aim is to encourage more Australians to enjoy and study mathematics.

I came to AMSI in 2005 as one of the authors of *ICE-EM Mathematics*, and have developed a suite of online classroom mathematics and careers materials in my time here. I was one of the writers for the Australian Curriculum: Mathematics F–10, am an experienced primary teacher and have also worked as a lecturer in mathematics education at the University of Melbourne.

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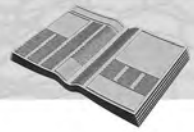

News

General News

Archives for distinguished fellows

The Kurt Mahler Archive was established in 2012 at https://carma.newcastle.edu.au/mahler/ and reported on in detail in *Gazette* 41(1), pp. 11–21. A link has also been created from the Society's site.

The Society's Steering Committee suggests that it would be desirable to establish an archive for others, following the template used for Professor Mahler's. Natural candidates are deceased Fellows with prominent students who can lead the archival work. If you are interested in constructing such an archive please keep the Society informed through the AustMS secretary, Peter Stacey.

New Mathematics Education Special Interest Group

Deb King and Joann Cattlin are happy to announce the establishment of a new Mathematics Education SIG of the AustMS.

Over the past two years or so, there has been growing interest amongst mathematicians in tertiary mathematics education. This has been evident in the activities of research projects such as FYiMaths http://fyimaths.org.au/ and mathsassess http://mathsassess.org/ (both funded by the Office for Learning and Teaching) and conferences such as Delta (tertiary mathematics education), ACSME (Australian Conference for Science and Mathematics Education) and ANZMC8. We felt that the establishment of a Mathematics Education Special Interest Group was needed to ensure that AustMS members can contribute to, and be informed of, the current national discussions in tertiary mathematics education on issues including:

- Retention and progression of tertiary mathematics students
- Online learning and eLearning
- Declining lecture attendance and lecture recording
- Assessment in mathematics
- The challenges of teaching underprepared students and addressing high failure rates
- Transition from secondary to tertiary mathematics
- The declining number of students studying intermediate and advanced level mathematics in upper secondary school
- Increased teaching performance expectations
- Connections with the secondary education sector and the Australian Curriculum

The first meeting of the SIG will be held at the AustMS meeting at Flinders University (exact date yet to be confirmed). The interim Chair and Secretary will be Dr Deborah King and Joann Cattlin, both of The University of Melbourne. Expressions of interest will be sought for an interim Treasurer at the 2015 AustMS meeting. The group will not formally be established until first membership fees can be collected for the SIG in 2016, but we would like to start building membership now. If you would like to nominate to join this SIG please email Joann Cattlin (joann.cattlin@unimelb.edu.au). You will be able to nominate to officially join the SIG when you renew your AustMS membership next year.

Further details about the SIG will be available on the AustMS website in the near future.

Events at University of New South Wales

15 May: the UNSW School of Maths and Stats hosted its 10th annual 'Girls Do The Maths' workshop. This year saw an unprecedented number of registrations, with over 70 attendees. Girls Do The Maths is aimed at female students finishing their high school studies (years 11 and 12), and hopes to inspire them to consider mathematics as a career.

1 June: Professor Pierre Del Moral delivered his Professorial Inaugural Lecture. This talk was the third in the Lecture series, whereby all of UNSW's newly promoted and recruited Professors are invited to deliver an Inaugural Lecture.

11 June: UNSW School of Maths and Stats hosted its Second Postgraduate Conference, now planned to be an annual event. This exciting day featured talks and poster presentations from 40 of our postgraduate students across diverse areas of maths and stats.

Free copies of the Journal and Bulletin

Cheryl Praeger (cheryl.praeger@uwa.edu.au) has a full collection of both the *Journal* and the *Bulletin*. She is moving to a much smaller office, so cannot keep them. If anyone is interested in all or some of them (to fill out an existing collection), please contact her. There is no cost, but the recipient would be responsible for the costs of transporting them from Perth.

Completed PhDs

ANU

- Dr Xi Chen, *The spectral measure on non-trapping asymptotically hyperbolic manifolds*, supervisor: Andrew Hassell.

La Trobe University

- Dr Waruni Abeysekera, *New recentered confidence spheres for the multivariate normal mean*, supervisors: Paul Kabaila and Davide Farchione.

