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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.

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

Deadlines for submissions to 41(3), 41(4) and 41(5) of the *Gazette* are 1 June, 1 August and 1 October 2014.

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Editorial

At the time of writing this editorial, the Australian Federal Treasurer has just delivered his Budget speech and signalled significant change to university and school funding. It will be interesting to see how this affects the Australian higher education system over the next decade. The Treasurer also signalled a big increase in medical research funding, but no similar increase in research support outside medicine, which is very disappointing. In particular, once again the importance of basic research has not been recognized. The Treasurer referred to the fact that no Australian university is in the top 20 universities worldwide. But no university can move into the top 20 universities worldwide based solely on its medical research achievements. In his President's Column this issue, Peter Forrester asked: 'Is there a market for a purely teaching university in Australia, and if so, what would it look like with respect to the mathematical sciences?' Perhaps the deregulation of universities announced in the Federal Budget brings us one step closer to this reality and answering Peter's question.

Congratulations to Alan Carey, Matthew England, Hanna Kokko, Ivan Marusic, and George Willis on their election as Fellows of the Australian Academy of Science

In this issue we have two interesting, some might say important, articles. They are 'Flipping the maths tutorial: a tale of n departments' by Katherine A. Seaton, Deborah M. King and Carolyn E. Sandison and 'Factors affecting success in CHEM101 at UOW' by Becky Armstrong, Mark Fielding, Stephen Kirk and Jacqui Ramagge. One might think that we all know what constitutes a mathematics tutorial. However, in the first of these two articles, there is a full description of how these can be, and indeed are, managed differently at three Australian universities. In the words of the authors: 'This style of class truly flips the chalk-and-talk responsibilities in a tutorial and replaces the 'sage on the stage' with a 'guide on the side'. Its sustained use and its adoption in a number of Australian university mathematics departments, which we discuss, speaks to its effectiveness.' This article should be read because the innovation reported on is not simply innovation for innovation's sake but rather a thoroughly tested approach over 40 years at three universities which is refreshingly different from that used at other universities. Forgive the pun, but they deserve a standing ovation. The second article reports on a rather surprising observation at the University of Wollongong: 'the level of mathematics studied for the Higher School Certificate (HSC) is a better predictor of performance in CHEM101 than either the HSC Chemistry mark or the student's Australian Tertiary Admission Rank.'

In this issue of the *Gazette*, Nalini Joshi, Chair, National Committee for Mathematical Sciences, reports on a proposal to develop 'M.A.G.I.C. (Mathematical Games and Interactive Course)' which the National Committee for Mathematical Sciences is currently discussing. M.A.G.I.C. would be aimed at Year 7 to 10 students.

As usual we have reviews of a number of books, this time the books are titled 'Oxford Figures', 'Origins of Mathematical Words: A Comprehensive Dictionary of Latin, Greek and Arabic Roots' , and 'A History of the Central Limit Theorem: From Classical to Modern Probability Theory'.

Geoff Prince, Director of AMSI, says: "It is no longer a secret that the theme of this year's AMSI Winter School at sunny Brisbane's University of Queensland is Contemporary Aspects of Cryptography. In fact the only secret about the pivotal role of mathematics in cryptography and cybersecurity in particular are the mathematicians' salaries. The School will be attractive to postgraduates and postdocs who want to learn about, for example, post-quantum cryptography (in a pre-quantum computing world!) from Australian and international experts .... The speaker list includes, amongst others, Professor Tanja Lange of Technische Universiteit Eindhoven. Tanja has published more than 50 research papers bridging the gaps between algebraic geometry, theoretical cryptography, and real-world information protection .... Tanja will also be speaking at the Women in Maths networking event at the Winter School on 16 July."

AustMS News invites nominations for various Medals and for Vice-President and Council Members of the Society.

This issue also includes Ivan Guo's Puzzle Corner #37.

David and I hope that you will enjoy reading this issue.

Sid Morris, Adjunct Professor, La Trobe University;
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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 140 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

Peter Forrester*

The Australian Mathematical Society is a member of Science Technology Australia (STA). One of the events organised by STA is *Science meets Parliament*. Members of STA are eligible to support two delegates to this event, and it is recommended that these be early- to mid-career. Last year, *Science meets Parliament* was due to be held in August, but due to the federal election had to be cancelled. Starting with this year, it is intended to hold *Science meets Parliament* in March, and the 2014 event has now happened with the AustMS delegates being Bronwyn Hajek and Marcel Jackson. Both reported that it was very worthwhile. For the benefit of future delegates, they have prepared a report, including practical tips like 'bring a business card', 'have a plan for your meeting' and on dress code and punctuality. Reading from the report, on the agenda for Day 1, one sees that the theme is science communication, especially presenting your research to a wider audience, and the broader issue of successfully engaging politicians.

In relation to mathematics education, significant progress on the latter has been made by AMSI over the past few years, with highlights such as the Canberra forum 'Maths for the future: Keep Australia competitive', with keynote speaker Professor Celia Hoyles, former mathematics advisor to the British Government in February 2012. It is reasonable to suggest that the importance placed on mathematics in subsequent speeches and policy documents released by the Chief Scientist Professor Ian Chubb, for example the May 2012 document 'Mathematics, Engineering and Science in the National Interest', were influenced by AMSI's efforts. In January this year, Ian Chubb was part of a 7.30 segment on the ABC by reporter Tracy Bowden, which also featured former AustMS Council member Jacqui Ramagge and SSAI President John Henstridge. In the segment, it is pointed out that since 1995 there has been a 33 percent drop in students taking advanced maths. In addition to warning of a bleak economic future due to a serious lack of qualified workers, Professor Chubb issues a challenge to all: 'We need everybody in the tent. We need the employers indicating what they need, we need the educators making maths compellingly interesting so that people want to do it. We need the universities doing that and as well saying that in order to do certain subjects, you've got to have mathematics.'

Last month, as chair of the Decadal Plan subcommittee on Research Centres, I submitted a report to Peter Hall as chair of the steering committee. As the Decadal Plan is still to be finalised, I'll hold off on discussing details. But with respect to the issue of communication, and presenting a compelling case, there's no doubt that the formation of a national Research Centre in the mathematical sciences will require a unified effort from the broad sector. This can

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be argued to be worthwhile on a number of fronts. For example, data contained in the 2012 NSERC report 'Long-range plan for mathematical and statistical research in Canada 2013–2018' states that NSERC funded mathematical sciences institutes have a total budget of $4.14 million in 2013–2014, with leveraging from provincial governments, universities, international agencies, commercial and industrial partners, and private contributions, measured to be four-to-one purely on the basis of cash flow.

In my previous President's Column, I speculated on some university administrators doing away with mass lecture courses in favour of prerecorded videos. I've since come to learn that this is already the case in some universities in Japan, courtesy of a recent visit by a Japanese collaborator. In brief, this is an outgrowth of what is Japanese are called *juku* — private cram schools offering after-hours lessons. According to the article 'Public good or private commodity? Mathematics education in Japan and implication for the U.S.' by Linda H.L. Furuto, this is a huge industry, with nearly 70% of all students participating by the end of year 9, and generating $12 billion in revenue. My Japanese colleague tells me that the lessons are prerecorded and delivered over satellites, with the teachers being skilled actors who have similar status to the some of the students as rock stars. The next stage has been for these same private companies to use the same actors/teachers to prepare prerecorded lectures on university level subjects, and to sell them to private universities. This also brings to mind the peculiarity of the Australian tertiary education system, where all institutions are nominally both teaching and research. Is there a market for a purely teaching university in Australia, and if so, what would it look like with respect to the mathematical sciences?

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

Puzzle Corner

Ivan Guo*

Welcome to the Australian Mathematical Society *Gazette*'s Puzzle Corner number 37. Each puzzle corner includes a handful of fun, yet intriguing, puzzles for adventurous readers to try. They cover a range of difficulties, come from a variety of topics, and require a minimum of mathematical prerequisites for their solution. Should you happen to be ingenious enough to solve one of them, then you should send your solution to us.

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

The deadline for submission of solutions for Puzzle Corner 37 is 1 July 2014. The solutions to Puzzle Corner 37 will appear in Puzzle Corner 39 in the September 2014 issue of the *Gazette*.

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

Interesting intersection

Peter has drawn several (not necessarily convex) polygons on a piece of paper. He notices that any pair of the polygons have a non-empty intersection. Prove that Peter can draw a straight line which intersects all of the existing polygons.

Simplifying series

Simplify the following expression:

$$\frac{1}{1^4+1^2+1}+\frac{2}{2^4+2^2+1}+\cdots+\frac{100}{100^4+100^2+1}.$$

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Cake cutting

Christie is holding a dinner party. It is known that either X or Y guests will attend. In preparation, Christie would like to cut a cake into some number of pieces (not necessarily of equal size), so that the cake can be equally shared between the guests in either scenario.

(i) If X and Y are relatively prime, what is the minimal number of pieces required to achieve this?

(ii) What if X and Y are not relatively prime?


Photo: Aneta Blaszczyk, SXC

Baffling bisection

Given an angle $\angle ABC$, it is well-known that we can construct its angle bisector using only a compass and a straight edge. For the reader's interest, the steps are as follows.

- Draw a circle centred at B, let it intersect the segments AB and AC at points P and Q respectively.
- Draw two (fairly large) circles of equal radii with centres at P and Q. Let these two circles intersect at points X and Y.
- The line XY is the required angle bisector.

In particular, note that the point B was used in the first step. Is it still possible to construct the angle bisector of $\angle ABC$ if the point B is not allowed to be used at all?

Solutions to Puzzle Corner 35

Many thanks to everyone who submitted. The \$50 book voucher for the best submission to Puzzle Corner 35 is awarded to Dave Johnson. Congratulations!

Row of reciprocals

Harry writes down a strictly increasing sequence of one hundred positive integers. He then writes down the reciprocals of the integers.

(i) *Is it possible for the sequence of reciprocals to form an arithmetic progression?*

(ii) *Apart from the last two reciprocals, is it possible for each reciprocal to be the sum of the next two?*

(iii) *Would the answers to the previous questions change if Harry had started with an infinite sequence instead?*

Solution by David Angell: (i) The answer is yes. Let $a_1, a_2, \ldots, a_{100}$ be any strictly decreasing arithmetic progression of positive integers. If Harry writes down

$$\frac{\prod_{i=1}^{100} a_i}{a_1}, \ \frac{\prod_{i=1}^{100} a_i}{a_2}, \ \ldots \ \frac{\prod_{i=1}^{100} a_i}{a_{99}}, \ \frac{\prod_{i=1}^{100} a_i}{a_{100}},$$

which is a strictly increasing sequence of positive integers, then the reciprocals form an arithmetic progression.

(ii) Again the answer is yes. Apply the same construction to a decreasing 'reverse Fibonacci' sequence of positive integers $a_1, a_2, \ldots, a_{100}$ with $a_{99} > a_{100}$ and

$$a_{98} = a_{99} + a_{100}, \quad a_{97} = a_{98} + a_{99}, \quad \ldots, \quad a_1 = a_2 + a_3.$$

Once again, the sequence

$$\frac{\prod_{i=1}^{100} a_i}{a_1}, \ \frac{\prod_{i=1}^{100} a_i}{a_2}, \ \ldots, \ \frac{\prod_{i=1}^{100} a_i}{a_{99}}, \ \frac{\prod_{i=1}^{100} a_i}{a_{100}}$$

satisfies the required properties.

(iii) Neither construction is now possible. For (i), any strictly decreasing arithmetic progression must eventually be negative. But since the reciprocals are always positive rationals, this is clearly impossible.

For (ii), suppose that we have an infinite sequence of positive integers $a_1, a_2, \ldots$ with the property that

$$\frac{1}{a_1} = \frac{1}{a_2} + \frac{1}{a_3}, \quad \frac{1}{a_2} = \frac{1}{a_3} + \frac{1}{a_4}$$

and so on. It is easily shown by induction that, for $n \geq 3$,

$$\frac{(-1)^n}{a_n} = \frac{f_{n-1}}{a_2} - \frac{f_{n-2}}{a_1},$$

where the f_ns are the Fibonacci numbers beginning with $f_1 = f_2 = 1$. We may rewrite this as

$$\frac{(-1)^n a_2}{a_n f_{n-2}} = \left(\frac{f_{n-1}}{f_{n-2}} - \frac{a_2}{a_1}\right).$$

Since the left-hand side converges to 0 as $n \to \infty$, we must have a_2/a_1 converging to the golden ratio ϕ,

$$\frac{a_2}{a_1} = \lim_{n\to\infty} \frac{f_{n-1}}{f_{n-2}} = \phi = \frac{1+\sqrt{5}}{2}.$$

This is impossible since a_2/a_1 is rational but ϕ is irrational.

Pebble placement

(i) *There are several pebbles placed on an $n \times n$ chessboard, such that each pebble is inside a square and no two pebbles share the same square. Perry decides to play the following game. At each turn, he moves one of the pebbles to an empty neighbouring square. After a while, Perry notices that every pebble has passed through every square of the chessboard exactly once and has come back to its original position.*

Prove that there was a moment when no pebble was on its original position.

(ii) *Peggy aims to place pebbles on an $n \times n$ chessboard in the following way. She must place each pebble at the centre of a square and no two pebbles can be in the same square. To keep it interesting, Peggy makes sure that no four pebbles form a non-degenerate parallelogram.*

What is the maximum number of pebbles Peggy can place on the chessboard?

Solution by Dave Johnson: (i) Consider the moment immediately after the move that takes the last pebble out of its original square, say S. At this moment, all the other pebbles have left their original squares. Also none of them has passed through S, so they cannot yet return to their original positions. Thus at this time, no pebble was on its original position, as required.

(ii) The maximum number is $2n - 1$. This may be achieved by placing pebbles all along the top row and down the leftmost column. It is clear that in this configuration, no four pebbles may form a parallelogram.

Now we show that it is not possible to place $2n$ or more pebbles without creating parallelograms. Begin with any configuration of at least $2n$ pebbles. Suppose that there are r_i pebbles in row i. In that row, the distances between the leftmost pebble and the other $r_i - 1$ pebbles are all distinct, forming $r_i - 1$ distances. Summing over all the rows, there must be at least

$$\sum_{i=1}^{n}(r_i - 1) \geq 2n - n = n$$

distances from the leftmost pebbles. Since the possible distances must take values from $1, 2, \ldots, n-1$, there must be two pairs of pebbles from two distinct rows with equal horizontal distances, creating a parallelogram.

Flawless harmony

Call a nine-digit number flawless *if it has all the digits from 1 to 9 in some order. An unordered pair of flawless numbers is called* harmonious *if they sum to 987654321. Note that (a, b) and (b, a) are considered to be the same unordered pair.*

Without resorting to an exhaustive search, prove that the number of harmonious pairs is odd.

Solution by Joe Kupka: As an example, one harmonious pair is given by

$$(123456789,\ 864197532).$$

If we switch the order of the last two digits, the new pair

$$(123456798,\ 864197523)$$

also happens to harmonious. This is not a coincidence. In general, suppose we have a pair (m, n) with

$$m = 100X + 10a + b, \quad n = 100Y + 10c + d,$$

where $2 \le a, b, c, d \le 9$. In order for (m, n) to be harmonious, or $m+n = 987654321$, we must have $a + c = b + d = 11$. Then it is clear that the pair (m', n') given by

$$m' = 100X + 10b + a, \quad n' = 100Y + 10d + c$$

also satisfies $m' + n' = 987654321$. Thus (m', n') is harmonious as well.

