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The Australian Mathematical Society

Gazette

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- 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

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Deadlines for submissions to 41(5), 42(1) and 42(2) of the *Gazette* are 1 October 2014, 1 February 2015 and 1 April 2015.

Volume 41 Number 4 2014

Editorial

As the Australian education system is experiencing turbulence and our discipline is facing serious challenges, it seems appropriate to begin this Editorial by mentioning the very interesting US National Research Council report 'The Mathematical Sciences in 2025' (visit www.nap.edu/catalog.php?record_id=15269 to download it). The following is the description:

> The mathematical sciences are part of nearly all aspects of everyday life–the discipline has underpinned such beneficial modern capabilities as Internet search, medical imaging, computer animation, numerical weather predictions, and all types of digital communications. *The Mathematical Sciences in 2025* examines the current state of the mathematical sciences and explores the changes needed for the discipline to be in a strong position and able to maximize its contribution to the nation in 2025. It finds the vitality of the discipline excellent and that it contributes in expanding ways to most areas of science and engineering, as well as to the nation as a whole, and recommends that training for future generations of mathematical scientists should be re-assessed in light of the increasingly cross-disciplinary nature of the mathematical sciences. In addition, because of the valuable interplay between ideas and people from all parts of the mathematical sciences, the report emphasizes that universities and the government need to continue to invest in the full spectrum of the mathematical sciences in order for the whole enterprise to continue to flourish long-term.

The chapters include 'Vitality of the Mathematical Sciences'; 'Connections Between the Mathematical Sciences and Other Fields'; 'Important Trends in Mathematical Sciences'; 'The Changing Academic Context'.

Nalini Joshi, Chair of the National Committee of Mathematical Science in her report, brings to our attention the fact that the Australian Academy of Science is about to embark on an exercise to assess the economic impact of the physical sciences (chemistry, earth sciences, mathematics and physics) on the Australian economy. She says: "To whet your appetite for this extremely important study, I wanted to describe a recent study of the economic impact of the mathematical sciences on the Dutch economy and its major findings." She goes on to say: "The resulting calculations of economic impact are astonishing. The direct impact of mathematical sciences employment on the Dutch economy is estimated to be 71 billion Euro in gross value added (GVA). The indirect effect, arising from procurement of goods and services by mathematically intensive parts of industries from other industries amounts to 37 billion Euro in GVA. The induced effect, i.e., impact of household spending resulting from direct and indirect effects of mathematical sciences jobs, amounts to an additional 51 billion Euro in GVA."

Peter Forrester in his President's Column in this issue updates us on ERA and ARC matters. It is important that research active academics keep abreast of what is happening in these areas. Peter also makes mention of the fact, highlighted by the Editor-in-Chief Cheryl Praeger, that only five books have been published in the last decade in the Australian Mathematical Society Lecture Series. As the Founding Editor-in-Chief of that series of books, I encourage Australian authors to consider publishing books there.

Geoff Prince, AMSI Director, reminds us that "biology is being revolutionized by mathematics, statistics and computer science" and encourages participation in BioInfoSummer 2014 at Monash University, 1–5 December and also reminds readers of the 2014–2015 Vacation Research Scholarships. Last year AMSI offered a record 55 six-week vacation scholarships to mainly third-year students.

This issue also contains an obituary for Professor Pavel Karel Smrz.

And finally congratulations to Terry Speed and Kate Smith-Miles: "For his superb leadership of the bioinformatics team at the Walter and Eliza Hall Institute of Medical Research and his other contributions to the science of bioinformatics, Terry Speed has been awarded the CSIRO Eureka Prize for Leadership in Science"; The ARC recently announced the award of a Georgina Sweet Laureate Fellowship to Professor Kate Smith-Miles of Monash University.

David and I encourage you to enjoy the items mentioned above as well as the Puzzle Corner, book reviews, conference reports, Lift-Off fellowship Report by Natalie Aisbett and the report of the AMSI monitoring of participation in Year 12 mathematics by Frank Barrington and Peter Brown.

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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*

With ERA 2015 on the horizon, AustMS has been asked by the ARC to provide feedback on the assignment of journals to FoR codes. This task was carried out by Andrew Francis (Pure), Larry Forbes (Applied) and Jan de Gier (Mathematical Physics). Jan had assistance from Peter Bouwknegt. Jerome Droniou has been working with our webmaster Ross Moore on the construction of electronic application forms, amongst other high-level technical tasks. Such voluntary professional services are essential to the running of AustMS, and are examples of the many activities undertaken by members for the benefit of the profession.

It still being the summer break in the northern hemisphere, this is the time of year when our departments see a number of former students back in town to visit family and friends, and to share with us some of their recent work. I personally hosted the visit of one such former student, James Saunderson. James first came to my attention when I was vacation scholar coordinator, and he partnered up with Nick Sheridan (now a postdoc at the IAS, Princeton) and Maurice Chiodo (now a postdoc in Germany) to work on a problem in knot theory under the supervision of Craig Hodgson. James is in the final year of his PhD studies at MIT on the topic of convex optimisation in engineering problems. Coincidentally, I noticed Maurice in the department just last week. As I mentioned in a recent President's column, AustMS is generally keen to enhance community among expat Australian mathematicians. I said we can make use of their successes to provide inspiration for our student and ECR members. It is also in our interest to actively encourage Australian mathematicians abroad to contribute quality articles to our journals and/or to our Lecture Series. As highlighted by the Editor-in-Chief of the latter, Cheryl Praeger, only five Lecture Series titles have appeared in the past 10 years. To have a contribution or two from an expat would help rejuvenate this publication and may well encourage others in the local community to do similarly.

ARC matters, ERA included, are always of much interest to the AustMS membership. Recently Council member Scott Morrison drew attention to the issue of visitors and travel funds within DP grants. One concrete change in the DP14 round was that there is a \$50 000 limit on travel over the life of the project (subsection 5.2.1j of the funding rules). In the DP15 rules, it is now explicitly stated (A5.2.1.m) that workshop and conference costs that are necessary for the conduct of the proposed research may be supported. Julie Clutterbuck brought to my attention the fact that in the recent Future Fellowships round, none were awarded in 0101 (Pure). It was subsequently pointed out that the five Future Fellowships awarded in the mathematical sciences out of the 150 in total is not too

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different in percentage terms to the 47 out of nearly 1000 in previous five rounds. Nonetheless, it remains disappointing to those mathematicians who missed out.

In June I was happy to be able to present the opening address at the First Year in Maths Project (FYiMaths) workshop organised by Deb King and Joann Cattlin. The attendance at the workshop was excellent, with speakers and participants from all over the country, and New Zealand. Topics explored included flipped classroom teaching, video tutorial instruction, online maths courses and student support for first-year students. There are some innovative and progressive measures already in use. On the other hand, their implementation is uneven, begin driven mostly by individuals and not so much a collective movement within departments or the universities themselves. It seems to me that the lack of engagement in higher level courses that I have been reporting is a collective responsibility and will have to be addressed as such.

Of late I've become more involved in the issue of the serious under-representation of women in teaching/research positions in my own Department, and together with some colleagues have put a proposal to our Head for action on the problem. My colleague Kerry Landman has often remarked that the lack of female lecturers is noticed by the students, and this may well be harming our retention of female students. There's no doubt that the problem is extreme. Last Friday I gave a talk at our undergraduate maths society seminar series: out of the 31 in attendance, none were female. Right now, I'm just back from the department colloquium, coincidentally given by AustMS Vice President (Annual Conferences) Ole Warnaar, and out of the healthy sized audience, only one was female.

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 39. Each puzzle corner includes a handful of fun, yet intriguing, puzzles for adventurous readers to try. They cover a range of difficulties, come from a variety of topics, and require a minimum of mathematical prerequisites for their solution. Should you happen to be ingenious enough to solve one of them, then you should send your solution to us.

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

The deadline for submission of solutions for Puzzle Corner 39 is 1 November 2014. The solutions to Puzzle Corner 39 will appear in Puzzle Corner 41 in the March 2015 issue of the *Gazette*.

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

Integral means

Given n positive integers $a_1, a_2, \ldots, a_n$, their arithmetic, geometric and harmonic means are defined as follows:

$$\text{arithmetic mean} = \frac{a_1 + a_2 + \cdots + a_n}{n},$$
$$\text{geometric mean} = \sqrt[n]{a_1 a_2 \cdots a_n},$$
$$\text{harmonic mean} = \frac{n}{\frac{1}{a_1} + \frac{1}{a_2} + \cdots + \frac{1}{a_n}}.$$

Can you find n *distinct* positive integers such that their arithmetic, geometric and harmonic means are also positive integers?

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Products of sums

We are given an $n \times n$ table where n is odd. An odd integer is written in each of its squares. Is it possible for the product of the column sums to be the negative of the product of the row sums?

Negative base

Given a positive integer b, a *base* $-b$ *representation* of a number n refers to the following form:

$$n = a_0(-b)^0 + a_1(-b)^1 + \cdots + a_k(-b)^k$$

where $a_0, a_1, \ldots, a_k$ are positive integers less than b.