- Dr Alexandra Garnham, *Improving modern dimension reduction methods through transformations*, supervisors: Luke Prendergast and Bob Staudte.
- Dr Naghmana Tehseen, *Geometric symmetry techniques for partial differential equations*, supervisors: Geoff Prince and Philip Broadbridge.

Queensland University of Technology

- Dr Jegar Pitchforth, *Bayesian networks for information synthesis in complex systems*, supervisor: Paul Wu.

University of Melbourne

- Dr Michael Neeson, *Compound drops*, supervisors: Derek Chan and Rico Tabor.
- Dr Caley Finn, *One-dimensional stochastic models with open boundaries: integrability, applications, and q-deformed Knizhnik–Zamolodchikov equations*, supervisors: Jan de Gier, Richard Brak and Mark Sorrell.
- Dr Mariam Kreydem, *Lebesgue density notions on the Cantor space*, supervisor: Hyam Rubinstein.
- Dr Emily Duane, *New data generation and solution techniques for the sequential ordering problem with time windows*, supervisors: Heng-Soon Gan and Natashia Boland.

University of New South Wales

- Dr Yuguang Wang, *Filtered polynomial approximation on the sphere*, supervisor: Ian Sloan.

University of South Australia

- Dr Paraskevi Thomas, *Markov models and computer simulations of water management in connected dams with an application to a stormwater system in the City of Salisbury*, supervisors: Phil Howlett and Julia Piantadosi.
- Dr Ben Martini, *ForFACTS: a forensic framework for analysis of cloud technologies and services*, supervisor: Raymond Choo.

University of Southern Queensland

- Dr Mayada G. Mohammed Al-Badri, *Dynamics of active systems with nonlinear excitation of the phase*, supervisors: D.V. Strunin and T. Tran-Cong.

University of Sydney

- Dr Alex Badran, *Arbitrage-free models for VIX and equity derivatives*, supervisors: Ben Goldys and Marek Rutkowski.
- Dr Darren Engwirda, *Locally optimal Delaunay-refinement and optimisation-based mesh generation*, supervisor: David Ivers.

University of Western Australia

- Dr Milena Jacobs, *Improved rounding methods for binary and ordinal variables under multivariate normal imputation*, supervisor: R. Nazim Khan.

Awards and other achievements

La Trobe University

- Professor Phil Broadbridge has received a JSPS Invitation Fellowship, 'Exactly solvable difference equations for heat and mass transport', from the Japan Society for Promotion of Science/Aust Academy of Science, to work with Professor Kenji Kajiwara in Kyushu University, October–December 2015.
- Dr Philipp Bader (post-doctoral fellow) has been accepted to attend this year's highly prestigious Heidelberg Laureate Forum in Germany.

Swinburne University

- Associate Professor Birgit Loch commenced as Chair of the AustMS Standing Committee for Mathematics Education late last year.
- The MathsCasts team, together with the PhysCasts team, won the Vice-Chancellor's Teaching Excellence Award for 2014, with team members Associate Professor Birgit Loch and Dr Stephen Bedding from the Department of Mathematics.

University of Adelaide

- Parsa Kavkani, Alex Tam, Leon Chea, Helen Geng and Susan Pang participated in this year's Mathematical Contest in Modeling, run by the Consortium for Mathematics and Its Applications (COMAP).

  One team, with Parsa Kavkani and Alex Tam, was designated an Outstanding Winner for Problem A and was awarded an INFORMS award for their work. Only five outstanding winners were selected from over 5000 entries for this problem, which is an amazing achievement.

  The other team, with Leon Chea, Helen Geng and Susan Pang, was designated a Meritorious Winner for Problem A. There were about 640 meritorious winners out of the 5000, which is also an excellent achievement.

  The coaching team included Sanjeeva Balasuriya, Luke Bennetts, Ed Green, Judith Bunder and Sarthok Sircar.

University of South Australia

- Vivian Waller, Linda Blackall and John Boland have received a $324,000 grant for 'Carbon reductions from composting food waste for food production — fitting recycling models to urban forms' from CRC for Low Carbon Living, for 2015–2017.