In most cases, the pairs (m, n) and (m', n') are different. The notable exception is when we have $m = n'$ and $n = m'$. This can only happen if $A = C$, $a = d$ and $b = c$. It is easy to check (by working out the digits of $A = C$ backwards) that the only pair satisfying these equalities is given by

$$(493827156,\ 493827165).$$

Therefore the number of harmonious pairs must be odd.

Balancing act

There are some weights on the two sides of a balance scale. The mass of each weight is an integer number of grams, but no two weights on the same side of the scale share the same mass. At the moment, the scale is perfectly balanced, with each side weighing a total of W grams. Suppose W is less than the number of weights on the left multiplied by the number of weights on the right.

Is it always true that we can remove some, but not all, of the weights from each side and still keep the two sides balanced?

Solution by Jensen Lai: Let the number of weights on each side of the scale be x and y, so $W < xy$. If $x = 1$, then $W < y$. This is not possible since each of the y weights have integral masses. Thus $x > 1$ and similarly, $y > 1$.

Assume now that no mass appears on both sides of the scale. Since no two weights on the same side share the same mass, all $x+y$ weights are unique. Since they all have integral masses, the minimum total mass of the weights is $(x+y)(x+y+1)/2$. This gives

$$\begin{aligned} & \frac{(x+y)(x+y+1)}{2} && \leq 2W < 2xy \\ \Longrightarrow \quad & (x+y)(x+y+1) && < 4xy \\ \Longrightarrow \quad & (x-y)^2 + x + y && < 0. \end{aligned}$$

Since x and y are positive, this implies $(x-y)^2 < 0$ which is impossible.

Thus there must exist a mass, say M, which appears on both sides of the scale. We can then simply remove M and keep the two sides balanced. Note that since $x, y > 1$, we have not removed all the weights.

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

Communications

Australian Academy of Science Fellows

Twenty-one leading scientists were honoured on 27 March by being elected as Fellows of the Australian Academy of Science. Amongst them were five practitioners of mathematics. Our congratulations to all of them!

Professor Alan Carey FAA (Mathematical Sciences Institute, Australian National University)

Elected for his original research in several distinct areas of mathematics, particularly in infinite dimensional groups and their application to quantum field theory.

Professor Matthew England FAA (Climate Change Research Centre, University of New South Wales)

Elected for his work on modelling the Southern Ocean and deep ocean ventilation, and its application to climate models.

Professor Hanna Kokko FAA (Research School of Biology, Australian National University)

Elected for her significant contributions to ecology and evolutionary biology using novel mathematical methods.

Professor Ivan Marusic FAA (Department of Mechanical Engineering, University of Melbourne)

Elected for his contributions to fluid mechanics, most notably advancing our understanding of wall-bounded turbulent flows.

Professor George Willis FAA (School of Mathematical and Physical Sciences, University of Newcastle)

Elected for his innovation in diverse fields of mathematics, including insights into locally compact groups and fundamental concepts such as the scale function and flatness.

The Asia Pacific Consortium of Mathematics for Industry (APCMfI)

Inaugural APCMfI Committee*

Announcement: Motivation and planning for the formation and launch of APCMfI

Mathematics for Industry (MfI) aims at the development of mathematics and its applications to enhance the quality of life on the planet by creating new technologies, improving industrial mathematical research and stimulate the two-way interaction between mathematics and industry. In Industrial Mathematics, it is the questions spawned by real-world applications that drive the resulting two-way interaction between a particular application and the associated mathematics that is utilised and developed and that sometimes involves, quite unexpectedly, deeper aspects and newer areas of mathematics than initially anticipated.

Though its significance has often been overlooked, Industrial Mathematics has always been an essential aspect of the history, culture, traditions and development of mathematics, including much of modern theoretical mathematics. Directly and indirectly, developments in mathematics can be traced to the initial attempts to answer quite practical questions. The development of Galileo's telescope and the design of clocks represent early stimuli. Harmonic analysis and Fourier analysis have their origins in the study of heat transfer in metals. The conservation and minimisation of energy engendered in the study of thermodynamics and fluid motion underlie much of the foundations of modern theoretical mathematics as well as applied and industrial mathematics.

The increasing sophistication of modern industry reflected in, for example, medical measurements, game theory applications in economics, psychology, behavioural science and biology, computer-controlled instrumentation, the efficient development of geothermal energy, the microbial treatment of waste water, Ito calculus in finance, has generated a need and demand for mathematical expertise to stimulate, foster and implement the associated innovations. Even the theoretical areas of algebraic geometry, abstract algebra, topology, differential geometry and group theory are playing an increasingly important role in industrial endeavours connected with entertainment (such as games and movies), architecture, analysis of protein structure and error-correcting codes.

There is general agreement and support in the Asia Pacific region to have regular industrial mathematics exchanges, conferences, internships etc., which build on the activities already occurring. In fact, over the years since the concept of an

*Bob Anderssen, Frank de Hoog, Alexandra Hogan, Zainal Aziz, Yasuhide Fukumoto, Masato Wakayama, and Graeme Wake. Corresponding author: Bob.Anderssen@csiro.au

Asian Consortium of Mathematics for Industry was first proposed and more recently when planning to formalise possibilities, there has been strong support and encouragement from colleagues in China, Hawaii, Korea, Malaysia and Singapore as well as Australia, New Zealand and Japan.

Left to right: Yasuhide Fukumoto, Zainal Aziz, Graeme Wake, Alexandra Hogan, Masato Wakayama, Frank de Hoog, Geoff Mercer (recently deceased), and Bob Anderssen

Consequently, a small group, with the encouragement of various colleagues throughout the Asia Pacific region, met in Canberra 31 March to 2 April 2014 to do the initial planning for the formation and launch of APCMfI with the emphasis being fundamentally Mathematics-for-Industry. Those directly involved in the discussions in Canberra were Bob Anderssen (Australia), Zainal Aziz (Malaysia), Frank de Hoog (Australia), Yasuhide Fukumoto (Japan), Alexandra Hogan (Australia), Geoff Mercer (recently deceased) (Australia), Masato Wakayama (Japan) and Graeme Wake (New Zealand).

In any endeavour that involves the initiation and implementation of a new opportunity, the situation is similar to planting and nurturing a seed which will grow into a strong and robust tree. The meeting and deliberations of this group represent the preparation of the ground for the planting of the seed. The subsequent planting and nurturing will involve the wide distribution of this Announcement throughout the Asia Pacific region; the seeking of seed funding from various mathematics departments, societies, agencies and industry; the establishment of a website; the launch of APCMfI under the MfI banner.

ANZIAM 2014

In fond memory of Professor Geoff Mercer who packed the auditorium for the last plenary talk of the conference

Steve Taylor*

The 50th ANZIAM Conference was held on 2–6 February 2014 in the Millennium Hotel, Rotorua, New Zealand. The conference was well attended, with 99 students and 136 non-students resulting in a very full programme of eight one-hour plenary talks and 209 shorter talks, of which 95 were given by students. Highlights of the conference included the plenary talks, the Women in Mathematics Lunch, the Early Career Workshop on 7 February, a special session on Industrial Mathematics, and the Conference Dinner and Awards Ceremony.

The plenary talks comprised five invited talks and three 2013 Medalist talks:

- Alison Etheridge (Oxford): 'Modelling evolution of different genetic types in spatially structured populations';
- Lisa Fauci (Tulane): 'Modelling the bio-fluid dynamics of reproduction: successes and challenges';
- Douglas Heggie (Edinburgh): 'Mathematics, astronomy and physics – a three-body problem';
- Shane Henderson (Cornell; Fonterra Speaker): 'Real-time control of ambulance fleets through statistics, simulation and optimization';
- Shaun Hendy (University of Auckland; E.O. Tuck Medalist): 'Slippery issues in micro and nanoscale flows';
- Bernd Krauskopf (Auckland): 'Discovering the geometry of chaos';
- The late Geoff Mercer (ANU; E.O. Tuck Medalist): 'Disease modelling and its impact on policy decisions';
- Terry O'Kane (CSIRO; J.H. Michell Medalist): 'The statistical dynamics of geophysical flows with application to ensemble prediction and data assimilation';

Further details of the talks, including short biographies of the speakers, are at the conference website http://anziam2014.auckland.ac.nz. For the wonderful selection of invited speakers, we owe our thanks to the conference invited speaker committee: Robert McKibbin, Massey (Chair); Graeme Hocking, Murdoch; Vivien Kirk, Auckland; Kerry Landman, Melbourne; Geoff Mercer, ANU; Winston Sweatman, Massey; Tim Marchant, Wollongong; Graham Weir, IRL; Ilze Ziedins, Auckland.

The Women in Mathematics Lunch was designed to highlight the mathematical careers of Professors Alison Etheridge and Lisa Fauci, the female plenary speakers at

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ANZIAM 2014, to celebrate women in mathematics, and to stimulate conversation on topics that impact the careers of all mathematicians. All conference delegates were invited to this special lunch in the Millennium's Nikau Restaurant, which was filled to capacity. The lunch began with a *Karanga*, a traditional Maori welcome given by a Maori woman. The lunch was associated with question–answer documents completed by Lisa and Alison which can be found at the conference website and at http://www.austms.org.au/ANZIAM2014-QA. The event was organised by Nalini Joshi (University of Sydney) with help from Bronwyn Hajek (University of South Australia) and Sarah Lobb (University of Sydney). It was supported by ANZIAM, the Women in Mathematics special interest group of the AustMS and the Australian Research Council through Nalini Joshi's Georgina Sweet Australian Laureate Fellowship.

The Early Career Workshop ran on Friday 7 February, a day after the ANZIAM Conference ended. This is the first time that such an event has occurred with an ANZIAM conference but they presently occur in association with Australian Mathematical Society Meetings. Fifty-seven people registered for the free event and approximately 50 of these attended. Ten of the participants were postdoctoral fellows or early career academics. All others were PhD students. There were four invited speakers (Pen Holland, Landcare Research; James McCaw, Melbourne; Clemency Montelle, Canterbury; Claire Postlethwaite, Auckland), who, along with the organisers formed the panel and offered advice at the sessions. Feedback from participants was very positive and the Workshop organising committee (Alex James, Canterbury (Chair); Roslyn Hickson, Newcastle; Richard Brown, Massey) also managed to keep the costs low, so they did a wonderful job arranging the event. The venue of the workshop was the Millennium where the main conference was held. Although workshop finances were run through the main conference account, the workshop itself was not funded by conference registrations; instead there was an agreement between AMSI, AustMS and ANZIAM to cover the costs. For more details of the Workshop, see http://www.math.canterbury.ac.nz/ANZIAM_ECW_2014/.

The New Zealand branch of ANZIAM sponsored a special session on Industrial Mathematics on the first day of conference talks. This session was aligned with other contributed talks on Industrial Mathematics and the Fonterra-sponsored plenary talk given by Shane Henderson. The session itself consisted of four talks followed by a panel discussion on methods to foster the interaction between academia and industry. The talks: Kevin Ross (Fonterra) 'Analytics at Fonterra and beyond'; Bernd Krauskopf (Auckland) 'The dynamics of aircraft as ground vehicles'; Troy Farrell (QUT) & Winston Sweatman (Massey) 'Reflections on MISG 2014'; Jo Simpson (Fonterra) 'Determining cheese brining times: outcomes from MISG 2014'. Graeme Wake facilitated the following panel discussion with panelists Shaun Hendy (Auckland), Kevin Ross (Fonterra), Bram Smith (KiwiNet) and lively audience participation.

The Blue Baths was the venue for the Conference Dinner and Awards Ceremony. This art deco building opened in 1933 with geothermally heated swimming pools and it has since been converted to a unique venue for dinners and live shows. Conference delegates enjoyed a wonderful meal and jazz music which complemented the art deco setting from leading Rotorua band Count Me In. What makes this event so special is that it serves as the venue for announcements of the special awards of ANZIAM. The following awards were announced:

- The 2014 ANZIAM Medal: Professor Kerry Landman (University of Melbourne). The ANZIAM Medal is the premier award offered by ANZIAM. It is presented biennially.

Kerry Landman receives the ANZIAM medal and the congratulations of the new ANZIAM president, Larry Forbes. Bob Anderssen reads the citation.

- The 2014 J.H. Michell Medal: Dr Ngamta (Natalie) Thamwattana (University of Wollongong). The J.H. Michell Medal is awarded annually by ANZIAM to at most one outstanding new researcher who has carried out distinguished research in applied or industrial mathematics within Australia and New Zealand.
- The T. M. Cherry Prize: This prize is for the best student talk at the ANZIAM conference and sometimes goes to two students. Two students received the prize at ANZIAM 2014: Mr Matthew Chan (University of Sydney) for his talk 'Modelling the spread of a deliberate Wolbachia introduction' and Mr David Khoury (University of New South Wales) for his talk 'Removal of malaria parasites by an infected host'. David also won this prize at ANZIAM 2013!
- The Cherry Ripe Prize: This prize is for the best non-student talk at the conference and its winner is chosen by students. This year's winner was Dr Peter Kim (University of Sydney).
- The 2014 A. F. Pillow Applied Mathematics Top-up Scholarship: This award is for student research in applied mathematics. Ms Audrey Markowskei (Macquarie University) was awarded the A. F. Pillow Applied Mathematics Top-up Scholarship for 2014.

For further details of these awards please see the March 2014 edition of the Gazette: http://www.austms.org.au/Publ/Gazette/2014/Mar14/ANZIAM.pdf.

David Khoury wins the T. M. Cherry Prize.
Alona Ben-Tal (Massey University) presented the two prizes.

Matthew Chan (University of Sydney), on behalf of Peter Kim (also from University of Sydney), accepts the Cherry Ripe Prize from the ANZIAM student representative Michael Rose. Matthew had won the T. M. Cherry Prize a few minutes earlier.

We are very grateful to Dr Alona Ben-Tal of Massey University and the other members of her T. M. Cherry Prize Committee who took up the challenge of selecting prize winners from a record 95 student talks.

The ANZIAM conferences are very supportive of student involvement which is only possible with suitable funding for student attendance. For this we particularly wish to acknowledge the CSIRO sponsorship of 44 students to attend the conference.

We also thank our sponsors, especially our major sponsors, Fonterra and the New Zealand Mathematical Society, for their sponsorship of the conference.

Finally, I personally wish to thank the conference organising committee, Graeme Wake and Winston Sweatman (Massey), Andrea Raith, Richard Clarke and Shixiao Wang (Auckland) for all of their hard work.

Factors affecting success in CHEM101 at UOW

Becky Armstrong,* Mark Fielding,** Stephen Kirk† and Jacqui Ramagge††

Abstract

In 2010 the Faculty of Science at the University of Wollongong (UOW) decided to inform its admissions policy by analysing the results in the introductory chemistry subject CHEM101. The data was analysed by members of the School of Mathematics and Applied Statistics using a generalised linear model. This paper discusses the model and its implications. One of the conclusions is that the level of mathematics studied for the Higher School Certificate (HSC) is a better predictor of performance in CHEM101 than either the HSC Chemistry mark or the student's Australian Tertiary Admission Rank. As a result of the analysis in this article, the Faculty of Science at UOW changed its early admission procedures. A pdf file of a presentation by the first author on this material and an interactive passing probability calculator based on the model are available at [11] and [10] respectively.

1. Introduction

Admission of Australian high-school students to universities is typically based on their performance as measured by a single number called the Australian Tertiary Admission Rank (ATAR). It is calculated on a state-by-state basis using a statistical analysis of the performance of all the students in the state across all their subjects [1]. Our analysis involved students whose ATAR was calculated in the state of New South Wales (NSW) on the basis of their performance in the Higher School Certificate (HSC).