Prove that, for any positive integer b, every integer (not just positive) has a unique base $-b$ representation.

Ranking matches

(i) Four table tennis enthusiasts are gathered to pit their skills against one another. There is a clear order in their table-tennis abilities and the better player always wins in a match. How many matches are needed to rank everyone according to their skill levels?

(ii) What if there were five table tennis enthusiasts to begin with?

Circular cuts

Submitted by Ross Atkins

The magician announces his next trick. "I have here, a piece of cardboard in the shape of a perfect circle. For my next act, I shall cut it into a number of pieces, so that all the pieces are absolutely identical to each other in shape and size..."

"So what", a restless audience member interjects, "anyone can do that, you've never seen a sliced pizza before?"

The magician keeps his composure. "Please let me finish. When I'm done cutting, at least one of the final pieces would not have touched the centre of the original circle to begin with."

Some started to scratch their heads. "Surely that's impossible!"

Will the magician be able to back up his words?

Solutions to Puzzle Corner 37

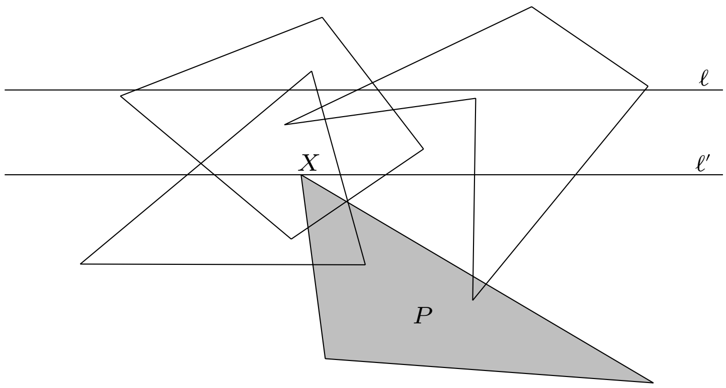
Many thanks to everyone who submitted. The $50 book voucher for the best submission to Puzzle Corner 37 is awarded to Joe Kupka. Congratulations!

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.

Solution by Dave Johnson: For the sake of contradiction, assume that the required line does not always exist. Consider such a configuration which has the minimal number of polygons. If we delete a polygon, say P, then by minimality, there exists a line ℓ which intersects all other polygons. Furthermore, ℓ cannot intersect P.

Denote the point on P closest to ℓ by X. Construct the line ℓ' which is parallel to ℓ and passes through X.



By definition, ℓ' intersects P. Since every other polygon must intersect both ℓ as well as P, which lie on opposite sides of ℓ', it follows that every polygon must intersect ℓ', a contradiction.

Note: In fact, the same argument shows that Peter could draw a required line parallel to any direction. Also, it is not much harder to show that the same statement still holds even if there are infinitely many polygons.

Simplifying series

Simplify the following expression:

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

Solution by Anthony Sofo: We begin by performing the following algebraic manipulation:

$$\begin{aligned}\frac{i}{i^4+i^2+1} &= \frac{i}{(i^2+1)^2-i^2}\\ &= \frac{i}{(i^2+i+1)(i^2-i+1)}\\ &= \frac{1}{2}\left(\frac{1}{i^2-i+1}-\frac{1}{i^2+i+1}\right)\\ &= \frac{1}{2}\left(\frac{1}{(i-1)^2+(i-1)+1}-\frac{1}{i^2+i+1}\right).\end{aligned}$$

Thus the required summation can be evaluated via telescoping:

$$\begin{aligned}\sum_{i=1}^{100}\frac{i}{i^4+i^2+1} &= \frac{1}{2}\sum_{i=1}^{100}\left(\frac{1}{(i-1)^2+(i-1)+1}-\frac{1}{i^2+i+1}\right)\\ &= \frac{1}{2}\left(\frac{1}{0^2+0+1}-\frac{1}{100^2+100+1}\right)\\ &= \frac{100^2+100}{2(100^2+100+1)}\\ &= \frac{5050}{10101}.\end{aligned}$$

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?*

Solution: To improve the notation slightly, let us use X and Y to denote the two potential groups of guests, and use x and y to denote the corresponding sizes of the groups. We claim the answer is $x + y - \gcd(x, y)$. For convenience, let the cake have size xy. So that if group X shows up, each guest will enjoy a slice of size y. Whereas if group Y shows up, then each guest will have a slice of size x.

Consider any scenario in which Christie has finished cutting the cake in a manner suitable for both groups. Furthermore, being an organised host, she has put name tags on the cake slices to indicate who they potentially belong to. Then each slice of cake would have exactly two names on it, one guest from X and another from Y. Without loss of generality, we may assume that any pair of names appears on at most one slice of cake (otherwise the repeating slices can simply be merged to achieve this).

Now construct a graph of $x + y$ vertices, where the vertices represent the guests from the two groups. Each edge of the graph represents a cake slice, joining the two vertices indicated by the names appearing on the slice. Since everyone receives some cake, every vertex must belong to at least one edge.

Consider any particular connected component in this graph, say it contains a vertices from X and b vertices from Y. The edges in this connected component precisely represent the cake shared by either the a guests from X or the b guests from Y. Computing the total size of these slices, we have

$$ay = bx \qquad \Longleftrightarrow \qquad \frac{a}{b} = \frac{x}{y} = \frac{x/\gcd(x,y)}{y/\gcd(x,y)}.$$

In particular, a must be a multiple of $x/\gcd(x, y)$. Since this holds for any connected components of the graph, and the various values of a must sum up to x, we conclude that there are at most $\gcd(x, y)$ connected components.

If $\gcd(x, y) = 1$, then the entire graph must be connected. It is easy to see that, in order to connect a graph of $x + y$ vertices, we require at least $x + y - 1$ edges. A similar argument shows that if there are at most $\gcd(x, y)$ connected components, then there must be at least $x + y - \gcd(x, y)$ edges. Recalling that the edges biject to the slices, it implies Christie needs at least $x + y - \gcd(x, y)$ slices of cake.

It remains to provide a construction for exactly $x + y - \gcd(x, y)$ slices. For the sake of argument, let the cake be a $1 \times mn$ rectangle. Christie simply measures along the length of the cake, mark out all multiples of x and y, and make cuts across the cake at those points. The multiplies of x and y only coincide at multiples of $\operatorname{lcm}(x, y)$. We arrive at the correct number of slices due to the well-known identity

$$\gcd(x,y) = \frac{xy}{\operatorname{lcm}(x,y)}.$$

Therefore $x + y - \gcd(x, y)$ slices are needed to satisfy the appetites of both groups.

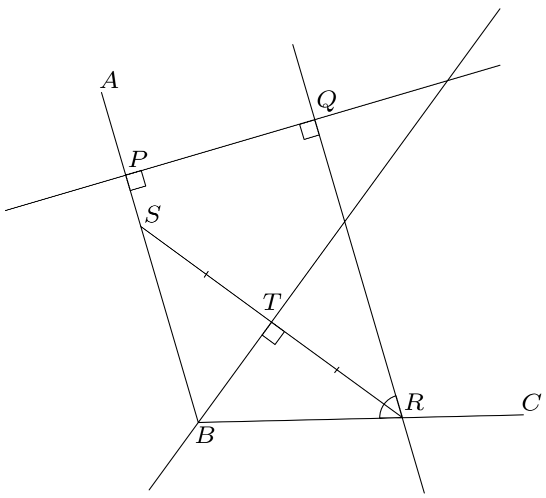
Baffling bisection

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?

Solution by Joe Kupka: We shall construct the bisector without ever letting B touch either ends of the compass. Refer to the following diagram.



Here are the steps in detail:

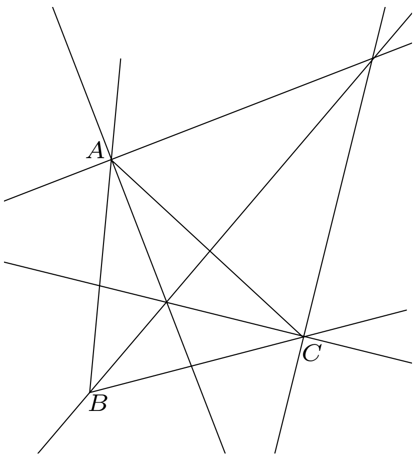
- Begin by choosing any point P on AB and construct a line through P perpendicular to AB. Constructing a perpendicular uses the same technique as bisecting an angle, except the angle here is $180°$.
- Now choose a point Q on the recently drawn line and construct new line through Q perpendicular to PQ. Let it intersect BC at R.
- Bisect the $\angle BRQ$, and let the bisector intersect AB at S.
- Construct the perpendicular bisector of SR. This can be done by drawing two (fairly large) circles of equal radii with centres at S and R, then joining the two points of intersection by the two circles. The perpendicular bisector is also the required angle bisector of $\angle ABC$.

To briefly explain the construction, note that the line QR is, by definition, parallel to AB. Then

$$\angle BSR = \angle SRQ = \angle SRB,$$

so triangle BSR is isosceles. Thus by symmetry, the perpendicular bisector of SR must also bisect $\angle ABC$.