- Professor John Boland and Dr Julia Piantadosi have been made Fellows of the Modelling and Simulation Society of Australia and New Zealand.

University of Sydney

- David Manescu and Uri Keich won the best paper award at RECOMB 2015 for their article entitled 'A symmetric length-aware enrichment test'.

Appointments, departures and promotions

Australian National University

- Dr Jiang Feida, Postdoctoral Fellow arrived on 1 May 2015. He is working with Professor Neil Trudinger.

University of Adelaide

- Professor Mike Eastwood has been appointed to the University of Adelaide part time.

University of Melbourne

New Research Fellow

- Dr Duy Vu

University of South Australia

- Professor Jim Hill joined the School of Information Technology and Mathematical Sciences.
- Dr Lesley Ward has been promoted to Associate Professor.

University of Sydney

- Professor Jacqui Ramagge has accepted the position of Head of School. Jacqui joined the School as an ordinary member of staff on 1 July 2015 and will take up the role of Head of School on 1 January 2016.

University of Western Australia

- Eric Swartz will be departing the School on 16 July 2015.

University of Wollongong

- Professor Arunas Verbyla has joined as a Professor of Applied Statistics.
- Professor Jacqui Ramagge has resigned. She moved to University of Sydney on 1 July.

New Books

University of New South Wales

Mohamed A. Khamsi and Wojciech M. Kozlowski (2015). *Fixed Point Theory in Modular Function Spaces*. Birkhäuser, Basel. ISBN: 978-3-319-14050-6, ISBN: 978-3-319-14051-3 (eBook).

Simon Hubbert, Quôc Thông Lê Gia, Tanya M. Morton (2015). *Spherical Radial Basis Functions, Theory and Applications*. Springer (Briefs in Mathematics). ISBN-10: 3319179381, ISBN-13: 978-3319179384. http://www.amazon.co.uk/Spherical-Functions-Applications-SpringerBriefs-Mathematics/dp/3319179381/ref=pd_rhf_dp_p_img_1.

University of South Australia

Ryan Ko and Kim-Kwang Raymond Choo (Editors) (2015). *The Cloud Security Ecosystem*. Syngress Publishing/Elsevier. ISBN: 978-0-12-801595-7.

Conferences and Courses

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

The Mathematics of Conformal Field Theory

Date: 13–17 July
Venue: The Australian National University
Web: http://maths.anu.edu.au/events/mathematics-conformal-field-theory

See the website or *Gazette* 42(2), p. 120 for more details.

Talented Students' Day

Date: Wednesday 15 July 2015
Venue: Macquarie University
Web: https://www.mansw.nsw.edu.au/student-activities/talented-students-day/talented-students-day

See the website or *Gazette* 42(2), p. 120 for more details.

Industrial & Applied Mathematics Symposium 2015

Date: 16–17 July 2015
Venue: University of Wollongong
Web: http://eis.uow.edu.au/smas/anziam-symposium-2015/index.html

See the website or *Gazette* 42(2), p. 120 for more details.

Baxter 2015: Exactly Solved Models & Beyond

Date: 19–25 July 2015
Venue: Palm Cove, Queensland
Web: http://baxter2015.anu.edu.au/

For further details see the website, or *Gazette* 42(1), p. 54.

Workshop on Harmonic Analysis and Nonlinear PDE

Date: 20 July 2015
Venue: University of Wollongong
Web: http://www.maths.usyd.edu.au/u/PDESeminar/analysis-and-pde/2015/07/

The Australian National University, Macquarie University, University of Newcastle, University of New South Wales, University of Sydney and University of Wollongong invite you to a one-day seminar day about Analysis and PDE on Monday, 20 July 2015 at the University of Wollongong, McKinnon Building (Building 67), Room 302.

The aim of this seminar day is to bring together, twice a year, specialists, early career researchers and PhD students working in analysis, partial differential equations and related fields in Australia, in order to report on research, fostering contacts and to begin new research projects between the participants.

Speakers include:

- Ian Doust (UNSW)
- Xuan Duong (Macquarie)
- Sean Gomes (ANU)
- John Harrison (Newcastle)
- Bishnu Lamichhane (Newcastle)
- Galina Levitina (UNSW)
- Rod Nillsen (Wollongong)
- Joshua Peate (Macquarie)
- Pierre Portal (ANU)
- Chris Thornett (Sydney)

Please visit the website of the Analysis and PDE workshop for further details.