The only compulsory subject in the NSW HSC is English, and you can't tell by looking at a student's ATAR whether they have studied mathematics. Universities in Australia typically have few prerequisites as a barrier to entry. This is a matter for some consternation, and recommendation 12 in [2] is that government

> urge universities to send accurate signals about the value of mathematics, engineering and science to schools, students, teachers and careers advisors.

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Some universities encourage students to take appropriate subjects at high school by increasing the ATAR of students who achieve various levels of performance in relevant subjects at high school. Schemes such as these typically reward students for taking subjects that are considered relevant by the Faculty making the decisions, rather than on an analysis of the impact on performance of studying the subjects.

We analysed the performance of students at UOW in CHEM101 (Chemistry 1A: Introductory Physical and General Chemistry) in the Autumn session of 2010. CHEM101 was chosen because it is a key enabling science subject that is compulsory in many majors in a Bachelor of Science (BSc) and in other degree programs. Some analyses have been done on the impact of mathematical background on the performance of students at other institutions [5], [9], [13]. All conclude that increased mathematical competencies result in improved success at university. Our results would support this conclusion as well as results specific to chemistry [3], [6], [4]. In particular, our results support research [4] concluding that mathematical difficulties experienced by chemistry students were more likely to be a result of insufficient understanding of mathematics rather than an inability to use their mathematical knowledge in a chemical context.

We develop a generalised linear model of the data which enables us to test quite specific scenarios. While one always has to be careful when extrapolating data, the sample size is reasonable (383 students) and the conclusions are striking.

The model produced enables the calculation of the probability of a student with a given background (in terms of the variables considered) passing CHEM101. Our calculations indicate that the single variable with the strongest positive correlation to passing CHEM101 is the high-school mathematics result. This is followed by the high-school chemistry result, and then the ATAR.

In order to give a more detailed summary of the implications of the model we first describe the variables considered. Four levels of mathematics are available to students undertaking the HSC in NSW. In order of mathematical sophistication, they are: General Mathematics, Mathematics, Mathematics Extension 1, and Mathematics Extension 2. Students taking Mathematics Extension 2 must also take Mathematics Extension 1. Students taking Mathematics Extension 1 but not Mathematics Extension 2 must also take the Mathematics course. Mathematics can be taken on its own, and General Mathematics cannot be taken in conjunction with any of the other mathematics subjects. There is only one chemistry subject available to HSC students, namely Chemistry. Students who did not study Chemistry but wish to enrol in scientific degrees at UOW have the option of taking a chemistry summer bridging course. The chemistry bridging course is encouraged but not compulsory.

Our model suggests that students entering the Faculty of Science having not done Chemistry at high school and not having undertaken a chemistry bridging course need to have a score of over 85 in General Mathematics if they are to have probability of at least 50% of passing CHEM101. In contrast, students with the same profile in terms of the non-mathematical variables who undertake higher levels of mathematics at high school are almost certain to pass CHEM101.

The analysis gives insight into which factors most influence performance, enabling informed policy decisions to be made regarding admission into subjects and degree programs. Our results were so striking in the context of students at UOW that immediate action was taken; Early Entry to the Faculty of Science was only considered for students studying Mathematics or Mathematics Extension subjects at high school.

Careers Advisors often advise students to undertake lower levels of mathematics in the expectation that they will perform better, and in the hope that this performance will result in a higher ATAR. This is often, unfortunately, reinforced by teachers [7]. Our results indicate that advising students to undertake lower levels of mathematics at high school is essentially encouraging them to mortgage their future.

2. The data set and the construction of the model

2.1. The data set

The data set consists of 383 domestic undergraduate students who studied CHEM-101 in Autumn session 2010 at UOW, having completed the HSC in 2009 or earlier. The data available for each student includes: ATAR; HSC year; university degree and faculty; flags indicating whether or not the student studied HSC Chemistry, completed a UOW chemistry bridging course, or took part in Peer Assisted Study Sessions (PASS) for CHEM101; the student's HSC Chemistry mark (if applicable); the level of HSC mathematics studied; the student's HSC Mathematics mark and Mathematics Extension mark (if applicable), and the student's CHEM101 final mark and grade.

For the purposes of our analysis, we worked with a dichotomous Pass/Fail variable; any mark less than 50 in CHEM101 was considered a Fail, and any mark greater than or equal to 50 was considered a Pass. The average ATAR of the students who failed CHEM101 in 2010 was approximately 74, and 17 of the 383 students had not done any mathematics at the HSC.

2.2. The model

We built a logistic regression model using the forward selection approach to stepwise regression. The outcome of interest is a Pass grade for CHEM101. The stepwise regression was conducted using the statistical programming language R, with ANOVA F-tests used to test predictors for statistical significance. In the forward selection method, predictors are considered separately before interactions are analysed. However, Mathematics and Chemistry marks are only meaningful for students who studied those subjects, and hence these variables were only ever considered for inclusion as interaction terms. We refer the reader to [8] for further general information on the formation of the logistic regression model.

In the first stage, the interaction term consisting of HSC mathematics marks and the level of mathematics studied was found to be the most important factor. ANOVA tables were then generated comparing this fit to potential new models (each consisting of the HSC mathematics interactive term and one other factor), and the process was repeated, resulting in the interaction term for HSC Chemistry being added to the model. The forward selection process was continued in this way until it was found that the factor associated with the greatest deviance was not statistically significant. Several new interaction variables were then tested for significance, and an interaction term linking the chemistry bridging course flag and the CHEM101 PASS flag was added to the model although, independently, neither of these variables was found to be significant.

The following factors, listed in order of significance, are included in our final model: Interaction variable — HSC mathematics marks and level of mathematics studied; Interaction variable — HSC Chemistry marks and HSC Chemistry flag; ATAR; Faculty; HSC Year; Degree; Interaction variable — chemistry bridging course flag and CHEM101 PASS flag. The statistical significance drops markedly after the first three.

Rather than describe the model in numerical detail, we have posted an interactive scenario-builder on the UOW website at [10].

3. Observations and scenarios

The model may be used to estimate the probability of a student passing CHEM101 given specific values for each of the predictor variables, irrespective of whether an actual student had that particular profile in 2010. The relative significance of the variables is also noteworthy. We emphasise that care must be taken when using the model as extrapolation from the data must be done carefully. This is particularly true of smaller cohorts such as those who studied no mathematics at HSC (only 17 people) and those who were in small degree cohorts. The largest single cohort of students was those enrolled in a BSc in the Faculty of Science who did the HSC in 2009; this is therefore the safest baseline assumption.

3.1. Impact of level of mathematics studied

The level of mathematics studied for the HSC and the HSC mathematics mark are a better predictor of performance in CHEM101 than either the HSC Chemistry mark or the ATAR.

Scenario 3.1. Suppose Hermione completed the HSC in 2009, received an ATAR of 74, and enrolled in a BSc at UOW. Suppose also that she did not study HSC Chemistry, did not attend the chemistry bridging course, and did not participate in PASS for CHEM101. What mark would she need to have in her HSC mathematics subject in order to have a greater than 50% chance of passing CHEM101? If she studied General Mathematics then her mark would need to be at least 87. In contrast, if she studied Mathematics, then only a mark of at least 19 would be required.

Thus, according to our model, the two scenarios summarised in the table below are equivalent for the purposes of passing CHEM101.

Maths type	Maths mark	Chemistry mark	ATAR	Bridging/PASS
General Maths	87	–	74	–
Mathematics	19	–	74	–

No students in CHEM101 had a score below 49 in Mathematics, so the second of these scenarios is extrapolating far from the original data and should be interpreted with caution. However, it suggests that even a borderline performance in Mathematics is more advantageous than a strong performance in General Mathematics. In fact, 92.8% of Mathematics students in the data set passed CHEM101, as did 94.7% of Mathematics Extension 1 or 2 students, whereas only 62.5% of General Mathematics students passed CHEM101. It seems to be a matter of content rather than performance.

Students who take General Mathematics rather than a higher level of mathematics at school are mortgaging their future.

3.2. Relative impact of HSC mathematics and chemistry marks versus ATAR

Scenario 3.2. Suppose that two students, Harry and Ron, completed the HSC in 2009, enrolled in a BSc at UOW, and neither student completed the chemistry bridging course or participated in PASS for CHEM101. Suppose further that Harry received an ATAR of 90 and did not study Chemistry or any level of mathematics for the HSC whereas Ron received an ATAR of 50 but studied both Chemistry and Mathematics, receiving marks of 78 and 52, respectively. According to the model, both Harry and Ron have approximately an 80% chance of passing CHEM101.

The BSc degree typically has an ATAR cut-off of 75 at UOW, meaning that Harry would be admitted into the degree, but Ron would not. The model suggests that both students are equally likely to pass CHEM101.

Scenario 3.3. If Ron, like Harry, had not studied chemistry or mathematics for the HSC, his chance of passing CHEM101 would have only been approximately 10%. Alternatively, if it had been General Mathematics rather than Mathematics for which Ron had received a mark of 52, his chance of passing CHEM101 would have been approximately 11%. Even though he did not receive high marks for Chemistry or Mathematics, the probability of Ron passing CHEM101 was significantly improved by the fact that he studied these subjects.

It is tempting to conclude that the ATAR alone is a poor criterion on which to base admission to the BSc. In reality, of course, a student's ATAR is dependent on their performance in their HSC subjects. Given a score of 78 in Chemistry and a score of 52 in Mathematics, Ron would have to perform very weakly indeed on his remaining HSC subjects in order to receive an ATAR of 50. In any case, it would seem that the trend to award extra ATAR points for the study of degree-specific subjects at high school is justified. Moreover, prospective science students should be awarded bonus ATAR points for studying higher levels of HSC mathematics as well as HSC Chemistry.

3.3. The (in)significance of the Faculty and Degree variables

One could hope that students in certain Faculties/degrees are more motivated to do well in chemistry. There is some evidence for this as students who did General Mathematics were more likely to pass CHEM101 if they were general science students than if they were engineers or physicists, despite the fact that the BEng has a higher ATAR cut-off than the BSc. However, both Faculty and degree paled into insignificance for students with higher levels of HSC mathematics.

3.4. The effect of gap years

Some of the students had done the HSC in 2009, some in 2008, and some earlier. Of those who did the HSC in 2008, most studied CHEM101 in 2010 because they had not started university studies until 2010, although some took CHEM101 in their second year of university studies. We do not distinguish between these two cohorts and refer to both as *gap year* students.

Scenario 3.4. Suppose Sally scored 78 in Chemistry, 52 in General Mathematics, received an ATAR of 74, and did not participate in PASS. If she had done the HSC in 2009 the probability of her passing CHEM101 in 2010 would have been just under 50%. If instead she had done her HSC in 2008 (and received a UAI rather than an ATAR), she would have the same chance of passing CHEM101 as Harry and Ron in Scenario 3.2, namely 80%.

Generally, gap-year students were more likely to pass CHEM101 than students with comparable backgrounds who took CHEM101 the year after finishing high school. This may be influenced by the change in methodology from the calculation of a Universities Admission Index (UAI) in 2008 to an ATAR in 2009.

Scenario 3.5. In Scenario 3.1 we saw that Hermione needed a score of 87 in General Mathematics to have at least a 50% chance of passing CHEM101 having done her HSC in 2009. If all other factors remained unchanged except that she did her HSC in 2008, she would only need a score of 69 in General Mathematics to have at least a 50% chance of passing CHEM101. This still compares poorly with the score of 19 required in Mathematics if she sat the HSC in 2009.

The gap-year advantage did not outweigh mathematical advantage; gap-year students were less likely to pass CHEM101 than students who took higher levels of mathematics in their HSC in 2009. The level of mathematics students undertake at high school has a significant impact on university performance for at least two years after leaving high school, even if they undertake a year of university study.

3.5. HSC Chemistry, chemistry bridging courses, and concurrent support

The statistical significance of participating in the chemistry bridging course is low compared to the significance of studying HSC Chemistry. Chemistry bridging courses are no substitute for HSC Chemistry; keeping up is more beneficial than catching up.

The lack of statistical significance of both the chemistry bridging course and the CHEM101 PASS program independently but the statistical significance of the interaction variable between them is noteworthy. Our interpretation is that remedial support for students with a weak chemistry background should take the form of intense preparation prior to session combined with ongoing support throughout session. Each type of support is on its own insufficient to ensure success but the combination is mildly beneficial.

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Flipping the maths tutorial: A tale of n departments

Katherine A. Seaton* Deborah M. King,** and Carolyn E. Sandison***

Abstract

The *flipped classroom* is attracting much attention recently as an innovation in tertiary teaching. In this article we describe a mathematics tutorial style which, while not new, is still novel. This style of class truly flips the chalk-and-talk responsibilities in a tutorial and replaces the 'sage on the stage' with a 'guide on the side'. Its sustained use and its adoption in a number of Australian university mathematics departments, which we discuss, speaks to its effectiveness.

Introduction

In this *Gazette*, in a 1990 report on a Survey of [Australian] Entry Level Courses, Mack commented that

> On the tutorial side, our students are given tutorial work well in advance and yet, regularly, fewer than 50% turn up to tutorials having prepared anything, thus splitting the group in two. There is merit in trying the La Trobe method of handing out problems at the beginning of each class and insisting that all work during the class.
>
> Mack [9]

The 'La Trobe method' referred to, of which active tutorials and practice classes are only one aspect, had recently been described [7] in the DEET *Discipline Review of Mathematics and Science Teacher Education* under the heading 'Examples of Good Practice'. Though the description, written by the key figure in the establishment of the La Trobe method [3], Arthur Jones, was written in 1989, in it he mentions that the system of teaching had been in use there since the 1970s.[1]

In this article, we discuss the adoption and adaptation of this tutorial style by $n \geqslant 3$ university departments, and describe the history of how this came about. We also discuss the strengths of this method under a number of headings, and give some differing perspectives. There is a rather large number of direct quotes given

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[1]The dates are pinned down even more precisely by Don Taylor, who worked at La Trobe only from 1972 to 1974 and recalls them clearly.

in this article, as some of the sources referred to (e.g. [7], [10], [15]) are not readily accessible.

Black-and-white boardrooms

Think for a moment of what you envisage when you hear someone mention a 'tutorial' in mathematics. You will probably find that what you experienced as a student or currently do yourself (or have done by casual or Level A staff) is what you think a normal/standard/traditional tutorial to be. Talking to colleagues from various Australian universities (and having experienced and delivered tutorials in several of them), we know there are various models in operation:

- a class in which the tutor does on a board exercises related to recent lectures, preparing students to do further exercises at home or for an upcoming assignment;
- a class for which students are expected to have already done exercises related to recent lectures (at home), and the tutor asks which of these the group wishes to see done for them on the board, possibly calling for suggestions as to how to proceed from the floor;
- a class to which students come prepared to be called on, to do [part of] a problem on the board for their peers;
- a class wherein the tutor discusses common errors in an assignment, which has already been completed and marked.

The furniture in the room may be chairs with writing arms, or chairs and tables, facing the board. The exercises may be a list of problems from a text book, or may have been set by the lecturer on a handout (or these days, available in electronic form in an LMS and read from a tablet in class).