Note: Of course there exist many alternate solutions. Here is a diagram depicting a solution which involves constructing four angle bisectors about the points A and C. See if you can iron out the details!



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.

AMSI monitoring of participation in Year 12 mathematics

Frank Barrington* **and Peter Brown****

Summary

- Over the last two decades, the proportion of Year 12 students taking some mathematics has remained at roughly 80%.
- However, both the number and proportion of Year 12 students now taking Advanced mathematics is much lower than in 1995: there has been a significant shift to the non-calculus mathematics subjects.
- Females continue to be outnumbered by males (almost 2:1) in Year 12 Advanced mathematics.
- This data-collection project began with AustMS, but ongoing monitoring of Year 12 participation rates is now done by AMSI.

A very short history

In 2004, Tony Guttmann (the then President of AustMS) referred anecdotal claims of falling enrolments in the 'more difficult' Year 12 mathematics subjects to the AustMS Education Committee. We (Barrington and Brown) were members of that committee, which encountered numerous problems with enrolment data, including different counting and reporting procedures between the various state and territory authorities.

Jan Thomas (at that time the AustMS Exective Officer) suggested that the task be handballed to AMSI, and late in 2004, Garth Gaudry (then Director of AMSI ICE-EM) commissioned Helen Forgasz (Monash University) to undertake a detailed study of Australian Year 12 mathematics enrolment trends. At the same time, Garth Gaudry asked us (Barrington and Brown) to inspect the syllabi of all of the 2004 Year 12 mathematics subjects and to work through the examination papers, for every Australian state and territory, in order to 'verify' the splitting of subjects into three categories: 'Advanced', 'Intermediate' and 'Elementary'. In fact, John Malone (Curtin University) [2] had previously used these descriptors in compiling time-series data on Australian secondary school mathematics enrolments from about 1970, in collaboration with colleagues John Dekkers and John de Laeter. These descriptors acknowledge the tiered structure of Year 12 mathematics in all states and territories of Australia.

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In December of 2004, we two met with Helen Forgasz and Michael Evans (AMSI), and soon resolved that the categorisation of subjects and the assembly of enrolments data be done in tandem. The Barrington and Brown Report [1] which compared the then Year 12 mathematics subjects across Australia was published by AMSI in October 2005, followed in February 2006 by Helen Forgasz's comprehensive report of over 100 pages [3] on Year 12 mathematics enrolments for the period 2000 to 2004. Both these reports are still available on the AMSI website. Later in 2006, we obtained data back to 1995, and since then we have collected data, mostly by direct access to the websites of the state and territory secondary boards of studies. Since 2004, via its website, AMSI has released a yearly update of percentage participation rates in the form of a simple table: the latest version for 1995 to 2013 is reproduced below.

Categories of mathematics students (current)

First, the terms 'Advanced mathematics student', 'Intermediate mathematics student' and 'Elementary mathematics student' require some explanation.

The number of Year 12 Advanced mathematics students in Australia is the sum of the enrolments in the subjects:

NSW Mathematics Extension 1[1]
VIC Specialist Mathematics
QLD Mathematics C
WA Specialist Mathematics MAS3CD
SA Specialist Mathematics
TAS Mathematics — Specialised
ACT Specialist Mathematics
NT Specialist Mathematics
IBO Mathematics HL

There were just over 21 000 Advanced mathematics students in 2013, compared with over 25 000 in 1995.

The Australian Year 12 Intermediate mathematics subjects are:

NSW Mathematics (2-unit)
VIC Mathematical Methods
QLD Mathematics B
WA Mathematics MAT3CD
SA Mathematical Studies
TAS Mathematics — Methods

[1] There are two types of NSW Advanced mathematics student. One type takes Mathematics Extension 1 together with the NSW Intermediate mathematics subject Mathematics (2-unit), while the second type takes Mathematics Extension 1 together with (the more challenging) Mathematics Extension 2.

ACT Mathematical Methods

NT Mathematical Studies

IBO Mathematical Methods SL

An Intermediate mathematics student is one who is enrolled in one of the Intermediate mathematics subjects above but is not enrolled in an Advanced mathematics subject.

In 2013 there were just over 42 000 Intermediate students in Australia, compared with approximately 48 500 in 1995. In 2013 the total number of enrolments in Intermediate mathematics subjects was about 60 000. Most (but not all) Advanced mathematics students take an Intermediate subject concurrently.

The Australian Elementary mathematics subjects are numerous: some are accepted for inclusion in tertiary entrance scores, some not. In 2013, there were approximately 115 000 Elementary mathematics students in Australia (that is, those taking an Elementary mathematics subject but not taking an Intermediate subject nor an Advanced one). The number of Elementary mathematics subject enrolments was in excess of 120 000 in 2013: many students now take both an Elementary subject and an Intermediate subject in their Year 12 certificate.

In the coming Australian Curriculum for Mathematics, as outlined in the AustMS *Gazette* in 2010 by Michael Evans [2], the first two levels of Year 12 mathematics course are labelled 'Course A' and 'Course B'. Both of these fit John Malone's Elementary mathematics schema to which we have adhered.

Yet in retrospect, 10 years ago we might have been better advised to distinguish between 'Course B' Elementary mathematics (such as NSW General Mathematics, VIC Further Mathematics, QLD Mathematics A etc.) and 'Course A' Elementary mathematics subjects which were designed as 'life skills' courses. In 2004, there were 74 Elementary mathematics subjects offered across Australia, and some were difficult to categorise as 'Course B' or otherwise. Hopefully, the coming Australian Curriculum Course A/Course B system will be a little more transparent. Clearly the Australian Curriculum 'Course C' mathematics can be equated to Intermediate mathematics and 'Course D' to Advanced mathematics.

Participation rates

Table 1 gives mathematics participation rates as a percentage of students eligible to complete Year 12 for the years 1995 to 2013.

We may be slightly adventurous allowing time series data to run for such a long period. Certainly there have been changes in some mathematics subjects in some of the jurisdictions, and some counting procedures have changed during the last 20 years. However, Advanced and Intermediate students have been easy to identify during this period, and the proportion of Australians enrolled and 'eligible to complete Year 12' (about 178 000 in 1995; about 221 000 in 2013) has remained at approximately 1% of the total Australian population for the last two decades. We have been unwilling to include pre-1995 data owing to our inability convincingly

Table 1.

	Advanced mathematics students	Intermediate mathematics students	Elementary mathematics students (estimated)
1995	14.2	27.3	37
1996	13.6	26.9	37
1997	13.6	27.2	39
1998	12.8	26.2	39
1999	12.4	25.2	41
2000	12.0	25.1	47
2001	11.4	24.3	45
2002	11.2	23.5	46
2003	11.8	23.7	47
2004	11.8	22.9	46
2005	11.2	22.7	47
2006	10.6	21.8	48
2007	10.2	21.2	48
2008	10.3	20.8	49
2009	10.2	20.5	49
2010	10.0	19.8	51
2011	9.5	19.7	52
2012	9.4	19.5	52
2013	9.6	19.1	52

to categorise the Victorian Year 12 subjects ‘Change and Approximation’ etc. of the early 1990s, and owing to the 1980s seeing a doubling of Year 12 participation generally.

The trends

Note that the proportion taking mathematics at least to Intermediate level (add the Advanced and Intermediate percentages) fell from 41.5% in 1995 to 28.7% in 2013. This decline was general, with all nine jurisdictions contributing to it. Why has there been such a pronounced shift away from Advanced and Intermediate mathematics in favour of Elementary mathematics, and hence a diminution in the proportions well prepared for tertiary Science and Engineering courses?

We two possess no particular wisdom here, but recent dismantling of course prerequisites by some universities and scaling (or lack thereof) of so-called ‘difficult’ subjects for inclusion in university entrance scores would have to be on a list of suspected causes. And some reasons may be societal, which are difficult to measure. As long ago as the year 2000, Jan Thomas [5] issued the warning that ‘there is a chronic shortage of mathematics teachers looming’. Secondary mathematics teaching now may not be such an attractive career for mathematics graduates and a shortage of suitably qualified secondary mathematics teachers may be a contributing factor.

Yet it is encouraging that from 2012 to 2013 the Advanced mathematics proportion recovered slightly. And, (adding the three percentages for each year) the proportion of students taking some mathematics in Year 12 has been slightly higher in recent years (just over 80%) than in the late 1990s (just under 80%), so perhaps general mathematical literacy in the community is being maintained.

Differing participation rates among the jurisdictions

All of the states and territories and IBO offer respectable Year 12 mathematics subjects in each category. To state the obvious, no direct inferences can be made from participation rates about the quality and standard of mathematics achieved by students exiting Year 12.

We are reluctant to quote individual jurisdictions' participation rates. Differences among the nine jurisdictions are largely explained by demographics; the proportion of the population finishing school to Year 12 varies across the country; and the jurisdictions all have protocols governing the use of the data on their websites. So for these reasons and others, we will not quote numbers for any particular one, but suggest that any reader interested in a particular state or territory's mathematics enrolments refer to the relevant secondary board of studies website.