Please register at https://www.eventbrite.com.au/e/harmonic-analysis-and-nonlinear-pde-one-day-workshop-tickets-17000833952.

International Workshop on Monte Carlo Methods for Spatial Stochastic Systems

Date: 21–23 July 2015
Venue: Emmanuelle College, The University of Queensland
Web: http://acems.smp.uq.edu.au/?page_id=18

See the website, or *Gazette* 42(2), p. 120, or email acems.admin@uq.edu.au for more details.

IGA/AMSI International workshop on Geometric Quantisation

Date: 27–31 July 2015
Venue: The University of Adelaide
Web: http://www.iga.adelaide.edu.au/workshops/July2015/

For further details and free registration, please see the website.

AMSI-ANZIAM Lecture Tour

Dates: 27 July to 12 August 2015
Venue: throughout Australia
Web: http://research.amsi.org.au/amsi-lecturer

Professor Michael Shelley will be touring Australia in July and August. He is the co-founder and co-director of the Applied Mathematics Laboratory at the Courant Institute of Mathematical Sciences, an arena where mathematical theory and numerical simulation collide with experimental observation and measurement.

His public lectures and specialist talks will appeal to those whose interests span applied mathematics, physics and biology.

For more information see the website.

ICIAM 2015, the Eighth International Congress in Industrial and Applied Mathematics

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

For more information, please see the website, or *Gazette* 41(3), p. 203.

Stochastic Processes and Special Functions Workshop

Date: Thursday 13 and Friday 14 August
Venue: The University of Melbourne
Web: http://acems.org.au

The ARC Centre of Excellence for Mathematical and Statistical Frontiers (ACEMS) invites you to this two-day workshop, which will concentrate on the theory and applications of special functions with particular emphasis on how they arise in stochastic processes.

Speakers include:

- Richard Brak (U Melbourne)
- Jon Borwein (U Newcastle)
- Jan De Gier (U Melbourne)
- Paul Keeler (Weierstrass Institute, Berlin)
- Alexander Novikov (UT Sydney)
- Phil Pollett (U Queensland)
- Nathan Ross (U Melbourne)
- Thomas Taimre (U Queensland)

- Peter Taylor (U Melbourne)
- Ole Warnaar (U Queensland)
- Michael Wheeler (U Melbourne)
- Wadim Zudilin (U Newcastle)

Please visit the ACEMS website to register if you are interested in attending.

Workshop in Honour of Brailey Sims

Date: Friday 21 August 2015 to Sunday 23 August 2015
Venue: CARMA, The University of Newcastle
Web: https://carma.newcastle.edu.au/meetings/sims2015/

See the website, or *Gazette* 42(2), p. 122, or contact Juliane Turner (Juliane.Turner@newcastle.edu.au, phone (02) 4921 5483, or facimile (02) 492 16898) if you have any questions. Note the extended dates!

Mathematics Education in a Connected World

Date: 16–21 September 2015
Venue: Grand Hotel Baia Verde, Catania, Italy

Please email Alan Rogerson at alan@cdnalma.poznan.pl for all details and updates.

Number Theory Down Under

Date: 18–19 September 2015
Venue: The University of Newcastle
Web: http://carma.newcastle.edu.au/meetings/ntdu3/

Please see the website for details and updates.

59th Annual Meeting of the Australian Mathematical Society

Date: 28 September to 1 October 2015
Venue: Flinders University
Web: www.austms2015.flinders.edu.au

See the website for more details and updates.

2015 Australian Conference on Science and Mathematics Education

Date: 30 September to 2 October 2015
Venue: Curtin University, Perth
Web: http://sydney.edu.au/iisme/conference/2015/index.shtml

IEEE International Workshops on Complex Systems and Networks

Date: 4–7 October 2015
Venue: Old Swan Brewery, Perth
Web: http://iwcsn.eie.polyu.edu.hk/2015/Home.html

Please see the website for updates and details of the program.