The aspect of a 'La Trobe method' tutorial highlighted by Mack above is that its success does not depend on students arriving having already worked through problems, prepared to ask their tutor to sort out points of difficulty. Where students either have not done this preparation or encountered no problems, such a tutorial is a passive experience for them, akin to a mini-lecture [12]. Rather, the problem sheets are handed out at the start of the class, and students work on them there.

But there are certainly models of mathematics tutorials, often called practice classes, which share this feature.

- Students work on problems handed out at the class, on their own, and raise their hand if they want assistance. The tutor may either be run off their feet, or field no questions at all.
- Students work on problems handed out at the class, in groups around tables, with the tutor circulating and 'dropping in' on groups. A spokesperson (or the group) may later be called on to present their work to the whole class.

This first style of active learning class can still be confronting to weaker students, who will frequently not ask for help if no-one else seems to need it, with cultural or gender norms compounding this reluctance [12].

So what is distinctive about the 'La Trobe method' tutorial?

What is *not* mentioned in [9] is that it takes place in a special style of room:

> The rooms in which tutorials are held are quite different from the usual ones in that there are no seats for the students to sit on. Instead they work at blackboards which line the walls of the room.
>
> Jones [7]

Another feature of such rooms, which perhaps is not so striking as it is an absence rather than a presence, is that there is no focal point or 'front' to the room. Rooms without rows, platform or single focus have recently received much attention in the *learning spaces* literature (see, for example, [14]).

The third feature of the tutorials is that the style is coherent within (and between) subjects [7]. Contrast this, if you will, with the alternative: that each tutor chooses how to run their tutorial and which examples to work through, so that students in the same subject can have quite different tutorial experiences. The focus on active learning is described by Jones as a thought-out joint response to disappointing student performance; again, contrast this positive pedagogical reform with the tendency to blame the students or their schools, which does not help the students that one currently has.

In the early 1990s two former La Trobe mathematicians, Sid Morris and Phil Broadbridge, arrived at the University of Wollongong within months of each other. Quite quickly the 'La Trobe method' tutorials were adopted under their influence.

A 1992 piece in the *Campus Review Weekly* [10] shows a photograph of Sid amidst students in front of a row of blackboards, and he further develops the ideas mentioned in that interview in [12].[2]

Peter Forrester moved from La Trobe to the University of Melbourne in 1994, and introduced the blackboard tutorials in one subject in 2001.[3] This had been in response to poor student results in that subject and it yielded immediate improvements. However, it was not clear that the 'La Trobe method' tutorial would spread beyond this subject. In 2002, Deborah King, who had studied at La Trobe, also took up a position at Melbourne, and championed by both Peter and Deb, the style became established, as she will describe below.

From now on, we will refer to the tutorials as 'board-tutorials', since no one institution owns them, and the boards used may be black or white.

Variations on a theme

In this section, we describe the development and application of the board-tutorial at each of three institutions and beyond.

La Trobe University

A student perspective. Deborah King writes: 'My first experience of board-tutorials was in 1985 when I arrived at La Trobe as a mature-aged student. At that time it seemed perfectly natural to me. I studied maths and history and to me the board-tutorial was the obvious analogue of a humanities tutorial; that is, you did some work prior to the class, and came ready to participate actively, sorting out any difficulties along the way.

'Observing the board-style tutorial from the perspective of an older student, I felt that the board-tutorial had real advantages over what I remembered a school class to be. For example, students were required to work in pairs. This simple activity has a variety of benefits ranging from making friends to helping students to learn by explaining to others or learning from other students, exposing students to many ways of thinking about a problem. It developed a sense of identity within the group and with the tutor; we were all on a path together.

'Another key benefit I observed as a student, was that each member of the class had the opportunity to interact with the tutor in every class. So the loudest, brightest or weakest student was never the main focus of attention. Each student was able to discuss with the tutor the particular difficulties or points of interest they had with the work.

[2] An up-dated version of [12] has appeared as [13].

[3] In this he was aided by Penny Wightwick, a tutor at Melbourne, who had been a student at La Trobe in the seventies.

'As a student it kept me on my toes. You couldn't go into a class unprepared! The tutor would generally give you enough help so you could move forward rather than show a complete solution, so there was always an element of discovery. Full solutions given at the end of class were valuable resources, since they modelled an acceptable answer including rigour and setting out, so you had a clear idea of the level of detail required for a good solution.

'As a student I loved the board-tutorials, I looked forward to them, I couldn't wait to be a tutor myself, I thought they *were* tutorials and didn't know there other ways of running tutorials. I was wrong.'

The current situation. In the Department of Mathematics and Statistics at La Trobe, the commitment to students spending 50% or more of their class time in active learning activities has been maintained, though the teaching model described by Jones [7] in the eighties and recognised as good practice within the wider University context [15] in the nineties, has seen modifications in the twenty-first century, in response to resource issues and a push to reduce face-to-face teaching hours. One result of University-wide curriculum renewal (*Design for Learning*) has been the heightened awareness that the Department should take primary responsibility for developing graduate capabilities, such as spoken and verbal communication and teamwork, in the students who are taking a mathematics or statistics major. Whereas board-tutorials were previously utilised across all first and second year mathematics subjects, including service-taught subjects, they are currently a unique and key feature of the second year subjects which lead to the capstone third year subjects in the major. Recently refurbished rooms within the mathematics building (computer laboratories and a small lecture room) include walls of whiteboards; the largest original blackboard room remains. (To misquote Mark Twain, the report of their demise [2] was greatly exaggerated!)

One of the points emphasised in the report [15] is the regular involvement of lecturers in the active learning classes, be they practice classes or board-tutorials for their subject, and in the production and refinement of well-crafted question sheets. Lecturers can reflect on the clarity and effectiveness of their lectures and teaching materials [7], and stay in touch with the attitudes, backgrounds and abilities of the current generation of students; that is, learning happens in both directions. Using blackboards (or whiteboards) invites the possibility for students to accept changes suggested either by their partners or by the tutor, fixing errors and false starts without the crossing out that comes when work is 'corrected' on paper, hence producing a polished final product.

University of Melbourne

Deborah King writes again, now from the perspective of a teacher: 'I spent a number of years at LaTrobe as a casual tutor while I was studying and later during my PhD. So by the time I came to teach at The University of Melbourne, I was well experienced in the art of the board. Being on the other side of the chalk had probably increased my enthusiasm for this interactive style of tutorial. As a teacher it held enormous advantages for me. First up, I could see what everyone was doing; who was working, who was not, who was flying, who was stuck. I could tailor my explanations to where each student was at, going very slowly and simply for some, throwing out challenges and extension opportunities to others, allowing students to develop their communication skills by explaining ideas to their peers and to me. I could work with a student to further their approach to a solution, rather than giving my own and expecting them to regurgitate it. It is amazing how many approaches to a problem you see . . . many you wouldn't have thought of yourself! If the whole class just didn't get something, I could feed this back to the lecturer, a really important link in the feedback chain.

'When I arrived at Melbourne in 2002, I realised that not all tutorials were board-style. Though Peter Forrester had introduced them in one subject, they had not spread. A shortage of appropriately equipped rooms was one difficulty, and it appeared that the benefits of this style were not apparent to all staff, so there was a reluctance to take it further.

'I was lucky to be the coordinator of tutorials in a second year operations research subject, so of course, I was quick to run these classes as board-style, which meant that I needed to ensure that the classes were timetabled in appropriate spaces. As the popularity of these classes caught on, rooms were refurbished with boards where possible. Over time we have equipped more and more rooms with whiteboards and now most of our tutorials run as board-style. When spaces are not available, the tutorials run along similar lines (that is the problems are given to students when they arrive, they work in pairs or groups at tables and get solutions when they leave) but it really isn't quite the same, unfortunately.

'The change I noticed in moving from traditional tutorials to board-style was significant. The traditional classes I taught here tended to be very flat. Students often came to class ill-prepared. They may have missed lectures, or not have attempted any problems themselves, so didn't have an idea of what their problems were or what they needed to ask. Tutes ran by students nominating questions they had trouble with, or the tutor could nominate questions, to be worked through at the front of the class and students would copy down solutions. This is very hit-and-miss for students, and tends to aim at the middle band. Students who really struggle don't ask questions in this setting, and students who have mastered the basic material are bored. This tended to result in poor attendance and a lack of engagement. However, in board-tutorials, the atmosphere is different. Students generally come to class ready to work, attendance is higher, students start to form friendships quickly, it gets really noisy, the engagement and enthusiasm is palpable. But perhaps the most important outcome is that every student in the class gets something out of it; no matter what their level, by the end of the class they have progressed.

'I am painting a rosy picture here, it's true, so by way of balance let me point out some difficulties. Not all students feel immediately comfortable with board-tutorials. We have some very shy students, students whose first language is not English, and students who don't like to make mistakes in public. For these reasons, it takes some sensitivity on the part of the tutor, to make students feel 'safe'; that is, to feel there is nothing wrong with making a mistake. Some students complain that "they are doing all the work", a comment I have always found amusing, since that's the whole point. Initially some staff (including casual tutors and graduate students who had been undergraduates pre-board-tutorials) thought that board-style tutorials would be easy for them: "I won't have to do anything". After a few weeks they told me how exhausted they were . . . it is hard work as a tutor bouncing backwards and forwards through different levels of material. Tutors do not have the same control, since all the questions are driven by students, not pre-prepared by the tutor.

'Some years down the track my feeling is that the board-tutorials are well established now. The feedback from students is overwhelmingly positive and has helped to establish and spread these tutorials [at Melbourne University]; that is, they would often comment when going on to a subject without board-tutorials, that the classes had been less effective and that they wished that subject had board-tutorials. The next generation of graduate students, who have been students of board-tutorials, take to it like ducks to water. It will never please all students or all staff, but as I walk through the department and see the happy and enthusiastic students engaged in mathematics, I can't help but smile.'

University of Wollongong

Caz Sandison writes: 'It was 1991–1992 when the then Department of Mathematics at the University of Wollongong was introduced to board-tutorials. Professor Sid Morris was recently appointed as the foundation Dean of the newly formed Faculty of Informatics — to which the Department of Mathematics belonged — and Phil Broadbridge became Professor in Applied Mathematics. Both had come from La Trobe and brought with them the concept of board-tutorials. The concept met with a little resistance from the University as it raised the contentious issue of 'space'. However, as Dean of Informatics, Sid was able to arrange the installation of the first board-tutorial room at Wollongong. Granted, it was at the far end of campus, a distance from most teaching spaces, in a building normally rented to external companies, but we had our room. It was air-conditioned (a rare commodity at that time), a necessity with the design of a room with blackboards on all four walls and no windows, and the only other furniture in the room was a collection of tall stools. The lack of tables was noticeable.

‘There was some skepticism amongst academic staff about the board-tutorials — although it was hard to tell whether this was towards the board-tutorial per se or as a result of the concurrent introduction of the policy that lecturers were now required to take a tutorial in their subject. One colleague who was around at the time of introduction comments now, “At the beginning, I thought that it was a fuss. I think now the whiteboard rooms are good for tutorials of larger first and second year classes.”

‘Board-tutorials were first used in 1992 for two large first year classes. In both subjects, upon arrival to tutorials, students were given a sheet of problems to attempt at the boards — either on their own or in pairs — and at the end, students were given a solution sheet, because it was recognised that students could not take their worked solutions home with them. Students were still encouraged to work on problems and exercises outside class time but the tutorial classes took on more structure. Instructions to tutors were to answer any questions students had on arrival to class, then simply ensure that students worked on the tutorial problems at the boards, putting their name at the top, and not erasing any working until it had been checked. Tutors could choose to ask students to work in pairs or on their own. Further advice to tutors was to only do a ‘class presentation’ if it seemed the majority of those in the room were having difficulty with a particular concept or question.

‘What a difference! Where tutorials had once been quiet, passive affairs, they were now full of animated, engaged learners and teachers. Previously, students mostly worked individually (if they worked) and the tutor responded to questions (if there were any); some tutorials were simply the time to submit and return assignments. With the introduction of board-tutorials, students interacted with the subject material, collaborated with other students, and interacted with the tutor; tutors could identify weaknesses and clarify misconceptions with ease, without the student having to take the first step. I remember coming out of my first board-tutorial exhausted and hoarse, yet hyped and with a sense of having genuinely helped students in my class.

‘In those early days, not all tutorial classes were board-tutorials as we only had the one room. However, the use of board-tutorials influenced how other tutorials operated as all tutors had at least one tutorial in the board room and they took what they could from that experience to a standard classroom. With a worksheet for each class, students had direction in what they were to complete in the class. Tutors asked students to work in pairs and in some cases, asked students to take turns writing on the one board in the room.

‘Within one semester, board-tutorials became a permanent fixture of first year Maths teaching at Wollongong. By 1994, we had negotiated to transform a second room on campus into a board-tutorial room — with the compromise that the standard tables and chairs remain so the room could be used by other groups. This allowed for other maths subjects to adopt them as well. Over the years, the rooms have been relocated around campus, whiteboards have replaced blackboards, and while we believe a square room with no tables equipped with boards on all walls is the best configuration, we would rather a rectangular room with tables and chairs but with boards on all walls than a regular classroom.

'Today at UOW, board-tutorials are still used comprehensively across our suite of standard first year calculus subjects. Essentially, the format introduced more than twenty years ago continues, with the only noticeable difference being that worked solutions are no longer handed to students, rather posted on the subject website. However, we are now beginning to see the effect of personal digital devices such as iPads and iPhones: many students now take photos of their board work before leaving class.

'The general opinion about board-tutorials among staff at UOW is a positive one, with comments such as "I would be very disappointed if tutorials were in rooms without whiteboards (unless they had blackboards!)", "[The format] gets students up and about, encourages social learning, discourages anti-learning activity", "[T]he first time I saw them in action was here in 2007. The feeling was one of 'where have you been all my life?!' ", "It provides a good environment for the tutor to address problems as necessary", "It was a new idea to me when I arrived in 2003... I don't think I'll ever leave Wollongong... but if I did then I would enthusiastically take the idea of whiteboard rooms with me!" '

The second degree of separation

So far, we have told human interest stories of how former La Trobe staff have spread the board-tutorials to two other universities. But they continue to spread, and we see them now rippling out from UOW and Melbourne to other places, one step removed from La Trobe.

Judy-anne Osborn, who was a graduate student and casual tutor at the University of Melbourne, has been at the University of Newcastle since 2011. Board-tutorials started there in 2012.[4] The previous tutorials had been based on text-book problems, so the writing of customised question sheets was required, in addition to the equipping of rooms with whiteboards. This was possible due to money being available (and needing to be spent) at just the right time. One refinement practised at Newcastle is that each member of a group must use a different colour marker, so their respective contributions are evident; free-loading or 'passenger' behaviour is one thing students and staff distrust in team-work situations.

Most recently, a UOW Master of Mathematics student, who is originally from the UK but works in the Caribbean, is doing some tutoring for a first year subject which uses the board-tutorials. He is so impressed with the style of classes that he intends on introducing the style into his teaching (at the A-level/first year level) when he returns. Sometime Head of Maths, he wants to roll it out as their standard

[4]Interview with Judy-anne Osborn by KS in December 2013.

way of teaching maths (and other generic skills). In a similar vein, school teachers who teach the University of Melbourne extension program in their schools are inducted into using the board-tutorials; some describe it as 'the best PD I have ever done'.

Finally, we have been able to spread the word formally and informally through workshops for OLT projects, and conferences such as ACSME and Delta 2013. We were amused by the email from one colleague, asking how many linear metres of board space each pair of students would need.[5] Another practicality is to consider the vertical height of the boards; having them lower on some walls than others can be useful for the taller and shorter students. With the introduction of board-tutorials, in the past there may have been an increase in printing costs and some complaints about chalk dust or the smell of markers (yes, really). However, these issues are outweighed in spectacular fashion by the incredible learning advantages of having board-tutorials and costs ameliorated by providing sheets electronically.