Yet we cannot resist mentioning that in 2013, NSW, the most populous state, had a few more Advanced mathematics students than VIC and QLD combined, yet had fewer Intermediate mathematics students than either VIC or QLD, both of which have substantially lower total Year 12 populations than NSW. We mean neither to praise NSW for its Advanced mathematics student participation rate being well above the national average, nor to censor it for having an Intermediate mathematics student participation rate well below average. However, we believe that the main reason for this phenomenon is that NSW has the luxury of a two-tier Advanced mathematics system.

The International Baccalaureate (IBO) student cohort in Australia is a select group, accounting for less than 1% of the Australian Year 12 population, and for these students, mathematics is a compulsory part of their program. Unsurprisingly, the IBO Diploma has higher Advanced and Intermediate mathematics participation rates than any of the states and territories, and the lowest Elementary mathematics participation rate.

The gender divide

Of the 221 000 students eligible to complete Year 12 in Australia in 2013, 52% were female. Of the girls, approximately 76% took some mathematics, compared with 85% of the boys. And more boys than girls took more than one mathematics subject.

Girls are still under-represented in Advanced mathematics: in 2013, 6.7% of girls took Advanced mathematics compared with 12.7% of boys. The 2013 overall Advanced mathematics participation rate was 9.6%, just slightly less than the arithmetic mean of the girls' and boys' rates because females outnumber males in Year 12.

Girls continue to be under-represented in the Intermediate mathematics cohort, but not severely so. In 2013, 17.6% of Year 12 girls were Intermediate mathematics students versus 20.7% of boys, for a combined rate of 19.1%. (These are percentages of students enrolled in an Intermediate mathematics subject but not enrolled in an Advanced mathematics subject.)

Girls have outnumbered boys in the Elementary mathematics cohort (those taking one or more Elementary mathematics subjects but not taking an Intermediate one nor an Advanced one) every year since we began keeping records, but not by much, and not in every jurisdiction. For 2013, we estimate that 52% of the Year 12 population were Elementary mathematics students.

Further information

Year 12 mathematics participation rates and schools data from other sources are reported in the AMSI annual Discipline Profile, which can be found on the AMSI website www.amsi.org.au.

Since its establishment, AMSI has been active in promoting the importance of the mathematical sciences to the nation, and data on participation rates in Year 12 mathematics has been a part of its 'ammunition' in the lobbying of governments. To this end, it has been useful to be able to quote with reasonable precision the proportions of Australian Year 12 students attempting each level of mathematics, the proportion choosing to take none at all, and the gender differences in participation.

Acknowledgement

The authors would like to thank Dr Bob Anderssen, current chair of the AMSI Educational Advisory Committee, for offering us encouragement to write this article.

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57th Annual Meeting of the Australian Mathematical Society

Laurentiu Paunescu*

The 57th Annual Meeting of the Australian Mathematical Society was hosted by the School of Mathematics and Statistics of the University of Sydney from 30 September to 3 October 2013 (http://www.maths.usyd.edu.au/u/austms2013/).

The meeting was attended by 420 mathematicians (including a significant number of overseas participants coming from more than 10 countries) registered for a four-day program covering a wide range of topics in pure and applied mathematics and statistics. The meeting consisted of four days of plenary lectures and contributed talks, public lectures, an education afternoon, a number of social and networking events including a women in mathematics dinner and a conference dinner. The meeting was preceded by the AustMS Early Career Researcher Workshop, organised by the School of Computing Engineering and Mathematics of the University of Western Sydney and held at the Waldorf Leura Gardens Resort in the Blue Mountains west of Sydney. The Early Career Speaker was Sommer Gentry from the United States Naval Academy.

The conference began on campus on Sunday evening with a registration desk and welcome reception at Sancta Sophia College. About the same time, a Women in Mathematics Dinner was held under the umbrella of the Women in Mathematics Special Interest Group of the Australian Mathematical Society, funded and supported by Nalini Joshi's Georgina Sweet Australian Laureate Fellowship.

On Monday morning, the University of Sydney Vice Chancellor, Dr Michael Spence, welcomed the participants and the NSW Chief Scientist and Engineer, Professor Mary O'Kane, who officially opened the conference. They both gave remarkable speeches about the perception and importance of mathematical research and teaching in general.

This was followed by the announcement of the award of the Australian Mathematical Society Medal in absentia to Craig Westerland of the University of Melbourne followed by a short talk by Stephen Keith (one of the two 2012 medalists).

The conference itself commenced with the Plenary Lecture of Anthony Henderson, the other recipient of the 2012 AustMS Medal.

The plenary lectures given by internationally renowned mathematicians were broadly accessible and provided an opportunity for all participants to learn of developments outside their own specializations. The speakers included nine overseas visitors (two

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of them expatriate Australians) (Stephen Boyd, the Planet Earth Plenary Speaker, Robert Bryant, Iain Johnstone, Mattias Jonsson, Akshay Venkatesh, the Mahler Lecturer, all from USA, Nicolas Champagnat, France, Donghoon (David) Hyeon, South Korea, Masatoshi Noumi, Japan and Claus M Ringel, Germany) and three Australians (Natashia Boland, the Hanna Neumann Lecturer, Markus Hegland, the ANZIAM Lecturer, and Anthony Henderson).

There were also two Public Lectures one by Akshay Venkatesh of Stanford University and one by Sommer Gentry of the United States Naval Academy.

The special sessions provided everyone with an opportunity to interact with mathematicians in their own research area. There were 20 special sessions comprising 304 talks with particularly large sessions in Mathematical Physics, Geometry & Topology and Algebra, Mathematics in Biology and Medicine. The meeting is always an important opportunity for students to present their work, this time with 76 short talks by PhD students altogether.

The B.H. Neumann Prize was awarded to Adrian Dudek, from the Australian National University for his talk entitled 'Primes in Short Intervals' Honourable mentions were given to Alex Amenta (Australian National University), Stephen McCormick (Monash University), John Nakhoul (University of Sydney), Matthew Tam (University of Newcastle) and Tri Thang Tran (University of Melbourne).

Many speakers kindly provided us with the files of their talks which may be accessed at http://www.maths.usyd.edu.au/u/austms2013/talks.html.

There was a very successful Education Afternoon on Tuesday aimed at undergraduates, teachers and prospective mathematics teachers. It was attended not only by conference registrants, but also by secondary school teachers and students, in all 120 participants

The Conference Dinner on the Wednesday evening was a Sydney Showboat Dinner Cruise on the incredibly beautiful Sydney Harbour.

I would like to finish my report by thanking all those who helped to make the 57th Annual Meeting such a great success. In particular, thanks to the Program Committee members, the special session organisers, the local organisers, the EC workshop organisers, the staff and student volunteers in the School of Mathematics and Statistics at the University of Sydney, John Banks at La Trobe for setting up the registration system; all played a vital role in the smooth running of the conference. Special thanks to the University of Sydney, in particular to the Faculty of Science, for acknowledging the importance of mathematics and supporting our conference in many ways.

The next annual meeting, jointly with the New Zealand Mathematical Society, is being hosted by the University of Melbourne. I wish Paul Norbury and his team all the best in their preparations for the 58th Annual Meeting.

Computational & Algorithmic Topology in Sydney

The University of Sydney, 2–4 April 2014

Stephan Tillmann*

Reasons for holding the meeting

This workshop at the University of Sydney brought together experts and emerging researchers from Australia, the USA and Europe to report on recent results and explore future directions in computational and algorithmic topology. A focus was placed on problems in low-dimensional geometry and topology and on the development of practical algorithms and their implementation. This is an area with an abundance of computational and algorithmic challenges, where practical solutions to many solvable problems, such as the homeomorphism problem, remain elusive. Five of the nine speakers develop freely available software to assist in their theoretical research or in the analysis of their algorithms and computational techniques.

The methods and key notions of this workshop appealed to a broad audience: even though it was held during a teaching week, it attracted 29 registered participants. The organiser is extremely pleased that 9 of the 29 participants were students, and anecdotal evidence shows that the workshop was not only beneficial to the experts in the field, but also to the early career researchers and students who attended. Many informal discussions were facilitated through the catered tea and lunch breaks. The high quality of the talks and the relaxed atmosphere not only stimulated interaction, but brought about new collaborations on difficult problems that cannot be tackled from one viewpoint alone.