ABACBS Conference 2015

Date: 10–11 October 2015
Venue: Garvan Institute of Medical Research, Sydney, NSW
Web: http://www.abacbs.org/conference/

The Australian Bioinformatics And Computational Biology Society (ABACBS) is pleased to announce the ABACBS Conference 2015, following a successful Australian Bioinformatics Conference in Melbourne last year. We are currently working hard to compile an exciting line up of international and national speakers. Martha Bulyk (Harvard, US), Sean Grimmond (University of Glasgow, UK), Alistair Forrest (Harry Perkins Institute of Medical Research, AU), Aaron Darling (UTS, AU), Jean Yang (University of Sydney, AU), and Melissa Davis (University of Melbourne, AU) are confirmed speakers. Abstract submissions for either oral or poster presentations will be opening shortly. A limited number of travel bursaries will be available for students and early career researchers; applications close 14 August.

Registration ($99, or $124 including a BBQ Dinner) is open and available at the website. Please submit your abstracts for consideration via our ABACBS 2015 EasyChair page. If you do not have an EasyChair account you will need to register (free) prior to submission. We will notify outcomes on 11 September. Closing date for submission is 14 August.

Convenors: Nicola Armstrong and Richard Edwards.
Organising Committee: Kim Carter, Brian Gloss, Joshua Ho, Mirana Ramalison, Ashley Waardenberg.
Programme Committee Chairs: Shoba Ranganathan, Bruno Gaeta.

Questions? Email us: conference@abacbs.org

Australian Mathematical Sciences Student Conference

Dates: 2 November to 30 December 2015
Venue: University of Tasmania

Further details to follow.

The 21st International Congress on Modelling and Simulation (MODSIM2015)

Date: Sunday 29 November to Friday 4 December 2015
Venue: Gold Coast Convention and Exhibition Centre, Broadbeach, Queensland
Web: http://www.mssanz.org.au/modsim2015/index.html

For further details see the website or *Gazette* 42(1), p. 56.

Engineering Mathematics and Applications Conference (EMAC)

Date: 6–9 December 2015
Venue: UniSA, City West Campus Adelaide
Web: https://emac2015.unisa.edu.au/

EMAC is the biennial meeting of the Engineering Mathematics Group (EMG), a special interest group of ANZIAM. This meeting provides a forum for researchers interested in the development and use of mathematical methods in engineering and applied mathematics. It aims to foster interactions between mathematicians and engineers, from both academia and industry and will also include a special session on engineering/mathematics education. Invited speakers include Christine Mangelsdorf, Kylie Catchpole, Martyn Nash, Darryn Reid and Ben Rubinstein.

Registration for the 2015 Engineering Mathematics and Applications Conference (EMAC) is now open.

- Abstract submission closes: 9 October
- Early-bird registration closes: 23 October
- To register or find out more, visit the website.

KOZWaves 2015

Date: 6–9 December 2015
Venue: The University of Adelaide
Web: http://www.maths.adelaide.edu.au/kozwaves2015/index.html

The second international Australasian conference on wave science: see *Gazette* 42(1) p. 56 or the website for further details.

39th Australasian Conference on Combinatorial Mathematics and Combinatorial Computing

Date: Monday 7 December to Friday 11 December 2015
Venue: University of Queensland
Web: http://39accmcc.smp.uq.edu.au/

See *Gazette* 42(1) p. 56 or the website for further details, or email Darryn Bryant at db@maths.uq.edu.au.

BioInfoSummer 2015

Date: 7–11 December 2015
Venue: The University of Sydney
Website: http://bis15.amsi.org.au/

Courses include: Introduction to Biology and Bioinformatics, Epigenomics, Translational Genomics, Proteomics and Metabolomics, Systems Biology, Networks and Data Integration. Student Travel Grants are available and earlybird rates are available for this event. Register for event updates at the new website.

Earlybird registration closes: 1 October 2015
Poster abstract submissions close: 6 November 2015

Registration closes: 27 November 2015
Travel Grant Applications open: 20 August 2015
Travel Grant Applications close: 16 October 2015

Conference on Geometric and categorical representation theory

Date: 14–18 December 2015
Venue: Mantra Hotel, Mooloolaba, Queensland
Web: https://sites.google.com/site/masoudkomi/mooloolaba

2016 AMSI Summer School

Date: 4–29 January 2016
Venue: RMIT University
Web: http://ss16.amsi.org.au/

A reminder that

- Travel Grant applications open: 13 August 2015.
- Travel Grant applications and first registration close: 1 November 2015.
- Final registration closes: 25 November 2015.