Benefits

Despite the variations outlined above, there are underlying, common pedagogical benefits from the board tutorials. While we intend to explore some of them further in future publications, we describe them briefly under a number of headings.

Active learning. Halmos, in the article from which the first line only is often quoted,[6] uses the analogy:

> For a student of mathematics to hear someone talk about mathematics does hardly any more good than for a student of swimming to hear someone talk about swimming.
>
> Halmos, Moise and Piranian [5]

The board-tutorials require students to be actively engaged in discussing, solving and writing solutions to mathematical problems, learning in Halmos's best way, with support and guidance. The term 'built pedagogy' has been used [11] to refer to the way in which educational philosophy is embodied in architecture. The board-rooms support [socio]constructivism both through their decentredness [4] and their shared writable surfaces [18]. They are 'shaped by learning rather than instruction' [14]. On the other hand, the traditional classroom configuration and the unflipped tutor-led tutorial suggest, perhaps unintentionally, an instructivist or transmission model of teaching.

[5] It's not a silly question; 1.2–1.4 m per group is cosy but not too squishy.

[6] 'The best way to learn is to do; the worst way to teach is to talk.'

Help when and where it is needed.

> The advantage of [board-tutorials] is that the tutor can see at a glance what each student is doing, and can correct mistakes *as they are being made.* Students who need help receive it, while others are not disturbed.
>
> Jones [7]

Two important outcomes of this advantage are early detection of students at risk, and identifying misconceptions the students themselves are unaware they have. The tutor is able to direct help and correction towards the students who require it. In this way, students get immediate feedback which is more likely to be retained and there is little time for incorrect ideas to become established. Students who have prepared can check their understanding and gain clarification; if there are no misconceptions, the student has confirmation of their understanding. Compare this to assignment feedback that more often than not comes at least a week after completion of the task. Knight [8] refers to conversational, informal feedback as background assessment, and rates its authenticity as high (provided the tasks are well-designed), since it takes place during normal activity.

We have also noticed that board-tutorials are good for transitioning from High School where the teacher is 'looking over the shoulder' and guiding much more closely. Finally, if there is a problem common to more than one person or group, the tutor can run a demonstration/discussion for those students on their board— sometimes, this might be the entire tutorial class.

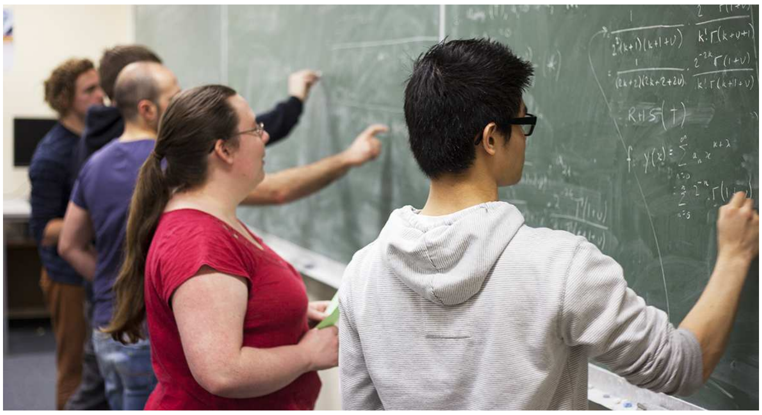
Peer learning. In board-tutorials, students learn from one another, as well as from the tutor. Jones remarked:

> The use of blackboards encourages students to work in small groups and to discuss their work with other students. More able students can be asked to explain points to other students.
>
> Jones [7]

Morris noted that this extends beyond the students they are working with:

> [Students] can move around the room looking at what other students are doing and interact with each other.
>
> Morris and Hudson [12]

Top students can hone their understanding through explanation to others; less able students receive the help they need and those in the middle who need a tip or two can receive it without any fuss by looking across the room, each group's work being visible to other students, as well as to the tutor.



Breaking down barriers: student to student. Making connections to peers has been identified as a strong predictor of persistence and retention at university [6]. The board-tutorials promote such connections:

> In the first few tutorials students are asked to write their names on the top of their blackboards so as to encourage them to get to know each other and to break down their sense of isolation. The intimacy of working in a smaller group ... provides some variety in the teaching program.
>
> Jones [7]

Students observe that others need help, too, and this boosts their feeling of belonging.

Breaking down barriers: student to teacher. Similarly, board-tutorials break down the formality between tutor and student inherent in the 'sage on the stage' model of teaching. Quite literally students and teacher are on the same footing; they are standing shoulder-to-shoulder, the same writing implement in hand. Shyer students can approach a tutor to ask their questions without the whole group having to hear them, or find that the tutor comes to them, if they are observed as making slow progress. Student contact with staff who 'know their name' is another factor related to engagement by the report [6].

Generic skills: group work and communication. We have already mentioned in our various accounts of board-tutorials at our institutions the not-directly-mathematical skills that are used and developed in a board-tutorial. Students can work together, the tutor can hold all members of a group accountable for what is on the board in front of them, they communicate to one another and the tutor about what they are thinking, and they write up solutions or proofs and refine them together. Rather than having to devise ways to incorporate generic skills into our subjects, they grow naturally alongside mathematical proficiency.

Authentic preparation. The board-tutorials provide an insight to the work of the research mathematician: collaboration, experimentation, visualisation. Think of how you use the whiteboard in your office or tea-room:

> Mathematicians don't just use boards for teaching. Ideas are written up to consider privately and with colleagues. The contents of these boards are essentially ephemeral. Things get amended, refined and perfected then rubbed out.
>
> Shepherd [16]

But they also provide an important example to future teachers, as noted by Weissglass [19]; we can model that maths learning should be active, participatory and engaging.

Benefits to the teachers. Board-tutorials have been described as 'exhausting... but more satisfying' [10]. You never have to peer over a student's shoulder to try and see what lack of progress they are trying to conceal from you or ask for a show of hands—- it is all visible on the board, and you can tell where everyone is up to with a glance around the walls. By writing the question sheets and then using them with one's own group, skills in task design and the right level of explanation and clarity are developed. This can feed back (or rather forward) both into next year's iteration of the sheets, and into one's (next) lectures, especially when other tutors also provide feedback to their colleague. In this way, pedagogical content knowledge (that is, not knowledge *of* one's discipline, but knowledge *of how to teach* one's discipline [17]) is enhanced.

Conclusion

The *flipped classroom* is a currently prominent idea in tertiary teaching; for a recent review, see [1]. Technology is generally invoked, so that content is delivered as down-loadable out-of-class readings or using video recordings; we are not describing such a scenario. But at its core, in the flipped classroom pedagogy, face-to-face time is reserved for active engagement with the material, not as homework problems, but by discussion and interaction with peers and teachers. The intimidating 'sage on the stage' becomes the 'guide on the side', and responsibilities shift from being focussed on the teacher to being shared with the learner. It is in this sense that we suggest the board-tutorial is a tried-and-true, discipline-appropriate example of flipped teaching. Indeed, one post-doc being inducted into tutorials at La Trobe commented 'This is exactly the opposite of what I did before'.

Active participation in mathematics is the key to learning. As Sid Morris remarked:

> Maths is not a game for spectators. It's not like watching a game of football.
>
> McIvor [10]

The board-tutorial model demands such participation from students. Moving the responsibility of driving the class from the tutor to the students opens up opportunities for students to discuss mathematics and engage with the content in an environment that is non-threatening and inclusive. Everyone is compelled to be active in class: the low-ability student, the top student, and the ones in the middle; the students who prepare and the students who do not prepare. Furthermore, this model of tutorial makes the perfect companion to the more generally accepted concept of the flipped classroom — it is the ideal environment for discussion and practice of mathematical concepts and ideas. And the benefits extend to the tutor and the lecturer as they expand their pedagogical content knowledge while assisting a variety of students from different backgrounds.

Acknowledgements

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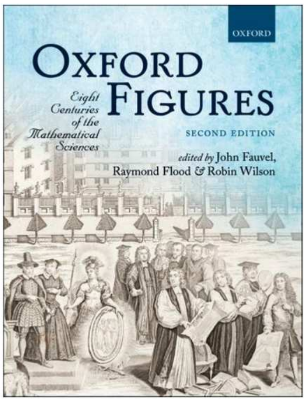
Carolyn (Caz) Sandison is Senior Lecturer of mathematics at the University of Wollongong. She has a keen interest in mathematics education, spending lots of time with students and working out more effective ways of teaching and assessing, while thinking about Topological Groups in her spare time.

Book Reviews

Oxford Figures

John Fauvel, Raymond Flood and Robin Wilson, Editors
Oxford University Press, 2013, ISBN 978-0-19-968197-6

In 2013, Oxford University opened its new Mathematical Institute. As part of the celebration, OUP published a new edition of its 2000 publication *Oxford Figures: Eight Centuries of the Mathematical Sciences*, an intellectual and social history of the 800-year-old mathematical community. This new edition adds a foreword from Marcus du Sautoy and a survey of recent developments by Peter Neumann. The editors (Fauvel died in 2001) are three distinguished mathematicians who are also accomplished historians of mathematics. The five Parts, covering the Medieval and Renaissance periods, the 17th Century, the 18th Century, the Victorian Era and the 20th Century, are divided into several chapters, each written by a specialist in the area.



There is a persistent English myth that you go to Oxford to study Arts, and to Cambridge to study Sciences. As far as the mathematical sciences are concerned, the real history suggests that this is somewhat unfair, firstly because of the long mathematical tradition of Oxford and secondly because of the strong nexus between the two ancient universities, including the frequent interactions of professors and students.

Right from its founding in the 12th Century as a centre of Medieval scholarship in the tradition of Christian Neoplatonism, mathematics played a leading rôle at Oxford. An early Chancellor, the philosopher Robert Grosseteste, and his colleague Roger Bacon, proclaimed the impossibility of understanding natural philosophy without knowledge of geometry. Oxford in the 13th Century was dominated by the Aristotelian influence of Merton College, prominently Thomas Bradwardine who went beyond Greek geometry to try to quantify intensities of light, heat, sound, hardness and density as well as, less effectively, certitude, charity and grace.

A characteristic of Oxford mathematics, in fact of English mathematics in general, is periods of intense activity followed by longer periods of relative quiescence. This is what appears to have happened in the 250 years from the mid 14th to the late 16th centuries. The revival was sparked by the great textbook writer Robert Recorde and the brilliant but eccentric Thomas Harriot and later by the founding of the Savilian Chairs of Geometry and Astronomy, and the Sedleian Chair of Natural Philosophy, which persist to the present day. Even though they suggest a division into pure, applied and mixed mathematics, the titles meant little, since each chair has been held at various times by distinguished scholars who worked in all three areas. Some of the more distinguished scholars who held the chairs include John Wallis, Henry Briggs, David Gregory and Christopher Wren.

English mathematics in the late 17th Century was dominated by Isaac Newton. Of course his name is associated with Cambridge, but the 'Newtonians' also flourished at Oxford, including the Savilian Professor of Geometry and later Astronomer Royal, Edmond Halley.

Another characteristic hiatus ensued until the mid 19th Century which saw the rise of the geometer Charles Hinton, the logician, algebraist and superb populariser Charles Dodgson (Lewis Carroll). Later in 19th Century came the number theorist Henry J. S. Smith, another Savilian Professor of Geometry, and then the formidable James Joseph Sylvester.

Before World War 2, 20th Century Oxford mathematics was dominated by G. H. Hardy, equally at home in Cambridge. After the war a brilliant stream of mathematicians carried the torch, including Henry Whitehead, E. C. Titchmarsh, Graham Higman, Alan Turing, Roger Penrose, Michael Atiyah, Ben Green and Peter Neumann. Mary Cartwright and Dorothy Wrinch were two early women mathematicians whose careers included spells at both Oxford and Cambridge.

But this book is not just a catalogue of famous names and dates. The contributors succinctly explain the practitioners' mathematics in context, at least of those prior to the 20th Century, as well as the social, religious and political milieus in which they worked. We learn about life at Oxford apart from mathematical discovery, including a glimpse at student life through the ages, the textbooks and instruments they used and the examination systems they suffered.

It was Chaucer who provided the definitive image of the ideal academic in his portrayal of the Clerk of Oxenford. The final line has become a cliché, but it is illuminating to quote the whole verse:

> Of studie took he most sure and most hede.
> Noght o word spak he more than was need,
> And that was seyd in form and reverence,
> And short and quick, and ful of hy sentence.
> Souninge in moral vertu was his speche,
> And gladly wolde he lerne, and gladly teche.

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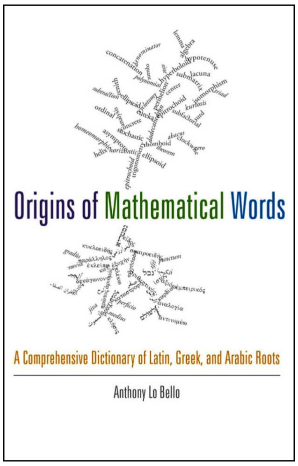
Origins of Mathematical Words: A Comprehensive Dictionary of Latin, Greek and Arabic Roots

Anthony lo Bello
The John Hopkins University Press, 2013, ISBN 978-1-42-141098-2
Also available for Kindle



All mathematicians are, or at least should be, concerned with the precise meaning(s) of mathematical words (and symbols) and almost every mathematician we know exhibits at least a passing interest in their etymology; their derivation, when and where they originated, perhaps by whom they were first coined, and their subsequent evolution in usage and meaning. If you entertain such curiosity, then this book is almost surely for you.

As one of us (JMB) knows first-hand, writing a dictionary [2] or like book [3] is a daunting task: be it highly successful [4] or less so [1].

After a somewhat provocative preface, the book settles into a dictionary-style format, with entries largely restricted to those mathematical terms with a root(s) traceable to one of the three languages listed in the subtitle: Greek, Latin or Arabic. In many, but not all, cases entries offer a precise mathematical definition together with details of the terms etymology; its origin, perhaps when and by whom it was first coined and something of its subsequent evolution. However, first and foremost it is what the subtitle proclaims: 'a comprehensive dictionary [giving the derivation of amenable words from] Latin, Greek and Arabic roots', thus typical entries are:

> **entire** This adjective came into English from the Latin *integer*, which means *whole*, through the mediation of the French *entier*.
>
> **pseudosphere** This modern word is correctly compounded of the prefix $\psi\varepsilon\nu\delta o$-, *false*, and the noun $\sigma\varphi\alpha\rho\alpha$, *a sphere*. The *pseudospere* is the surface of revolution produced by revolving a tractrix about its asymptote. It acquired the name because it is a surface of constant *negative* curvature.

It is also a book with a mission; wherever possible to eschew the use of Dr Johnson's *low* words (concoctions that are 'frequently acronyms or *macaronic* concatenations, the infallible sign of defective education' [from the preface]). Examples being:

> **CW complex** The use of letters to name mathematical objects is to be deplored. If the letters ever had a meaning, they are forgotten in the next generation.'

We do observe that pre-emptive naming has a fine tradition. Banach called his complete normed linear spaces ‘B-spaces’ and Fréchet called his metric extensions ‘F-spaces’. They just begged to end up called after their inventors. Nonetheless we have opted to have no BS-spaces in our joint corpus.