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Speakers

Visit http://www.maths.usyd.edu.au/u/tillmann/cats2014/ for the conference webpage. The following talks were given at the workshop:

1. Mark Bell (University of Warwick)
   Deciding Nielsen–Thurston types of surface diffeomorphisms
2. Ben Burton (The University of Queensland)
   Exploring parameterised complexity in computational topology
3. Nathan Dunfield (University of Illinois at Urbana–Champaign)
   Floer homology and orderability of 3-manifold groups
4. Stefan Friedl (University of Köln)
   The profinite completion of knot groups
5. Joachim Gudmundsson (The University of Sydney)
   Geometric spanner graphs
6. Joan Licata (Australian National University)
   Front diagrams via open book decompositions
7. Jessica Purcell (Brigham Young University)
   Geometrically maximal knots
8. Hyam Rubinstein (The University of Melbourne)
   Even triangulations of manifolds
9. Saul Schleimer (University of Warwick)
   'Fibered class' lies in NP
10. Jonathan Spreer (The University of Queensland)
    Bounds for the genus of a normal surface

Representation Theory in Geometry, Topology and Combinatorics

University of Melbourne, 28 October – 7 November 2013

Martina Lanini*, **Tony Licata****, **Arun Ram***
and Geordie Williamson***

The Australian mathematics community is flowering in this modern and exciting field bridging representation theory, topology, and category theory. Recent hires, such as Tony and Joan Licata and Scott Morrison at ANU, Kari Vilonen and Ting Xue at University of Melbourne, Alan Stapledon, Geordie Williamson and Oded Yacobi at University of Sydney, Masoud Kamgarpour at UQ, and associated research fellows on temporary positions Martina Lanini, Stephen Griffeth, and Paul Sobaje at University of Melbourne, Peter McNamara at University of Sydney, Pedram Hekmati, are complementing existing strengths (for example, Gus Lehrer, Anthony Henderson, Andrew Mathas, Ruibin Zhang, Alex Molev at Sydney University, Arun Ram at University of Melbourne, Jie Du at UNSW, John Bamberg and Alice Devillers at UWA) to make Australia a driving force in the international community in this field. This conference hosted a (mostly younger) group of internationally acclaimed movers and shakers in the field as plenary speakers and boasted significant attendance from Australian *and* international students. It was an exciting and stimulating couple of weeks, leaving all participants with a feeling of being swept up with a wave of enthusiasm and excellence.

The conference took place over two weeks, centred around 17 principal speakers: Dave Anderson (IMPA, Brazil), John Bamberg (UWA), Alice Devillers (UWA), Ben Elias (MIT, USA), Alexander P. Ellis (Oregon, USA), Stephen Griffeth (Talca, Chile), Pedram Hekmati (Adelaide), Anthony Henderson (Sydney), Daniel Juteau (Caen, France), Masoud Kamgarpour (University of Queensland), Nicolas Libedinsky (Santiago, Chile), Joan Licata (ANU), Anthony Licata (ANU), Peter McNamara (Sydney), Scott Morrison (ANU), Geordie Williamson (MPI Bonn, Germany), Oded Yacobi (Sydney); three minicourses:

- Dave Anderson (IMPA, Brazil), 'Geometry of Schubert varieties. A short course for graduate students in research in Algebraic Geometry',
- Martina Lanini (Melbourne), 'Moment graph tasting plate. A short course for graduate students in research in Algebra',
- Joan Licata (ANU), 'Introduction to contact geometry. A short course for graduate students in research in Topology';

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and a day of talks by international students and postdocs with speakers: Jacopo Gandini (Goettingen, Germany), Emanuele Ghedin (Oxford, UK), Jacinta Perez Gavilan Torres (Cologne, Germany), Antonio Sartori (Bonn, Germany), Neil Saunders (Bristol, UK), Alexander Weekes (Toronto, Canada).

As well as more senior participants, Jose Ayala Hoffmann (Melbourne), David Bowman (Adelaide), Joseph Chan (Melbourne), Dougal Davis (Melbourne), Alastair Dyer (Monash), Amelia Gontar (Sydney), Joshua Howie (Melbourne), Yi Huang (Melbourne), Guang Rao (UWA), Arthur Suvorov (Monash), Ioannis Tsartsaflis (La Trobe) and Jon Xu (Melbourne) were among the students and postdocs that made the whole experience wonderfully vibrant and provided a feeling of rapidly growing community and rapport transcending traditional frameworks.

The conference was supported by AustMS, AMSI and the University of Melbourne Mathematics and Statistics Department. Further details are available at the website at http://www.ms.unimelb.edu.au/~ram/RepTheoryConference/

Obituaries

Pavel Karel Smrz

10 December 1937 to 26 July 2014

Paul Smrz was born in Prague on 10 December 1937. He graduated from Jan Neruda High School in 1956 and from Charles University in 1960 majoring in physics. From 1961 to 1962 he was a research assistant in the High Energy Physics Laboratory of the Physics Institute of the Czechoslovak Academy of Sciences and began studying for his doctorate in nuclear physics. He married Eva in March 1961 and their son Michal was born in December of that year. From 1962 to 1965 he was a research assistant in the Joint Institute for Nuclear Research in Dubna, USSR. He took his doctorate from Charles University in 1965. His 13 research publications up to this time were in nuclear physics specialising in the collision of elementary particles. Paul's colleague at Dubna, Pavel Winternitz, says that Paul's most interesting and best received papers for this period were on Cherenkov radiation.

Back in Prague in 1965, Paul had to spend six months in military service. But then he was granted a two-year Canadian National Research Council post-doctoral fellowship at McGill University Physics Department. The Czechoslovak authorities had given him an exit visa for one year but when trying to extend it for 1966 he was told that he should return to Czechoslovakia. He decided then to stay in Canada to continue his research at McGill. This was a big step because it meant that he would not be able to return safely to his homeland to visit relatives. Clearly there was some concern in both countries because of Paul's research experience in the USSR.

In 1967 Paul's daughter Marcella was born in Canada. From 1967 to 1970, Paul was a postdoctoral fellow at the University of Alberta, Edmonton, but he began his teaching career as assistant professor from 1970 to 1971 at the University of Lethbridge, Alberta. During his stay in Canada, his research interests switched to general relativity and fundamental questions of space-time. He was interested in the underlying differential geometry and related quantum theory.

In 1971 Paul was offered a lectureship in mathematics at the University of Newcastle, Australia. He came by the ship Orsova bringing children Michal and Marcella and wife Eva pregnant with Hanna who was to be born in Australia. Paul and his family settled into Australia, their new homeland. Paul enjoyed teaching and was an accomplished lecturer in a variety of subjects mainly linear algebra but also statistics. His enthusiastic lecturing style was appreciated by his students. He was promoted almost immediately to senior lecturer and to an associate professorship in 1978. His delight was in lecturing to honours students on differential geometry. His research in general relativity was mainly carried out without collaboration.

Paul had several half-year periods of study leave when he caught up with the international research community. These included the universities of Waterloo Canada in 1975, Canterbury New Zealand in 1977, Utah USA in 1977 and Catania Sicily in 1983. He participated and contributed to a number of international conferences. From 1985 to 1990 he served as Head of the Department of Mathematics, Statistics and Computer Science. Paul retired in 1997 on his sixtieth birthday.

Paul had his share of personal tragedy with the loss of his daughter Marcella and his wife Eva. But he had a time of rejoicing with his marriage to Zdena in 2001 and the birth of his grandson Adrian in 2004.

Paul enjoyed walking in the Australian bushland. In the Hunter Valley his favourite was walking on Barrington Tops. But he also enjoyed exploring and camping in the Australian outback. On several occasions he persuaded overseas visitors to go with him. Zdena's introduction to Australia included several of Paul's outback safaris. He actually brought his brother Lada out from the Czech Republic to experience the joys of an outback expedition.

In his retirement Paul's life followed a pattern. He divided his year, spending time in the Czech Republic with his wife Zdena and his brother Lada, in Canada with Zdena's family in Ottawa and in Australia with his family and old maths colleagues in Newcastle. As a conjoint associate professor he kept a desk at the University of Newcastle and continued his research activity in particular with colleagues from North America.

From 1967 he published over 30 papers on general relativity. His 2007 paper gives a flavour of his research efforts: 'General relativity is extended by considering a torsion-free de Sitter reducible metric linear connection on a five dimensional manifold'. Paul Winternitz writes: 'what I appreciated most about Paul's work was his independent "out of the box" thinking and his originality in tackling profound aspects of mathematical physics'.

Paul was prepared to do collaborative research on wider fields. He renewed his collaboration with his old Czech colleague Robert Holub. They worked on an anomalous phenomenon discovered by earth scientists. They proposed that it might be a macroscopic quantum effect which occurs rarely but is nevertheless observable.

In Canada, Paul had several short-term appointments and research collaboration at the University of Ottawa. Mayer Alvo, whose background is in statistics, writes: 'We published a paper together involving the geometry of ranking data. We talked about the geometric representation of signed permutations, a very difficult problem. Paul had made some significant headway into it. While in Ottawa he would work incessantly coming up regularly with new ideas.'

Earlier this year Paul was diagnosed with bowel cancer. He died of complications after an operation on 26 July. He will be missed by his family, his research colleagues and his old friends from Mathematics at the University of Newcastle.

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Lift-Off Fellowship report
Polytopal realisations of cluster complexes

Natalie Aisbett*

As a Lift-Off Fellow, I have had the opportunity to continue doing research after submitting my PhD. The proposed area of research of my Lift-Off Fellowship was to investigate questions relating to polytopes proposed in the paper [2]. An important question they ask, is whether a particular family of simplicial complexes, which are known to be spherical, can be realised as the boundary of a polytope. I have been focussing on this question, and in the process I have been able to greatly expand my knowledge base. Since the completion of my PhD and being awarded the fellowship, I have also been able to conduct some research into permutation patterns in the paper [1]. In this article, I summarise the main definitions and results leading to the questions asked in [2], as well as summarising my results from [1].