Gromov-Witten Theory, Gauge Theory and Dualities

Date: 6–15 January 2016
Venue: ANU/Kioloa
Web: http://maths.anu.edu.au/events/gromov-witten-theory-gauge-theory-and-dualities

This Lecture Series/Workshop is one of the major events hosted by the 2015 MSI special year on 'Geometry and Physics'. The workshop will begin on 6 January 2016 in Canberra with a introductory workshop followed by an international conference at the ANU Kioloa campus from 10 January 2016. The introductory workshop aims to familiarise postgraduate students and young researchers to some of the main mathematical techniques for the study of the moduli spaces from gauge theory and Gromov–Witten theory. The purpose of the conference is to bring together leading international researchers in the areas of geometry and physics, with a main focus on the geometry and topology of moduli spaces arising from gauge theory and Gromov–Witten invariants, mirror symmetry and other dualities.

Organisers: Peter Bouwknegt (Chair), David Ridout, Bryan Wang.

ANZIAM 2016

Date: Sunday 7 February 2016 to Thursday 11 February 2016
Venue: QT Canberra Hotel, Canberra

ANZIAM 2016 is scheduled to be held from 7–11 February 2016 in Canberra. Further details including the conference website will be available later this year.

AMSI Big Day In

Date: 10–11 February 2016
Venue: Trinity College, The University of Melbourne
Web: vrs.amsi.org.au/big-day

Mathematical Methods for Applications

Date: 11–14 November 2016
Venue: Hangzhou, China
Further information: Phil Broadbridge (P.Broadbridge@latrobe.edu.au)

This is a joint meeting of ANZIAM and ZAPA, the Zhejiang Applied Mathematics Association. For further information, please email Phil Broadbridge.

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.

Prof David Allen; Edith Cowan; 1 August 2014 to 31 July 2015; stats; USN; Shelton Peiris

Dr Joel Andersson; Stockholm University; 1–31 October 2015; pure; USN; Leo Tzou

Dr Aline Aparecida de Souza Leao; University of Sau Paulo, Brazil; 1 July to 1 November 2015; UMB; Alysson Costa

Paul Baird; Laboratoire de Mathematiques, De Bretagne Atlantique; September to December 2015; UWA; Lyle Noakes

Professor Dror Bar-Natan; University of Toronto; 27 June to 12 July 2015; ANU; Scott Morrison

Dr Elizabeth Beazley; Haverford College, USA; 1 August 2015 to 31 January 2016; UMB; Arun Ram

A/Prof Lisa Carbone; Rutgers University, USA; 25 June to 28 July 2015; UMB; Arun Ram

Prof Dayue Chen; Peking University, PRC; 24–28 August 2015; UMB; Aihua Xia

Prof Peter Clarkson; University of Kent; 19–30 July 2015; UWA; Andrew Bassom

Thierry Coulhon; Paris Sciences et Lettres; 1 February to 31 December 2015; ANU; Peter Bouwknegt

Dr Zajj Daugherty; Dartmouth College, USA; 2–28 July 2015; UMB; Arun Ram

Michael Eastwood; 1 January to 31 December 2015; ANU; Thierry Coulhon

Dr Yi Fang; 31 March 2015 to 31 December 2015; ANU; Xu-Jia Wang

Prof Xin Gui Fang; Peking University, PRC; 24-28 August 2015; UMB; Aihua Xia

Dr Xiang Fu; Peking University, PRC; 24–28 August 2015; UMB; Aihua Xia

Dr Jürgen Fuchs; Karlstad University; 28 June to 18 July 2015; ANU; David Ridout

Prof Yasunori Fujikoshi; Hiroshima University; 12–19 September 2015; UWA; Berwin Turlach

Dr Han Gan; Washington University, USA; 1 June to 20 August 2015; UMB; Aihua Xia and Nathan Ross