> **nonagon** This is an absurd word used by the unlearned for *enneagon, q.v.* It is the same sort of concoction as *septagon, q.v.*

‘By their unnatural ugliness and comical pomposity, such words betray themselves to the reader, be his intelligence ever so limited’ [from the preface].

The author, however, grudgingly concedes that ‘immemorial custom’ condones the use of certain low words; two examples being *unequal* and

> **binomial** The prefix *bi-* is a Latin abbreviation of the adverb *bis*, *twice*. It should therefore be prefixed only to Latin words or words of Latin origin. The Greek noun νόμος means *rule* or *law*. Some claim that the word is legitimate because the second component is from the Latin *nomen*, *name*, with the adjectival ending *-alis* added, but this is unlikely, for then how does one explain the absence of the second *n*? What happened was that the Latin adjectival ending *-alis* was illiterately appended to the Greek noun, and the word became legitimate through its adoption by Newton, from whose authority there is no appeal.

This image comes from a Kindle screen capture and gives a fine flavour of the volume. When such an exception might be acceptable is largely left for the reader to decide. The current reviewers take an even less prescriptive approach to mathematical nomenclature; better an ugly universal term than competing elegant synonyms.

Thinly peppered throughout, one encounters small lapses in proof reading and cross checking, as the entry for *nonagon* betrays; the cited entry for *enneagon* is nowhere to be found. However, this should not come as a surprise, when [2] was made into software (see http://www.mathresources.com) nearly twenty years ago, the process uncovered more than 50 such dangling links (despite many seemingly careful readings by all involved in the original project).

Sadly the publishing industry has not yet quite mastered the ‘new’ technology. *Were this book* available online as a single file in searchable form it would be an informative and valuable resource. (Actually, it has a *Kindle* version, and is also available as a large set of alphabetic and other files in *Project Muse* http://muse.jhu.edu/books/9781421410999 for which you may have institutional access.)

There is, nonetheless, also a place for it on the shelf of a research mathematician and especially anyone teaching higher mathematics; certainly it is a must for any university/mathematics library.

References

[1] Bornemann F., Laurie, D., Wagon, S., Waldvogel, J. and Borwein, J.M. (2005). The SIAM 1000-digit challenge: a study in high-accuracy numerical computing. *Mathematical Intelligencer* **27,** 40–48.
[2] Borowski, E.J. and Borwein, J.M. (1989). *Dictionary of Mathematics.* Collins, Glasgow. Second revised edition (2002) (12th printing).
[3] Borwein, J.M. (2006). The Oxford Users' Guide to Mathematics. Feature *SIAM Review* **48,** 585–594.
[4] Borwein, J.M. (2009). The Princeton Companion to Mathematics. Feature *SIAM Review* **51,** 790-794

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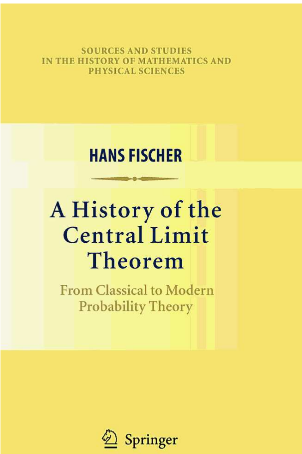
A History of the Central Limit Theorem: From Classical to Modern Probability Theory

Hans Fischer
Springer, 2011, ISBN 978-0-387-87856-0

At the outset, Hans Fischer points out that the phrase 'central limit theorem' is often used broadly to refer to a group of results in probability. There are many central limit theorems. However, it is convenient to talk about 'the central limit theorem' provided that we understand the limitation of this phrase.



The central limit theorem is one of the classical results in mathematics. It has attracted the attention of celebrated scholars such as de Moivre, Laplace, Cauchy, Bienaymé Chebyshev, Lyapunov, Bernstein, Kolmogorov, Feller and many others. Over a long period of time, mathematicians have devoted their energies to extending and refining the theory pertaining to this result. It is not surprising that many of these scholars made contributions to both approximation theory and the study of limit theorems in probability. The books by Gnedenko and Kolmogorov (1968), Araujo and Giné (1980), Hall (1982) and Petrov (1995) provide evidence of these theoretical developments. The central limit theorem is the basis for many methods in applied statistics that are concerned about inferences from large samples. The result has made its way into the curricula in university subjects in statistics in psychology and business, and now appears in the Australian senior mathematics curriculum for schools.

The central limit theorem has a well-deserved place in the history of ideas. Adams (2009) recognised this when he published the first edition of his work in 1974. Fischer's history of the central limit theorem deals mainly on developments between 1810 and 1935. To discuss the history of a technical mathematical result necessarily involves some technical mathematics. Fischer has done a fine job in balancing the mathematics and historical discussion.

One particular feature of this book that I enjoyed is that Fischer occasionally provides short discussion and pointers to the literature on topics that I did not expect to see. His discussion of the log-normal distribution is one example (pp. 133–134). The work certainly makes you aware of the importance of being able to read in several languages to appreciate historical aspects of mathematics.

There are numerous black-and-white photographs scattered throughout the book. The book is well bound and, as one would hope, has an extensive bibliography. I am proud to say that the bibliography lists the works of several Australian scholars, particularly Professor Eugene Seneta.

Most statistics subjects at university, and the corresponding text books, pay little attention to the history of the subject. Perhaps this is common for subjects that are developing rapidly. Fischer's work would be a useful reference for many subjects on probability and statistics at university. It may inspire a lecturer or student to find out more about the history of probability. Perhaps a graduate student writing a thesis might be motivated to add an historical chapter. I recommend Fischer's scholarly history of the central limit theorem for any university library.

What would be other fruitful topics for research in the history of mathematical ideas?

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Adams, W.J. (2009). *The Life and Times of the Central Limit Theorem*, 2nd edn. American Mathematical Society, Providence, RI.

Araujo, A. and Giné, E. (1980). *The Central Limit Theorem for Real and Banach Valued Random Variables.* John Wiley, New York.

Hall, P. (1982). *Rates of Convergence in the Central Limit Theorem* (Research Notes in Mathematics **62**). Pitman, Boston, MA.

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Petrov, V.V. (1995). *Limit Theorems of Probability Theory. Sequences of Independent Random Variables.* Oxford University Press, New York.

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Nalini Joshi*

M.A.G.I.C. (Mathematical Games and Interactive Course)

To promote scientific knowledge in Australia, the Australian Academy of Science has developed two widely admired educational programs *Primary Connections* and *Science by Doing* with the aim to inspire, engage and support school students and teachers in science. I write this column to let you know about a proposal that the National Committee for Mathematical Sciences is currently discussing to develop a program in mathematics to be offered in parallel with the *Science by Doing* program for high school students.

Most mathematicians would agree that mathematics is an indelible part of Science, but the two have been separated by a hard boundary in teacher education and curriculum development in Australia. Because of this separation, many science teachers profess a lack of confidence in tackling mathematical content. The proposal in discussion suggests that the Academy develop an inquiry-based program in mathematics tentatively called Mathematics and Games Interactive Course (M.A.G.I.C.).

When I spoke about this proposal at the recent meeting of the Australian Heads of Mathematical Sciences (ACHMS) meeting in Melbourne, the questions I received asked for clarification on how it might overlap or compete with other existing widely praised programs for mathematical sciences. These include the CSIRO Mathematicians and Statisticians in Schools program, the AMSI teacher development programs, the National Mathematics Summer School and the Australian Mathematics Trust enrichment and training programs for mathematics competitions. All of these engage with students and/or teachers in high schools by offering face-to-face or email-based interactions between specialists or mentors and students or teachers. Some of these run all year during school terms, whilst others run in certain time periods such as school holidays or development days that lie outside teaching periods. Some are designed for groups of students of particular ability, whilst others seek to engage students or teachers at all levels.

The M.A.G.I.C. proposal is different from all of these because it is based on a sequence of web-based modules as in *Science by Doing*. This comprehensive online program for years 7 to 10 consists of units that provide a sequence of hands-on and interactive activities to support the implementation of the Australian Curriculum: Science. An important element consists of digital resources for students containing engaging activities that include video and audio clips to help students understand complex science concepts. Other elements in the program are a student guide and

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a teacher guide for each unit. The program is freely available to all schools. The program is also supported by a well researched professional learning approach with digital professional learning modules. All the material for Science by Doing can be found at http://www.sciencebydoing.edu.au.

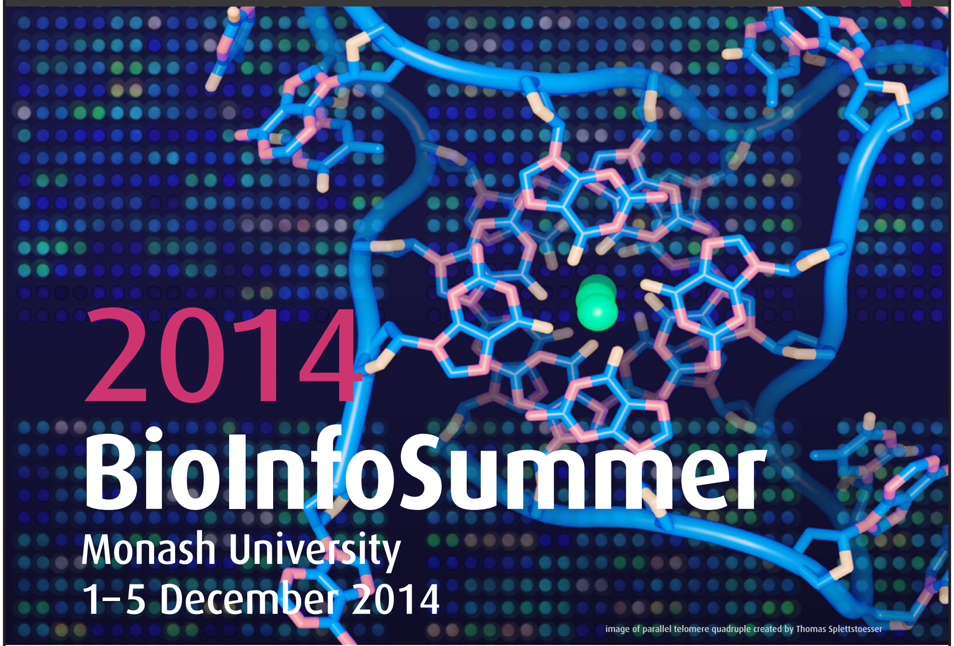
I was at the launch of the Science by Doing program at the Academy in October 2013. Students who were driving the displays of the online modules at the launch told me they very much enjoyed the interactive interface and wished they had similar modules for mathematics. These are students who also have access to other programs, such as Scientists in Schools, opportunities for participating in Science competitions and whose teachers participated in teacher development programs. Yet the Science by Doing program widened and deepened these students' engagement with science in new ways.

The aim of the proposed inquiry-based program is to help students re-engage with mathematics and in turn support the development of mathematical and scientific literacy in the Australian community. It is anticipated that M.A.G.I.C. will focus on the students' experience through learning processes that use digital technology in innovative ways, and at the same time, support the implementation of the Australian Curriculum: Mathematics and complement what is being developed for teachers. The modules developed for one year will be made accessible and adaptable for students with varying levels of interest or advanced/lessened achievement in other years. The template for the proposed program will consist of a student digital platform, a student resource for hands-on activities, a teacher guide and classroom resources and assessment items that are provided in an editable format adaptable to the needs of each class and teacher.

This proposal, if we undertake it, will require substantial support to come to fruition. If we decide to go ahead, the next step is to seek financial support from federal and state governments. It requires not only financial support but also champions in the mathematical community. The Academy has asked the National Committee to engage with the mathematical community to consult about the proposal. I look forward to your feedback.

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

Research
Australian Mathematical Sciences Institute



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

Register your interest for BioInfoSummer 2014

The program features:

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

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

Register www.amsi.org.au/BIS

AMSI News

Geoff Prince*

Vacation Research Scholarships hit 58

As a result of our partnership with the Commonwealth Department of Education, a record 58 students undertook Vacation Research Scholarships (VRS) at AMSI member departments. There is no doubt that we have a wealth of talent going on to third year, honours and masters programs in 2014. You can see them all at www.amsi.org.au, and their reports will be posted soon. Fifty-six students presented their VRS projects at CSIRO's Big Day In at UNSW on 11 and 12 February. The quality of the talks was exceptional and I enjoyed the whole event immensely. Thank you to the many supervisors who attended and chaired sessions. Congratulations to Thomas Moore (UQ) and Melissa Lee (UWA) who won the Cambridge University Press Book Prizes for the best AMSI presentations at Big Day In. Thank you to CSIRO's division of Computational Informatics for letting us be part of their standout event.

Winter School security breach

It is no longer a secret that the theme of this year's AMSI Winter School at sunny Brisbane's University of Queensland is Contemporary Aspects of Cryptography. In fact the only secret about the pivotal role of mathematics in cryptography and cybersecurity in particular are the mathematicians' salaries. The School will be attractive to postgraduates and postdocs who want to learn about, for example, post-quantum cryptography (in a pre-quantum computing world!) from Australian and international experts.

The first week consists of relatively broad courses, introducing the mathematical tools and techniques used in this area. The second week will feature specialised advanced courses building on the first week, giving an understanding of some current research aspects of modern cryptography.

The speaker list includes, amongst others, Professor Tanja Lange of Technische Universiteit Eindhoven. Tanja has published more than 50 research papers bridging the gaps between algebraic geometry, theoretical cryptography, and real-world information protection. She is an expert on curve-based cryptography and post-quantum cryptography. She is on the editorial board for two journals and serves on three steering committees, including the workshop series on Post-Quantum Cryptography. She has organised around 20 conferences and workshops, has served

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on more than 40 program committees. She is coordinator of the EU-FP7 project PUFFIN — Physically unclonable functions found in standard PC components.

Tanja will also be speaking at the Women in Maths networking event at the Winter School on 16 July.The University of Queensland's Professor Andrew White will be giving a public lecture in conjunction with BrisScience and the Winter School on 14 July.

The 9th AMSI Winter School will be held at the University of Queensland from 7 to 18 July. Registrations close on 2 May 2. The Winter School is supported in partnership with the Commonwealth Department of Education. The event website and a full speaker list is at www.amsi.org.au/index.php/higher-education/winter-school.

I strongly recommend this Winter School to all postgraduates and postdocs interested in this exciting area where maths meets technology meets business meets national security.

Erratum. In my last AMSI News piece I omitted Geoscience Australia (GA) from the list of government agencies participating in the new Agency–University network. GA were an enthusiastic partner and sponsor of the International Year of the Mathematics of Planet Earth 2013 and a driving force behind the successful mid-year MPE conference in Melbourne.

I completed a BSc (Hons) and secondary Dip Ed at Monash University in the 1970s and moved to La Trobe where I undertook a PhD in 1981 in geometric mechanics and Lie groups. I did a postdoc at the Institute for Advanced Study in Dublin.

I've taught at RMIT, UNE and La Trobe University, where I was Head of Department a couple of times in the last decade. I worked at AMSI from 2004 through to 2006 in part as executive director to Garth Gaudry and I oversaw the introduction of the AMSI/ICE-EM Access Grid Room project. I became AMSI director in September 2009.

My research interests lie mainly in differential equations and differential geometry and I work with friends in Europe: Mike Crampin, Willy Sarlet, Olga Krupkova and Demeter Krupka.

My partner is a mathematician and we have two children with a refreshing lack of interest in mathematics. On the margins I brew beer and ride a bike.