A *cluster complex* is a type of simplicial complex, which was originally defined by Fomin and Zelevinsky in [3]. Their definition was then extended so that it corresponded to all Coxeter groups by Reading in [6] [7]. *Subword complexes* are a family of simplicial complexes that were first defined by Knutson and Miller in [4], who then extended their definition to include all Coxeter groups in [5]. In [2], the authors Ceballos, Labbé and Stump describe a one-to-one correspondence between cluster complexes and a subset of the subword complexes, and then generalise cluster complexes to *multi-cluster complexes* by using the subword complex description. They introduce a parameter k, so that when $k = 1$, the multi-cluster complexes reduce to cluster complexes. The following definitions appear in [2].

A *finite Coxeter system* is a pair (W, S) where S is a finite set, and W is a finite group with presentation

$$\langle s \in S \mid (ss')^{m_{ss'}=1} \rangle,$$

with $m_{ss} = 1$ and when $s \neq s'$ we have $m_{ss'} \in \{2, 3, 4, \dots\} \cup \{\infty\}$. A group with such a presentation is called a *Coxeter group*, and it is a well-known fact that finite Coxeter systems biject to finite Coxeter groups.

Given a finite Coxeter system (W, S), let Q be a word in the generators S of W, and let $\pi \in W$. The *subword complex* $\Delta(Q, \pi)$ is the simplicial complex whose vertices are the letters in Q (there is a vertex corresponding to each copy of a generator in Q, even if it appears more than once), and whose faces are subwords P of Q such that $Q \setminus P$ contains a reduced expression for π. In [4], Knutson and

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Miller show that subword complexes are homeomorphic to either a sphere or a ball.

If (W, S) is a finite Coxeter system, then a *Coxeter element* c is a product of the generators S in some order. We let w_0 denote the longest element of the Coxeter group (which is known to be unique), and we let $\boldsymbol{w_0}(\boldsymbol{c})$ denote the *c-sorting word* for w_o, which is the lexicographically first subword of $\boldsymbol{c}^\infty$ that represents a reduced expression for w_0. Then the *multi-cluster complex*, denoted Δ_c^k, is the subword complex:

$$\Delta_c^k := \Delta(\boldsymbol{c^k}\boldsymbol{w_0}(\boldsymbol{c}), w_0).$$

The following interesting facts are known about multi-cluster complexes:

- For any Coxeter group W, any integer k, and any two Coxeter elements c, c', the complexes $\Delta_c^k(W)$ and $\Delta_{c'}^k(W)$ are isomorphic.
- When $W = A_{m-2k-1}$, the complex $\Delta_c^k(A_{m-2k-1})$ is isomorphic to the simplicial complex whose facets correspond to k-triangulation of a convex m-gon, which is denoted $\Delta_{m,k}$ (see [2]). When $k = 1$, this is the dual simplicial complex to the associahedra.
- When $W = B_{m-k}$, the complex $\Delta_c^k(B_{m-k})$ is isomorphic to the simplicial complex whose facets correspond to centrally-symmetric k-triangulation of a regular convex m-gon, which is denoted $\Delta_{m,k}^{\mathrm{sym}}$ (see [2]).

It is known that the simplicial complex $\Delta_{m,1}$ can be realised as the boundary complex of a polytope. However, it is not known whether this is true for multi-cluster complexes, or even the families $\Delta_{m,k}$ and $\Delta_{m,k}^{\mathrm{sym}}$ in general. Ceballos, Labbé and Stump conjecture that the multi-cluster complex is the boundary complex of a simplicial polytope, [2, Conjecture 9.9]. The same question was asked for the cluster complexes in [4, Question 6.4]. Solving this question has been the main focus of my research for the Lift-Off Fellowship.

On top of my research into finding a polytopal realisation of cluster complexes, I have been investigating pattern popularity within 132-avoiding permutations. A permutation σ *contains* the permutation τ if there is a subsequence of σ order isomorphic to τ. A permutation σ is *τ-avoiding* if it does not contain the permutation τ. For any n, the *popularity* of a permutation τ is the number of copies of τ in the set of all 132-avoiding permutations of length n. Rudolph shows in [8] that 132-avoiding permutations of length k with the same spine structure are equally popular within 132-avoiding permutations of any length n. Rudolph conjectures in [8, Conjecture 21] that for permutations τ and μ of the same length, the popularity of τ is less than or equal to the popularity of μ, if and only if the spine structure of τ is less than or equal to the spine structure of μ in refinement order. I was able to prove one direction of this conjecture in [1], by showing that if the spine structure of τ is less than or equal to the spine structure of μ, then for all n, τ is less popular than μ. I was able to disprove the opposite direction by giving a counterexample, and hence disprove the conjecture.

With gratitude, I acknowledge the Australian Mathematical Society for the Lift-Off Fellowship. This has given me the opportunity to substantially develop my expertise before obtaining a postdoctoral position.

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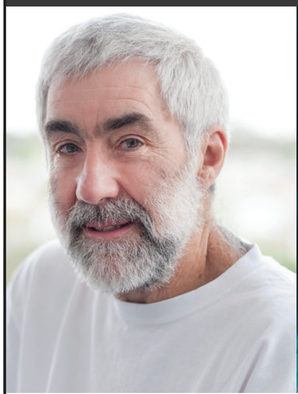
Natalie has recently completed a PhD at the University of Sydney under the supervision of Anthony Henderson. Her thesis was titled *The Gamma-Polynomial of Flag Homology Spheres* and was conducted in the area of geometric combinatorics. She was awarded the 2013 T.G. Room Medal for a PhD thesis in pure mathematics of outstanding merit. Previous to this, she completed a Masters by research at the University of Melbourne under the supervision of Arun Ram. Her master's thesis was titled *Duality Groups*, and focussed on a new classification of duality groups, which are a family of complex reflection groups. Natalie completed her undergraduate degree with honours in Applied Science at RMIT University.

Research
Australian Mathematical Sciences Institute



2014 AMSI-SSAI Lecture Tour

Starts 19 August 2014

Professor Terry Speed

Prime Minister's Prize for Science Recipient
Head of Bioinformatics
Walter and Eliza Hall Institute of Medical Research

Public Lecture - *A New Frontier: understanding epigenetics through mathematics*

19 Aug	5:30pm	Swinburne University of Technology
27 Aug	6:00pm	Australian National University
23 Sept	5:30pm	University of New South Wales
25 Sept	6:00pm	Charles Sturt University, Wagga Wagga
9 Oct	6:00pm	University of Western Australia
16 Oct	12:00pm	University of Tasmania
30 Oct	4:00pm	Queensland University of Technology
20 Nov	6:00pm	The University of Adelaide

AGR Seminar

20 Aug	3:00pm	Australian Mathematical Sciences Institute
8 Oct	1:00pm	University of Western Australia

Seminar

26 Aug	9:30am	Australian Bureau of Statistics
22 Sept	2:00pm	University of Western Sydney
24 Sept	3:00pm	University of Sydney
16 Oct	2:30pm	University of Tasmania

* *All times reflect local host time*

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Full tour details: www.amsi.org.au/speed

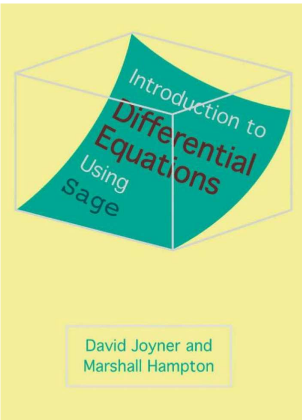
Book Reviews

Introduction to Differential Equations Using Sage

David Joyner and Marshall Hampton
The Johns Hopkins University Press, 2012, ISBN 978-1-4214-0637-4
Also available in eBook (ISBN 978-1-4214-0724-1)

Preliminary remarks

At an elementary level, there's not much new to be said about differential equations. In a first introductory course we would expect a handful of equations solvable by exact means: first-order linear, separable, Bernoulli, homogeneous, second-order linear with constant coefficients, and a sprinkling of others. And for the applications the usual suspects are trotted out: Newton's law of cooling, population growth, radiocarbon dating, mixing problems, electric circuits. Beginning students, flicking through a few texts, might reasonably wonder if this is it? Most differential equations which are used with such power in modern modelling are of course extremely complex, and systems such as the Navier–Stokes equations, Maxwell's equations, wave equations lead to some very subtle mathematics.



It is a problem for an educator in such an introductory course to find examples which are simple to define and describe, solvable, if not exactly, then with reasonable accuracy by simple numerical means. And an educator's job is made much easier if everybody has access to a computer algebra system. Not only can the system (if it's powerful enough) solve a large class of equations analytically, but also numerically. The system should also be able to draw graphs: of solutions, of direction fields, of different approximations to a solution.

For this text the authors have chosen Sage. Sage is somewhat of a new kid on the block, being less than ten years old. Initially it consisted of mostly other free and open source (FOSS) mathematical software, all pulled together with a consistent interface using the language Python. Since its inception it has grown hugely, has had an enormous amount of code written for it, and for algebraic geometry and number theory is probably the most powerful software in current use, with much of its code being contributed by some of the leading researchers in their fields. For calculus related material, Sage devolves most of its working to Maxima, which is the current FOSS version of the venerable system Macsyma, which is no longer in use. Maxima is part of Sage; when you download and install Sage, you also get a complete Maxima.