Prof Jana Gevertz; College of New Jersey; 13 to 24 July 2015; applied; USN; Peter Sehoon Kim

Mr Jacek Grela; Jagiellonian University, Poland; 15 March 2015 to 15 July 2015; UMB; Peter Forrester

A/Prof Jianyu Han; Anhui University, PRC; 1 August 2015 to 31 July 2016; UMB; Dr Guoqi Qian

Dr Viktoria Heu; University of Strasbourg; 2–15 August 2015; applied; USN; Nalini Joshi

A/Prof Mengbo Hou; Shandong University of China; February 2015 to February 2016; cryptography; USA; Raymond Choo

A/Prof Xian-Jiu Huang; Nanchang University, China; 1 October 2014 to 30 September 2015; ANU; Xu-Jia Wang

Dr Zhong Jin; Shanghai Maritime University; August 2014 to August 2015; optimisation; FedUni; David Gao

Dr Paul Keeler; Weierstrass Institute, Berlin; 22 August to 5 Septemper 2015; UMB; Peter Taylor

Professor Alexander Kleshchev; University of Oregon, USA; 1–15 July 2015; UMB; Arun Ram

Prof Satoshi Koike; 7 October to 7 November 2015; pure; USN; Laurentiu Paunescu

Prof Xin-Bing Kong; Soochow University; 19 July to 15 August 2015; stats; USN; Qiying Wang

Prof Shrawan Kumar; University of North Carolina; 16 July to 15 December 2015; pure; USN; Gus Lehrer

A/Prof Aaron Lauda; University of Southern California; 22 June to 1 August 2015; UMB; Arun Ram

A/Prof Jingjian Li; Guangxi University, PRC; September 2015 to September 2017; UWA; Cai Heng Li

Prof Han-Ying Liang; Tongji University; 12 July to 5 September 2015 stats; USN; Qiying Wang

Dr Wei Lin; Peking University, PRC; 24–28 August 2015; UMB; Aihua Xia

Zhe Liu; Zhejiang University; 1 April 2015 to 31 March 2016; UWA; Cai Heng

Johnathan Manton; University of Melbourne; 1 January to 31 December 2018; ANU; Alan Carey

A/Prof Si Mei; Shanghai Jiaotong University, China; 9 August 2014 to 8 August 2015; pure; USN; Andrew Mathas

James McCoy; University of Wollongong; 1 January to 31 July 2015; ANU; Ben Andrews

Dr Marco MacKaay; Universidade Do Algarve, Portugal; 22 June to 1 August 2015; UMB; Arun Ram

Dr Djordje Milicevic; Bryn Mawr College, Pennsylvania; 1 August 2015 to 31 January 2016; UMB; Arun Ram

Prof Pierre Milman; University of Toronto; 15 October to 15 November 2015; pure; USN; Laurentiu Paunescu

A/Prof Sylvie Monniaux; Université Aix-Marseille; 15 October 2014 to 15 July 2015; ANU; Pierre Portal

Samuel Mueller; University of Sydney; 1 January to 31 December 2016; ANU

Dr Kok Haur Ng; University of Malaya; 13–25 July 2015; stats; USN; Jennifer Chan

Prof Enzo Orsingher; Sapienza University of Rome; 18–29 August 2015; probability theory; LTU; Andriy Olenko

Mr Jay Pantone; USA; 25 Jun3 to 18 August 2015; UMB; Tony Guttmann

Dr Simona Paoli; University of Leicester, UK; 1 August to 31 December 2015; higher category theory; MQU; Ross Street

Prof Jongil Park; Seoul National University; 3–16 August 2015; UMB; Hyam Rubinstein

Mr Aaron Poole; Durham University; 20 July to 9 September 2015; applied; USN; Nalini Joshi

Dr Peter Price; 30 March 2015 to 31 December 2016; ANU; Dr Lilia Ferrario

A/Prof Helena Ramalhinho; Universitat Pompeu Fabra, Spain; 24 June to 10 July 2015; UMB; Alysson Costa

Prof Gueorgui Raykov; Pontificia Universidad Catolica de Chile; 9–13 July 2015; UWA; Lucho Stoyanov