I'm a proud Fellow of the Society and am currently a Council member and a steering committee member.

News

General News

International Congress of Mathematicians, Korea

The National Committee of Mathematical Sciences has requested information about mathematicians from Australia who are planning to attend the ICM in Korea, which is to be held 13–21 August 2014. If you are planning to do so, please email Nalini Joshi (nalini.joshi@sydney.edu.au), and let her know about your travel plans.

Call for nominations AAS awards

The Australian Academy of Science is currently calling for nominations for applications for Travelling Fellowships, Conference Awards and Research Awards. The closing date for nominations is 30 July. The available awards include the following:

- AK Head Travelling Scholarship for Mathematical Scientists
- 2015 Selby Fellowship.

For more details see http://www.science.org.au/awards.

New edition of the Administrative Directory

The December 2013 edition of the Administrative Directory of Australia is now available on the AustMS website. You need to log in with your username and password to gain online access to the Directory. Your username will usually be a single lower case word comprising your first initial followed by your surname. If you have forgotten your password, the log-in process enables you to ask for it. If you have difficulty with the log-in, please contact the AustMS office directly.

Completed PhDs

Australian National University

- Dr Mun-Ju Shin, *On model evaluation and characterizing uncertainty: the example of rain-fall runoff*, supervisors: Barry Croke and Tony Jakeman.

La Trobe University

- Dr Thi Thuy Dung Nguyen, *Presentations of context free shifts*, supervisors: John Banks and Marcel Jackson.

Monash University

- Dr Zohreh Heidarirad, *Aspects of locally compact quantum groups*, supervisors: Alan Pryde and Todd Oliynyk.
- Dr David James Hartley, *Stability of stationary solutions to curvature flows*, supervisors: Maria Athanassenas and Todd Oliynyk.

University of Newcastle

- Dr Andrew Morris, *Fourier and wavelet analysis of Clifford-valued functions*, supervisors: Jeffrey Hogan and George Willis.

University of New South Wales

- Dr Joshua Capel, *Classification of second-order conformally-superintegrable systems*, supervisor: J. Kress.
- Dr Ali Alkhaldi, *The parabola in universal hyperbolic geometry*, supervisor: N. Wildberger.

University of Queensland

- Dr Tim Brereton, *Monte Carlo methods for complex systems*, supervisor: Dirk Kroese.
- Dr Adam Grace, *Markov chain Monte Carlo for rare-event probability estimation*, supervisor: Dirk Kroese.

University of Western Australia

- Dr Brian Corr, *Estimation and computation with matrices over finite fields*, supervisors: Cheryl Praeger and Akos Seress.

University of Wollongong

- DrRubayyi Turki Alqahtani, *Modelling of biological wastewater treatment*, supervisors: Mark Nelson and Annette Worthy.
- Dr Hassan Alfifi, *Semi-analytical solutions for delay partial differential equations*, supervisors: Tim Marchant and Mark Nelson.
- Dr Muteb Alharthi, *Semi-analytical solutions for autocatalytic reaction-diffusion equations*, supervisors: Tim Marchant and Mark Nelson.

Awards and other achievements

Australian National University

- Professor Alan Carey is one of 20 new Fellows of the Australian Academy of Science.

Monash University

- Associate Professor Burkard Polster received the Monash Enhancement Program Teaching Award in 2013. This is the third year in a row that he has been given this award, voted by the students.
- Michael Brand has won the Mollie Holman Doctoral Medal for the best PhD thesis completed in the Faculty of IT at Monash University in 2013. One such medal is awarded in each Faculty, each year, at Monash. His thesis also won the 2013 Faculty of IT Doctoral Medal which has criteria for other contributions as well as thesis excellence. The thesis is titled *Computing with arbitrary and random numbers*, and is available at: http://arrow.monash.edu.au/hdl/1959.1/907035. Main supervisor was Graham Farr, associate supervisor was Ian Wanless. Michael graduates in May 2014.

University of Melbourne

- Congratulations to Professor Peter Hall who was recently awarded a Doctor Honoris Causa from the University of Cantabria in Spain. The honorary doctorate was awarded on 27 January with an inaugural lecture titled 'Una perspectiva de la estadística'.

University of New South Wales

- Recent former PhD student Steve Maher has been awarded an AustMS Lift-Off Fellowship, which he will use to visit Professor Francois Vanderbeck at the Institute of Mathematics at the University of Bordeaux.

University of Newcastle

- Professor George Willis is one of 20 new Fellows of the Australian Academy of Science.
- Congratulations to Dr Masoud Talebian from University of Newcastle, who, with his co-author Professor Garrett Van Ryzin from Columbia University, was runner-up in the INFORMS Case and Teaching Materials Competition for their submission Markdown Management at Sports Unlimited.

University of Queensland

- A 2012 paper in the journal *Neuron* by Libby Forbes, Andrew Thompson, Jiajia Yuan and Geoffrey Goodhill (University of Queensland) was awarded the Paxinos–Watson Prize by the Australasian Neuroscience Society for the most significant neuroscience paper published that year by one of their members (awarded in 2014). The paper describes a mathematical model for how calcium and cyclic AMP interact to determine the direction of nerve fibre growth during neural development.

  See https://www.ans.org.au/awards/paxinos-watson-award.

University of Sydney

- Alex Chalmers was awarded the K.E. Bullen International Conference Scholarship.
- Sanjaya Dissanayake was awarded the Kopystop International Conference Scholarship.
- Matthew Chan won the T.M. Cherry Prize for the best student talk at the ANZIAM 2014 meeting in Rotorua, New Zealand.
- Amelia Gontar was awarded a Google Bursary to attend the British Mathematical Colloquium at Queen Mary, University of London in April 2014.
- Ross Ogilvie was awarded the Philipp Hofflin International Research Travel Scholarship.
- Rory Anderson was awarded the CSIRO Mathematics, Informatics and Statistics (CMIS) Honours Scholarship.

University of the Sunshine Coast

- The mathematics community at USC recently won an internal grant to establish a Mathematics Teachers Hub on the Sunshine Coast (MATHS) to support mathematics teachers and pre-service mathematics teachers, with support from the USC mathematics community.

University of Wollongong

- Michelle Dunbar has received the Engineering and Information Sciences Faculty Outstanding Contribution to Teaching And Learning (OCTAL) Early Career award.
- Caz Sandison and Carole Birrell have received an Outstanding Contribution to Teaching And Learning (OCTAL) award for their project 'C2: Teachers of Maths for Primary Education'.

Appointments, departures and promotions

Charles Sturt University

- Dr Michael Kemp has been appointed Associate Head of School.
- Sharon Nielsen, Director of the Quantitative Consulting Unit, has been seconded to the Research Office.

La Trobe University

- In February, Professor Phil Broadbridge ended his five-year term as Head of the School of Engineering and Mathematical Sciences. He is now Professor in the Department of Mathematics of Statistics.

Macquarie University

- Dr Stuart Hawkins was promoted to Senior Lecturer in recognition of his contribution as an individual and for raising the profile of Mathematics at Macquarie.
- Dr Mingju Liu from Beihang University China has a postdoctoral position with Professor Xuan Duong for the year 2014.

Monash University

- Dr Kerri Morgan commenced as Lecturer in the Clayton School of Information Technology in May.
- Dr Rebecca Robinson commenced as Research Fellow in 2013.
- Professor Philip Hall commenced as the new Head of the School of Mathematical Sciences on 31 March 2014. Phil comes from Imperial College London where he was a former Head of Department from 1998–2003. His main research areas are fluid dynamics, turbulence and geomorphology.
- Professor Kate Smith-Miles, who was Head for the last five years, will continue as a Professor in the School with a new role as Director of the Monash Academy for Cross and Interdisciplinary Mathematical Applications (MAXIMA; see monash.edu/maxima).
- Dr Joel Miller commenced as Senior Lecturer. Joel's interests are in mathematical biology, network properties, and network dynamics. Usually his research has application to spread of infectious diseases, invasive species, ideas, or other processes.
- Dr Anja Slim commenced as Senior Lecturer. Anja's research interests are in fluid dynamics applied to the earth sciences and to industrial problems; carbon capture and storage; gravity currents; viscoplastic fluids.
- Mr Mario Andres Munoz A'Costa commenced as Research Fellow. Mario's research interests are in computational intelligence, in particular its application to continuous optimisation problems, pattern recognition, and control system design.
- Dr Jennifer Catto commenced as Research Fellow. Jennifer's research interests are in midlatitude weather systems: their relationship with rainfall including extreme rainfall; how they are represented by climate models; and how they may change in the future. Other interests include atmospheric and climate dynamics, and climate modelling.
- Dr Maria Lugaro, Senior Lecturer in Astrophysics, has resigned with effect from 30 April 2014. Maria will return to Europe.

Queensland University of Technology

- Eleftherios Kirkinis, Lecturer in applied mathematics, has left the university.
- Robyn Araujo, Lecturer in applied mathematics, has left the university.
- Associate Professor Steven Stern, Statistics, has left the university.

University of Adelaide

- Dr Ali Eshragh is leaving the University of Adelaide to join the School of Mathematical and Physical Sciences at the University of Newcastle as a Lecturer in statistics.

University of Melbourne

- Dr William Holmes (University of California at Irvine) and Dr James Osborne (University of Oxford) have been appointed as Lecturers in applied mathematics.

University of Newcastle

- Dr Ali Eshragh has joined the University of Newcastle as a Lecturer in statistics.
- Dr Bishnu Lamichhane has been promoted to Senior Lecturer.
- Dr Roslyn Hickson has left the university.
- Dr Eugene Vlachynsky has left/is leaving the university.
- Dr Ian Benn has left/is leaving the university.
- Dr Darfiana Nur has left/is leaving the university.
- Dr Paul Rippon has left/is leaving the university.
- Dr Liangjin Yao has left/is leaving the university.

University of Sydney

- Professor Norman Dancer has transitioned to Emeritus Professor.

University of Wollongong

- Associate Professor Michael McCrae has been appointed as an Honourary Principal Fellow.
- Professor Jacqui Ramagge and Associate Professor David Pask have been appointed as two of nine candidates for nine Faculty of Engineering and Information Sciences academic staff representatives to the University of Wollongong Academic Senate for the period 1 April 2014 to 30 June 2015.
- Associate Professor David Pask and Dr Marianito Rodrigo have been appointed to the steering committee of the Institute for Mathematics and its Applications, directed by James McCoy.
- Dr Ngamta (Natalie) Thamwattana has been appointed as Ethnicity Representative on the UoW Employment Equity and Diversity Committee for a period of two years.

New Books

University of New South Wales

Franklin, J. (2014). *An Aristotelian Realist Philosophy of Mathematics: Mathematics as the Science of Quantity and Structure*. Palgrave Macmillan, Basingstoke.

University of South Australia

Avrachenkov, K.E., Filar, J.A. and Howlett, P.G. (2013). *Analytic Perturbation Theory and Its Applications*. SIAM, PA.

University of Queensland

Lafaye de Micheaux, P., Drouilhet, R. and Liquet, B. (2013). *The R Software: Fundamentals of Programming and Statistical Analysis* (Statistics and Computing **40**). Springer.

Kroese, D.P. and Chan, J.C.C. (2013). *Statistical Modeling and Computation*. Springer.

Conferences and Courses

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

Cell Based and Individual Based Modelling (CBIBM)

Date: 10–12 June 2014
Venue: Pullman Cairns International, Cairns
Web: http://www.cs.ox.ac.uk/conferences/CBIBM/

For further details, see the website, or the *Gazette* 41(2), p. 64.

CoECSS Winter School 2014: Geophysical fluid dynammics

Date: 16–20 June 2014
Venue: Centre of Excellence for Climate System Science, ANU
Web: http://www.climatescience.org.au/winter-school-2014

The 2014 winter school theme is Geophysical Fluid Dynamics. This is a high-level education program for honours and graduate students interested in climate science. It will be of considerable relevance to those working in the atmospheric and ocean sciences, and also those in land-related disciplines with interest in the planetary boundary layer and land–atmosphere feedbacks. The winter school will consist of a series of lectures and lab sessions delivered by Centre of Excellence researchers from our five universities and partner organisations. An advanced Python tutorial will be delivered by our Computational Modelling Support Team.

Teaching Practices in Undergraduate Mathematics

Date: 23–24 Hybe 2014
Venue: University of Melbourne
Web: http://fyimaths.org.au/workshops-2/workshop-2/
Contact: Joann Cattlin (joann.cattlin@unimelb.edu.au)

The First Year in Maths project is holding a free professional development workshop on 'Teaching practices in undergraduate mathematics' over 1.5 days, on Monday and Tuesday 23 (full day) and 24 June (half day), at the University of Melbourne.

The workshop is aimed at academics who teach first-year mathematics in universities and would like to find out more about the range of teaching practices others are currently trialling. Day 1 will cover topics such as flipped classrooms, lecture recording, online learning, interactive tutorials and other innovative practices. Day 2 will be a half-day session on diagnostic testing.

The First Year in Maths project is an OLT-funded project that aims to establish a supportive network for academics teaching in first-year maths through information sharing, professional development and mentoring. The project has established links with mathematics departments in Australian and New Zealand universities through interviews, a workshop, meetings and a major forum in Sydney in February this year.

Further information and registration form are available on the website.

Interactions Between Operator Algebras and Dynamical Systems

Date: 30 June to 4 July 2014
Venue: University of Wollongong
Web: http://eis.uow.edu.au/smas/operator-algebra-dynamic-systems/index.html

Local organisers: Adam Sørensen, Michael Whittaker, Sam Webster (UOW) and Murray Elder (University of Newcastle).

Finance, Probability and Statistics workshop

Date: 2–6 July 2014
Venue: UTS, Sydney
Web: http://cfsites1.uts.edu.au/qfrc/news-events/events-detail.cfm?ItemId=35866

This is the fourth IMS-FPS (Institute for Mathematical Statistics–Finance, Probability and Statistics) workshop, it is a satellite workshop to the joint Australian Statistical Society and IMS Annual Meeting which will be held in Sydney (7–10 July). The main venue is the lecture theatre at Aerial UTS Function Centre which is located within the Broadway UTS Campus. In addition there will be a short course on Stochastic Optimal Control, designed for graduate students and practitioners.

The workshop topics include, but are not limited to:

- high frequency trading: data, models and strategies
- energy and weather derivatives
- change-point models
- volatility models
- stochastic optimal control
- decision making with incomplete information
- retirement products

- exotic options
- irregular markets
- risk and regulation

Speakers for plenary sessions include Carl Chiarella (UTS), Rong Chen (Rutgers University), Dilip Madan (University of Maryland), Juri Hinz (UTS), Tze-Leung Lai (Stanford University), Eckhard Platen (UTS), Albert Shiryaev (Moscow State University), Xunyu Zhou (Chinese University, Hong Kong).

2014 AMSI Winter School on Contemporary Aspects of Cryptography

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

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

GAGTA8: Geometric and Asymptotic Group Theory with Applications

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

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

Workshop in Harmonic Analysis and its Applications

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

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

Geometric Analysis and Probabilistic Methods in Geometry

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

The main themes of the conference are heat kernels, the Ricci curvature, the Willmore functional and stochastic differential geometry.

Organisers: Glen Wheeler and Valentina Wheeler (U Wollongong), Thierry Coulhon (ANU), Artem Pulometov and Huy Nguyen (UQ).

Funding from AMSI/AustMS, IMIA, UQ, and MSI (ANU).