The authors are both leading contributors to the Sage project, and the first author has worked closely with the lead developer, William Stein from the University of

Washington, from the very beginning. They are also both exemplary mathematicians and educators.

The Book

The book started out as course notes by the first author, which were then revised and extended by the second. The book still seems to me to have the feeling of course notes, rather than a text book, and although I can't fault its content or much of its exposition, there are places where the lack of some good independent editing is apparent.

First, the mathematical content. The book consists of four chapters: First Order DEs, Second Order DEs, Systems of DEs, and PDEs. Such numerical examples as are given are placed in the context of the equations, rather than as a separate section or chapter. And the first chapter contains most of the numerical material, although later chapters include some numerical examples.

Each chapter has a good mix of theory, Sage examples, and exercises. Exercises are given at the end of each section, and vary between pencil and paper exercises, Sage exercises, and applications. Sage examples are copiously scattered throughout the text, but there is a tendency to introduce Sage commands without explaining them first. I think the text needs either an introductory chapter describing how to download and install Sage, or how to access it on one of its public servers. I also think that the Sage examples would look nicer if they somehow simulated the notebook interface, where output can be mathematically typeset using LaTeX.

Occasionally there are typos which would have been picked up in an editing process. For example, on page 27, the Sage example defines a variable t, a function $x(t)$, but the DE is then given in terms of $y(t)$, following the example given just previously. Then the equation is solved for $x(t)$. This is confusing.

Occasionally also the book presents some enticing mathematics without any further development. For example, both Peano's and Picard's theorems for the existence of solutions are given very early on, but the authors seem to skate over the important fact that replacing continuity (for Peano's theorem) with Lipschitz continuity (for Picard's theorem) provides for the existence of a unique solution. Then we never hear any more about them. If such important results are to be included at all, I think they need more than a cursory page. In fact, a chapter devoted to some of the theory of DEs, as opposed to methods of solution, would be a wonderful addition. Maybe in the next edition. . . ?

I am biased, but I wish there was a little more detail on numerical solutions, and some examples of the use of Sage's `ode_solver()` command, which includes a Runge–Kutta–Fehlberg (RKF) adaptive stepsize method. The authors allude to such a method on page 50, but instead of using it, a function is given which compares a fourth-order Runge–Kutta method with a second-order improved Euler method. In fact in general for an adaptive stepsize approach the two methods used differ by an order of one, thus the RKF method compares the results of a fourth order method and a fifth-order method. It should also be noted that numerical methods for systems may differ from those used for a single equation. An Adams–Bashforth method is given without any approach at derivation, although in fact it's very easy, using the interface to Maxima and Maxima's `interpol` package for interpolation:

```
Sage

sage: maxima('load(interpol)')
sage: p = maxima('lagrange([[x0,f0],[x0+h,f1],[x0+2*h,f2],\
....:   [x0+3*h,f3]],x)')
sage: p.integrate(x,x0+3*h,x0+4*h).expand().factor()
```

$$(55f_3 - 59f_2 + 37f_1 - 9f_0)\frac{h}{24}$$

This is the term to be added to y_3 to obtain y_4, and can be seen to be the second term in equations 1.11 on page 49 (for $n = 0$).

In Chapter 2, in discussing the solution of the characteristic equation for a linear DE with constant coefficients, there is the following curious inclusion:

> To solve the homogeneous differential equation in (2.1), please *memorize these rules*
>
> real $r \Rightarrow e^{rt}$
> complex $\alpha + \beta i \Rightarrow e^{\alpha t}\cos(\beta t), e^{\alpha t}\sin(\beta t)$
> repeated roots $\Rightarrow$ repeated solutions, boosted each time by t

Now I'm sure we have all recommended that students memorize a few simple rules; and in a classroom this would be fine. But in a textbook? Why these particular rules and no others? There are no instructions to memorize, for example, the integrating factor technique for first-order linear equations. This is one of those places where there is an apparent lack of external editing.

This is the chapter in which a lack of consistency with the diagrams becomes apparent. Some diagrams seem copied as raster images from elsewhere and seem a bit blurred (figure 2.14 on p. 106); others (such as graphs of functions) are directly produced by Sage and copied in. But to give the best appearance in a LaTeX document the authors should have used a proper vector package, such as TiKZ, for all their figures. This would not only greatly improve the appearance of figures, but give some measure of homogeneity between them. On pages 184–186 for example, there are three circuit diagrams, all with different fonts and circuit elements; to my mind this looks sloppy. I think in a textbook every attempt should be made to make the book look as professional as possible, and this includes not only the elegance and correctness of the mathematics, but also of the diagrams.

In Chapter 3 (Matrix theory and systems of DEs) a full 25 pages is taken up with elementary linear algebra. I imagine the authors were keen to ensure that the book was as self-contained as possible, and they assumed that readers would have had some basic calculus, but no linear algebra. I think a better use of space would have been to present a very cut-down introduction, maybe including references to online material, and spend more time on the DEs, in particular on numerical solutions of systems. This chapter does finish with a splendid example of the now famous 'zombie attack' model, which is a delightful version of the standard SIR model for disease spread. A number of examples are given with different parameters showing how in some cases the 'zombies win' and in others the 'zombies lose'. (And in two of the three diagrams 'susceptibles' is mis-spelled 'suseptibles'.) More space might have allowed the authors to show how the parameters can be determined (by a least squares approach) to fit particular data. As with the previous two chapters there are some initial value problems given, but no boundary value problems.

Chapter 4 (PDEs) contains material relating to trigonometric series, and shows how these can be used to solve the wave equation and Schrödinger's equation. What is missing is the derivation of these equations, or much discussion of what they may mean as models of the physical world. For this reason this chapter seems a bit superficial. Also, as the authors point out, Sage's current ability to solve PDEs is very limited. I think that this chapter would have been better replaced with an introduction to Sage. Then there would have been also more room to investigate other DEs, such as Newton's gravitational equations and the derivation of Kepler's laws, or use Sage to take the students further afield with other DEs, such as Riccati equations.

I also have some concerns with the bibliography, which consists almost wholly of wikipedia articles. This is a contentious point: I myself love wikipedia, and I think that most of its mathematics is exemplary. But wikipedia is not peer-reviewed, and errors can creep in, sometimes with an edit, sometimes of fact. For this reason, although it is a superb resource, I don't believe it can take the place of reviewed and professionally edited published material. Possibly there should be two bibliographies, one of published material, and the other of non-reviewed online material (such as wikipedia) with a stern warning that such material may not necessarily be always correct.

Finally there is no website associated with the book at which you can download the Sage examples and functions. This is an omission which should be rectified.

Conclusions

In many ways this is a fine book: it contains pretty much all of the material one would expect to find in a first, introductory DEs course, and provides a nice mix of theory and symbolic computation. The pedagogy is excellent and the exercises are models of their kind. (I am always grumbling about the poor quality of exercises in mathematics texts, and for once I can't!) It is let down only by what seems to be to be hastiness in its publication, which has allowed some typos and inconsistencies of exposition to slip through. I hope this book sees a second edition — it deserves one — in which the text is tightened by appropriate editing.

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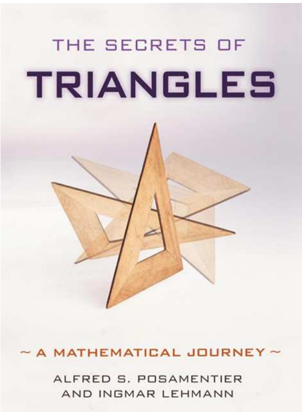
The Secrets of Triangles: A Mathematical Journey

Alfred S. Posamentier and Ingmar Lehmann
Prometheus Books, 2012, ISBN 978-1-6161-4587-3

Preliminary remarks

Euclidean geometry is one of those topics which seems to have disappeared from modern mathematics curricula. Although we all learn cartesian geometry very early on, the mathematics of Euclid and his contemporaries, and of more recent geometers (Poncelet, Steiner) is barely touched on. Partly this is due to the axiomatization of recent mathematics and of the more central role played by algebra; indeed Hilbert's approach was to denigrate the pictorial aspect of geometry; as he said in the very late 19th century: 'One must be able to say at all times — instead of points, straight lines, and planes — tables, chairs, and beer mugs.'[1] And Hilbert's view has coloured geometry ever since. I think this is a pity: Euclidean geometry, with its points and lines (sorry, Hilbert!) and diagrams has a charm all of its own, and one without which mathematics would be immeasurably poorer.



In spite of Hilbert and of the huge advances made by algebraic geometry, there has always been a steady undercurrent of Euclidean geometry, and new discoveries are constantly being made, with new theorems and proofs. Some of these results would fit nicely into an expanded Euclid; others require more advanced methods, using results from algebra, such as Gröbner bases.