Dr Hemanth Saratchandran; 14 April to 14 July 2015; pure; USN; Stephan Tillmann

Dr Thidaporn Seangwattana; Naresuan University, Thailand; May to July 2015; optimization; FedUni; Alex Kruger

Mr Muhamad Shoaib; Higher Education Commission, Pakistan; 1 May to 30 November 2015; statistics; USN; Shelton Peiris

A/Prof Mei Si; Shanghai Jiaotong University; 28 August 2014 to 8 August 2015; pure; USN; Andrew Mathas

Adam Sikora; Macquarie University; 1 January to 31 December 2015; ANU; Thierry Coulhon

A/Prof Lianta Su; Quanzhou Normal University, PRC; 1 August 2015 to 31 January 2016; UMB; Guoqi Qian

Dr Garth Tarr; 1 March 2015 to 31 December 2015; ANU; Alan Welsh

Levent Tunçel; University of Waterloo; 1–21 September 2015; optimisation; RMIT; Vera Roshchina

Prof J.M.A.M. Van Neerven; Technical University Delft; 13 June to 4 July 2015; ANU; Pierre Portal

Prof Jie Wang; Peking University, PRC; 24–28 August 2015; UMB; Aihua Xia

Prof Shincheng Wang; Peking University, PRC; 24–28 August 2015; UMB; Aihua Xia

Dr Ben Webster; University of Virginia, USA; 13–17 July 2015; UMB; Arun Ram

Dr Jeroen Wouters; 25 February 2015 to 24 February 2017; applied; USN; Georg Gottwald

Mr Wei Wu; UNSW; 30 July 2012 to 31 May 2016; financial maths; USN; Ben Goldys

Dr Binzhou Xia; Beijing International Center for Mathematical Research, PRC; 26 July to 26 August 2015; UWA; Cai Heng Li

Prof Qing Xiang; University of Delaware, USA; 16–30 July 2015; UWA; Cai Heng Li

Dr Fan Yang; Jiangsu University of Science and Technology, China; 1 October 2014 to 30 September 2015; UMB; Sanming Zhou

A/Prof Fuxi Zhang; Peking University, PRC; 24–28 August 2015; UMB; Aihua Xia

A/Prof Hua Zhang; Yunnan Normal University, PRC; 20 July to 14 August 2015; UMB; Sanming Zhou

Prof Lei Zhang; Peking University, PRC; 24–28 August 2015; UMB; Aihua Xia

Prof Pingwen Zhang; Peking University, PRC; 24–28 August 2015; UMB; Aihua Xia

Hui Zhou; Peking University, PRC; September 2015 to March 2017; UWA; Cheryl Praeger, Alice Devillers and Michael Giudici

A/Prof Jinxin Zhou; Beijing Jiaotong University, PRC; 3 July to 3 Sept 2015; UWA; Cai Heng Li

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The 2015 Annual General Meeting

The Society's Annual General Meeting for 2015 will be held at Flinders University on Tuesday 29 September at 5.30 pm. Papers for the meeting will be posted beforehand on the conference website http://www.flinders.edu.au/science_engineering/csem/research/centres/fmsl/austms2015/austms2015_home.cfm.

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Members of the Society interested in serving on any of the following committees of Council are invited to contact the Secretary, who will put their names to the Nominations and Publications Committee, which makes membership recommendations to Council.

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The Mahler Lecturer Committee
The Accreditation Committee
The Fellowship Committee
The Membership Committee
The Standing Committee on Mathematics Education
The Student Conference Support Committee.

AustMS Accreditation

Mr Man Fung Lo has been accredited as an Accredited Member (MAustMS).

The following members have been accredited as Fellows (FAustMS).

Professor Graham Farr of Monash University
Dr Ryan Loxton of Curtin University
Professor Aleksander Owczarek of the University of Melbourne
Professor Aidan Sims of the University of Wollongong
Professor Michael Small of the University of Western Australia
Professor Kok Lay Teo of Curtin University.

Peter Stacey
AustMS Secretary
Email: P.Stacey@latrobe.edu.au

Peter Stacey joined La Trobe as a lecturer in 1975 and retired as an associate professor at the end of 2008. Retirement has enabled him to spend more time with his family while continuing with some research and some work on secondary school education. He took over as secretary of the Society at the start of 2010.

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