International Congress of Mathematicians

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

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

Robust Statistics and Extremes conference

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

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

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

New Directions in Fractal Geometry workshop

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

CTAC 2014

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

BioInfoSummer 2014

Date: 1–5 December 2014
Venue: Monash University
Web: https://platforms.monash.edu/maxima/index.php?option=com_content&view=article&id=93:bioinfosummer&catid=24:latest-news&Itemid=199

38th Australasian Conference on Combinatorial Mathematics and Combinatorial Computing

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

For further details, see the website, or *Gazette* 41(1), p. 65.

8th Australia–New Zealand Mathematics Convention

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

For further details, see the website, or *Gazette* 41(1), p. 65.

Vale

Dr Jia Weng

It is with much sadness that we report the passing of Dr Jia Weng in March 2014. He had just celebrated his 76th birthday. He obtained a doctorate in Mathematics at Flinders University with the title 'Determining Shortest Networks in the Euclidean Plane' in 1993. He has since spent his time as a research fellow and then as a senior research fellow at the University of Melbourne, first in the mathematics department, and then in the engineering department. By anybody's yardstick, he was truly a first class mathematician.

Reyn Keats FAustMS

With regret we inform members that Professor Reyn Keats FAustMS died on 1 April, at the age of 96 years. An obituary will appear in the next issue.

Geoff Mercer

Tragically, Professor Geoff Mercer of the National Centre for Epidemiology and Population Health at the ANU passed away unexpectedly on Saturday, 12 April. The Society's Accreditation Committee has decided to posthumously accredit him as a Fellow of the Australian Mathematical Society (FAustMS).

The Research School of Population Heath at ANU has decided to honour Geoff's contributions and to continue his legacy of mentoring and support of students by establishing the Geoff Mercer Endowment. This will fund an annual award for postgraduate RSPH students to undertake an activity in pursuit of their academic goals, including travel to a national or international conference.

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.

Soren Asmussen; Aarhus University; 28 January to 28 February 2014; applied probability; SMP at UQ; Leonardo Rojas-Nandayapa

Prof Pascal Auscher; Université Paris-Sud; 15–24 April 2014; ANU; Thierry Coulhon

Prof Christoph Bandt; Ernst Moritz Arndt University Greifswald; 15 April 2014 to 10 May 2014; ANU; Michael Barnsley

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

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

Prof Alexey Bolsinov; Loughborough; 30 March 2014 to 3 April 2014; ANU; Katharina Neusser

Paul Carter; Brown University, USA; 2 April to 10 May 2014; applied; USN; Martin Wechselberger

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

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

Sam Chow; University of Bristol, UK; 15 March to 12 April 2014; UMB; Alex Ghitza

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

Prof David Evans; Cardiff University, Wales; 23–26 March 2014; UMB; Arun Ram

Prof Jarah Evslin; TPCSF, Institute of High Energy Physics; 18 April to 18 May 2014; ANU; Peter Bouwknegt

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

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

Alexandr Garbali; LPTHE - CNRS - UPMC, France; 11 March to 1 April 2014; UMB; Jan de Gier

Mark Handcock; University of California; 27 June to 7 July 2014; UWA; Gopal Nair

A/Prof Viktoria Heu; Université de Strasbourg; 6 April to 10 May 2014; applied; USN; Nalini Joshi

Ms Hong Diem Huynh; Cantho College, Vietnam; three weeks in April/May 2014; optimisation; FedUni; Alex Kruger

Valerie Isham; University College London; 27 June to 7 July 2014; UWA; Gopal Nair

Prof Bruno Iochum; University of Provence; 21 April to 11 May 2014; mathematical physics; UWG; Adam Rennie

Prof Masahiko Ito; Tokyo Denki University, Japan; 5–26 March 2014; UMB; Peter Forrester

A/Prof Hanna Jankowski; York University, Canada; 9 August 2013 to 30 June 2014; UMB; Peter Hall

Prof Phan Quoc Khanh; Vietnam International University; three weeks in April/May 2014; optimisation; FedUni; Alex Kruger

Prof Elena Kulinskaya; University of East Anglia, UK; 28 January to 30 April 2014; UMB; Richard Huggins

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

Prof Feng Luo; Rutgers University, USA; 17–21 March 2014; UMB; Craig Hodgson

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

Prof Hiroshi Matano; University of Tokyo, Japan; 15–23 May 2014; nonlinear partial differential equations and dynamical systems; UNE; Yihong Du

Prof Vladimir Matveev; Friedrich-Schiller University, Germany; 30 March to 9 April 2014; ANU; Michael Eastwood

Yolanda Moreno; University of Extremadura, Spain; 29 April to 1 June 2014; functional analysis; FedUni; David Yost

Prof Evgeny Mukhin; 5–31 May 2014; pure; USN; Alexander Molev

Dr Steven Noble; Brunel University, UK; 6–19 April 2014; UWA; Gordon Royle

Tanmoy Paul; Indian Institute of Technology, Hyderabad; 16 May to 15 July 2014; functional analysis; FedUni; David Yost

A/Prof Julia Pevtsova; University of Washington, USA; 19–23 March 2014 and 28 March to 1 April 2014; UMB; Arun Ram

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

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

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

Jan Nykvist Roksvold; University of Tromsø, Norway; 1 February to 1 May 2014; UNSW; T. Britz

Dr Ege Rubak; Aalborg University, Denmark; 31 March to 20 April 2014; UWA; Gopal Nair and Adrian Baddeley

Sergey Semin; Nizhny Novgorod State Technical University, Russia; 21 September 2013 to 10 July 2014; ocean wave dynamics in the coastal zone; USQ; Yury Stepanyants

Mr Mikael Slevinsky; University of Alberta, Canada; 7 February 2014 to 31 May 2014; applied; USN; Sheehan Olver

Dr Pablo Spiga; Università degli Studi di Milano-Bicocca; 17 March to 2 April 2014; UWA; Gordon Royle

Prof Ciprian Tudor; Universidad de Paris and Universit/'e de Lille; 1–21 June 2014; statistics; USN; Qiying Wang

Dr Rolf Turner; University of Auckland, NZ; 7–20 April 2014; UWA; Gopal Nair and Adrian Baddeley

Vincenzo Vespri; University of Florence, Italy; 1–30 April 2014; ANU; Neil Trudinger

A/Prof Mircea Voineagu; UNSW; 13–16 March 2014; UMB; Arun Ram

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

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

Prof Viola Weiss; University of Applied Sciences Ernst-Abbe-Fachhochschule, Germany; 2 April to 30 May 2014; statistics; UNE; Neville Weber

Mr Padarn Wilson; ANU; 13–20 March 2014; UMB; Aurore Delaigle

Mr Wei Wu; UNSW; 30 July 2012 to 30 June 2015; financial maths; USN; Ben Goldys

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

Prof Wenshang Zhang; Chinese academy of Sciences; 23 March to 5 April 2014; ANU; Qinian Jin

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

Dr Michael Zieve; University of Michigan; 19 March to 31 April 2014; UWA; Cheryl Praeger

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

Research

Australian Mathematical Sciences Institute

The 9th annual AMSI Winter School

Contemporary Aspects of Cryptography

7–18 July 2014, The University of Queensland

Historically, cryptography has effectively been synonymous with encryption and decryption. Modern cryptography involves sometimes surprising intersections of mathematics, computer science, and electrical engineering.

Full travel and accommodation scholarships available!

Lecturers include:

Assoc. Prof. Ben Burton, The University of Queensland
Assoc. Prof. Serdar Boztas, RMIT University
Dr Alessandro Fedrizzi, The University of Queensland
Dr Anna Foeglein, TSG Consulting
Dr Joanne Hall, Queensland University of Technology
Prof. Tanja Lange, Technische Universiteit Eindhoven
Prof. Alexei Miasnikov, Stevens Institute of Technology
Dr Douglas Stebila, Queensland University of Technology
Prof. Andrew White, The University of Queensland

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Election of officers and ordinary members of Council

Officers of Council

Nominations are invited for one Vice-President for the Session commencing after the Annual General Meeting to be held in December 2014. According to Paragraph 34 (ii) of the Constitution, A. Henderson is eligible for re-election.

Note: According to Paragraph 34 (i) of the Constitution, Professor P.J. Forrester will continue in office as the Immediate-Past-President, and Professor T.R. Marchant will move from President-Elect to President, after the AGM in December 2014.

According to Paragraph 34 (iii), the positions of Secretary and Treasurer will be appointed by Council at its December 2014 meeting.

The present Officers of the Society are:
President: P.J. Forrester
President-Elect: T.R. Marchant
Vice-President: A. Henderson
Secretary: P.J. Stacey
Treasurer: A. Howe

Ordinary Members of Council

The present elected Ordinary Members of Council are:

1. Members whose term of office expires after the AGM in 2014:
   J. Bamberg   N. Boland   A.R. Francis
2. Members whose term of office expires after the AGM in 2015:
   J. Filar   A. Glen   D. Mallet
3. Members whose term of office expires after the AGM in 2016:
   S. Morrison   J. Sumner

Accordingly, nominations are invited for three positions as Ordinary Members of Council, who shall be elected for a term of three consecutive sessions. Note that according to Paragraph 34(iv) of the Constitution, J. Bamberg, N. Boland and A.R. Francis are not eligible for re-election at this time as Ordinary Members.

To comply with Paragraphs 61 and 64 of the Constitution, all nominations should be signed by two members of the Society and by the nominee who shall also be a Member of the Society.

Nominations should reach the Secretary no later than *Friday 1 August 2014*.

Alternatively, members are encouraged to send informal suggestions to the Nominations and Publications Committee, by emailing Secretary@austms.org.au.

For the information of members, the following persons are currently ex-officio members of Council for the Session 2013–2014.

Vice President (Chair of ANZIAM):	L.K. Forbes
Vice President (Annual Conferences):	S.O. Warnaar
Representative of ANZIAM:	J. Piantadosi
Public Officer of AustMS and AMPAI:	P.J. Cossey
Chair, Standing Committee on Mathematics Education:	L.N. Wood
AustMS member elected to Steering Committee:	N. Joshi

Editors: S.A. Morris and D.T. Yost (Gazette)
J.H. Loxton (Bulletin)
R.R. Moore (Electronic Site)
J.M. Borwein and G.A. Willis (Journal of AustMS)
C.E. Praeger (Lecture Series)
A.P. Bassom and G. Hocking (ANZIAM Journal)
A.J. Roberts (ANZIAM Journal Supplement)

The Constitution is available from the Society's web pages, at
http://www.austms.org.au/AMSInfo/Const/amsconst.html

The 2015 J.H. Michell Medal: call for nominations

In honour of John Henry Michell, ANZIAM, a Division of the Australian Mathematical Society, has instituted an award for *outstanding new researchers*. At most one award will be made annually, but only to a candidate of sufficient merit. No person can receive more than one such award. The selection criteria for the award are:

1. The researcher must have carried out distinguished research in applied and/or industrial mathematics, where a significant proportion of the research work has been carried out in Australia and/or New Zealand; *and*
2. On 1 January in the year in which the AWARD is made, the recipient will be within the equivalent of the first ten years of their research-related career*, following the conferral of a PhD**; *and*
3. The researcher must have been a member of ANZIAM for at least the** three calendar years preceding the year in which the AWARD is made. Backdating of membership is not acceptable.

Notes
*Allowing for significant interruptions to research development, for example, parental duties, illness, career change.
**Any exceptional circumstances should be forwarded to the Executive Committee to assess eligibility.

Nominations

Nominations for the AWARD can be made by any member of ANZIAM other than the nominee. A nomination should consist of a brief CV of the nominee together with the nominee's list of publications and no more than a one-page resumé of the significance of the nominee's work. Nominations should be forwarded in confidence, electronically in pdf format, to Associate Professor Matthew Simpson (matthew.simpson@qut.edu.au), Chair of the Selection Panel, by *7 November 2014*.

Further details of the application process and the award criteria are on the ANZIAM website: www.anziam.org.au/The+JH+Michell+Medal.

The 2015 E.O. Tuck Medal: call for nominations

In honour of the late Ernest Oliver Tuck, FAustMS, FTSE and FAA, ANZIAM has instituted a mid-career award for outstanding research and distinguished service to the field of Applied Mathematics. At most one award will be made biennially, but only to a candidate of sufficient merit. No person can receive more than one such award and previous winners of the ANZIAM medal are ineligible. The award will not be offered in the same year as the ANZIAM medal. The selection criteria for the award are:

1. Outstanding research, relative to opportunity, in Applied and/or Industrial Mathematics, where a significant proportion of the research work has been carried out in Australia and/or New Zealand.
2. Distinguished service in the field of Applied Mathematics. Service in ANZIAM related activities will be highly regarded.
3. On 1 January in the year in which the award is made, the recipient will have normally had their PhD conferred more than ten and less than twenty years ago (see note 3 below).
4. Membership of ANZIAM for at least the five calendar years preceding the year in which the AWARD is made. Backdating of membership is not acceptable.

Notes

1. In criterion 1 the research portfolio will be assessed relative to opportunity. Any significant teaching and administrative responsibilities will be considered when assessing the volume of a candidate's research output and contribution.
2. ANZIAM considers it highly desirable that its members advance the profession into the future. The selection panel can consider the potential of the candidate to the discipline (for example, via their ability to be awarded prestigious research fellowships).

3. Any exceptional circumstances should be forwarded to the Executive Committee to assess eligibility; they will normally consider the types of career interruptions allowed by the ARC in their research fellowship guidelines.

Nominations

Nominations for the award can be made by any member of ANZIAM other than the nominee. A nomination should consist of a brief CV of the nominee together with the nominee's list of publications, a one page resumé of the significance of the nominee's research and a one-page resumé of the nominee's service contribution. Nominations should be forwarded in confidence, electronically in pdf format, to Professor Robert McKibbin (R.McKibbin@massey.ac.nz), Chair of the Selection Panel, by *7 November 2014*.

Further details of the application process and the award criteria are on the ANZIAM website: www.anziam.org.au/The+EO+Tuck+Medal.

AustMS Accreditation

Mr Jakub Tomczynk of the University of Sydney, has been accredited as a Graduate Member (GAustMS), Dr Thomas Booker of Blackrock has been accredited as an Accredited Member (MAustMS), Professor Jacqui Ramagge of the University of Wollongong has been accredited as a Fellow (FAustMS) and Professor Geoffry Mercer of the Australian National University has been posthumously accredited as a Fellow (FAustMS).

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.

The Australian Mathematical Society

Membership and Correspondence

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

Local Correspondents

Publications

The Journal of the Australian Mathematical Society

Editors: Professor J.M. Borwein and Professor G.A. Willis
School of Mathematical and Physical Sciences
University of Newcastle, NSW 2308, Australia

The ANZIAM Journal

Editor: Professor A.P. Bassom
School of Mathematics and Statistics
The University of Western Australia, WA 6009, Australia

Editor: Associate Professor G.C. Hocking
School of Chemical and Mathematical Sciences
Murdoch University, WA 6150, Australia

Bulletin of the Australian Mathematical Society

Editor: Associate Professor Graeme L. Cohen
Department of Mathematical Sciences
University of Technology, Sydney, NSW 2007, Australia

The *Bulletin of the Australian Mathematical Society* aims at quick publication of original research in all branches of mathematics. Two volumes of three numbers are published annually.

The Australian Mathematical Society Lecture Series

Editor: Professor C. Praeger
School of Mathematics and Statistics
The University of Western Australia, WA 6009, Australia

The lecture series is a series of books, published by Cambridge University Press, containing both research monographs and textbooks suitable for graduate and undergraduate students.

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