In particular, there is a constant stream of new 'triangle centres'. Possibly everybody is familiar with at least three: the *centroid*, which is the point of concurrency of the triangle medians (lines between vertices and mid-points of opposite sides); the *incentre*, which is the centre of the inscribed circle, and point of concurrency of the angle bisectors; and the *circumcentre*, which is the centre of the circle through the vertices, and point of concurrency of the perpendicular bisectors of the sides. Figure 1 shows them all, with M being the centroid, and I, E in the incentre and circumcentre respectively.

What is perhaps less well known is that there are (at the time of writing) nearly *six thousand* triangle centres, all of which are described at the *Encyclopedia of Triangle Centers* at http://faculty.evansville.edu/ck6/encyclopedia/ETC.html. This text by Posamentier and Lehmann may be considered as an enticement into this world.

[1] *Hilbert*, Constance Reid, Springer, 1996

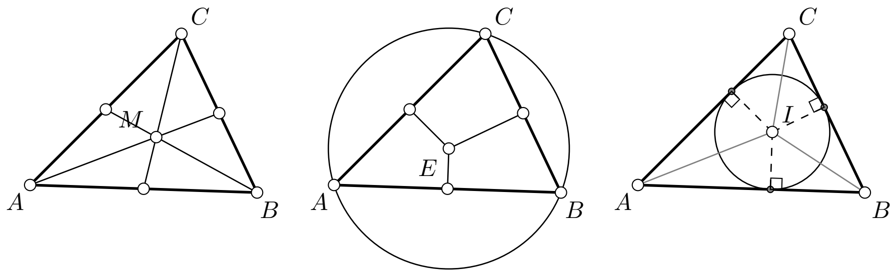


Figure 1: Three standard triangle centres

The book itself

The authors are well known as mathematics educators and writers of books for the general mathematical public, and this book (as its title suggests) concentrates on triangles, mainly from a Euclidean perspective. The copy I have for review is an 'Uncorrected Advance Reading Copy', which is not edited, and lacks an index, as well as a comprehensive bibliography. The unedited nature means that sometimes the caption of a diagram is on the next page, which makes the text harder to follow. Each diagram (in this copy) is accompanied by its file name, and thus it can be seen that the authors have used Geometers Sketchpad to create them. Although this software (and Geogebra) are mentioned, there is no discussion as to how they can be used to help understand the material. One problem with diagrams in geometry is that they can get complicated very easily, and the reader has to work hard to untangle the messy web of points, lines and circles. One such figure is 6.22, showing how the nine-point circle is also the nine-point circle of another triangle formed by the centres of circles. Many of the diagrams in this chapter are highly convoluted. It's interesting to turn to the great text of Coxeter[2] and to look at his diagrams, in which all extraneous material is removed. For the nine-point circle, Coxeter shows the points, and a minimal construction required for his proof, but not the circle itself. This makes for a very clear and readable diagram. The use of dynamic geometry software (Geometers Sketchpad, Geogebra, and others) is a real boon for students (and anybody else), as you can use different colours for different lines and curves, and of course pull points around and see what happens to the diagram.

I think it is a pity that a text like this does not make more use of such software, or provide a companion website where the material is available in files for the most common systems. A diagram which is complicated on the page can be rendered with greater clarity on a computer screen, with the addition of colours, line thicknesses, and placement of points.

Posamentier and Lehmann are keen to introduce the reader to much of the modern theory of triangles, without bothering too much about theorems and proofs, although a few are given. Ceva's theorem, which states the conditions under which

[2] *Geometry*, 2nd edn, H.S.M. Coxeter, Wiley, 1989

lines from vertices to the opposite sides are concurrent, is proved, and the concurrency of medians follows immediately. Morley's theorem, that the interior angle trisectors meet at the vertices of an equilateral triangle, has its proof given in an appendix (which is missing from my copy).

With nearly 6000 centres to choose from, the authors concentrate naturally on the most 'natural'; that is, the ones whose construction is fairly simple. The discussion of such centres makes up much of the first half of the book. The authors discuss centres obtained by concurrency of lines, and those obtained by concurrency of circles. The nine-point circle theorem is proved, in a somewhat long-winded fashion (in comparison, Coxeter's neat, exemplary proof takes about half a page).

The second half of the book looks at areas, constructions, inequalities, and finishes off with a pleasant little chapter about fractals, where as you would expect the Sierpinski Gasket (also known as the Sierpinski Triangle), and Koch's Snowflake Curve, are discussed, along with some others.

The chapter on areas gives Heron's formula — as you would expect — but not its proof, which is relegated to the (missing) appendix. I would have thought that such an elegant result would be worthy of a proof in the body of the text. This chapter also includes plenty of trigonometry, and the sine and cosine rules, for example, can be used to provide a very quick and straightforward proof.

On the subject of proofs, the authors have deliberately shied away from the formal lemma-theorem-proof style of mathematical writing to a more discursive approach. Pythagoras' theorem is in fact proved using similar triangles, but the authors discuss similar triangles and some relationships between them, out of which the theorem falls as a sort of corollary. This may be a fine style of writing, but I found it hard to make my way around in it.

The chapter on inequalities is a nice inclusion, and concentrates on inequalities relating to lines in the triangle, including the Erdős–Mordell inequality: for any point P inside a triangle ABC the sum of distances from P to the sides is less than or equal to half the sum of distances to the vertices (with equality when P is the centroid). Given the previous chapter on areas, I was sad not to see my favorite triangle inequality: Weitzenböck's inequality, which relates the area Δ of a triangle to its sides as $a^2 + b^2 + c^2 \geq 4\sqrt{3}\Delta$. However, one single book can't contain everything.

I also take exception to the authors' occasional breathless excitement; when a result is described as being 'amazing', 'wonderful', 'cute', 'fantastic', and 'nifty'. Heron's theorem is a 'nifty result'? It's certainly elegant, and if you're new to this area of mathematics, perhaps remarkable, but 'nifty'?

Conclusions

Who is this book for, and who would gain the most from it? A professional mathematician would not find much of interest here; the book is too discursive, and the various proofs are hard to track down. On the other hand, it *is* a nice compendium of many elementary triangle results, and would make for an enjoyable bedside read.

I think the book would be best suited for high school students, or the general interested public wishing to have a glance at this most enticing and accessible corner of mathematics.

It may be considered as a sort of extension to David Wells' *The Penguin Book of Curious and Interesting Geometry* (1992), which although having no proofs at all, does have some very elegant diagrams. Posamentier and Lehmann's book aims to be as chatty and interesting, yet also with a few proofs and a greater sense of formal enrichment.

I'm sure that the final published book, with properly named and placed diagrams, with the mysterious proof-rich appendix, and a decent bibliography and index, will go a long way to countering some of my niggles, and will deserve a place on the shelves of any mathematical library.

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Advocacy

Australian Mathematical Sciences Institute

Dealing with Australia's mathematical deficit

Australia's international position in key school mathematics indicators has declined sharply, according to a confronting report by the Australian Mathematical Sciences Institute (AMSI).

The Discipline Profile of the Mathematical Sciences 2014 highlights strategic trends in school education, higher education, research and research training, and career prospects for graduates. The annual Discipline profile is accompanied by a policy brief with measures to deal with the critical problems.

Available for download:

Discipline Profile

Policy measures

www.amsi.org.au/profile_2014

Nalini Joshi*

How mathematical sciences add value to the national economy

The Australian Academy of Science is about to embark on an exercise to assess the economic impact of the physical sciences (chemistry, earth sciences, mathematics and physics) on the Australian economy. To whet your appetite for this extremely important study, I wanted to describe a recent study of the economic impact of the mathematical sciences on the Dutch economy and its major findings.

The Dutch mathematical community was inspired by an earlier study in the UK[1] and commissioned Deloitte to assess the economic impact of mathematical sciences on the Dutch economy. The Dutch report[2] focusses on mathematical sciences and skills, methods and tools that result from higher education in mathematics, statistics and operations research.

There were three major steps in the study (see the summary on p. 8 of the report):

1. Identifying jobs that use mathematical sciences and estimating its extent in each job category. This leads to a calculation of the *mathematical sciences intensity* for each industry representing a grouping of jobs.
2. Calculating the direct, indirect and induced impact of the mathematical sciences on the economy by each industry.
3. Combining the above results to calculate the total economic contribution of mathematical sciences to the Dutch economy.

Most readers of the *Gazette* would know about major applications of mathematics and statistics. The Deloitte report highlights particular areas of mathematical thinking and tools that affect daily life in the Netherlands, in particular, a study of optimal dike heights, personal navigation systems, train schedules, computer chip manufacturing, medical imaging, and smart phone data management (p. 10).

However, many readers of the *Gazette* may not know how jobs data are categorised and classified. The Deloitte report points out the almost obvious fact that more accuracy in the estimates requires more refined categories of employment (p. 11). The Centraal Bureau voor de Statistiek of the Netherlands (CBS) uses 1211 defining categories of jobs. In comparison, the Australian Bureau of Statistics (ABS)

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[1] http://www.ima.org.uk/viewItem.cfm-cit_id=384406.html
[2] http://www.eu-maths-in.eu/download/generalReports/DeloitteMathematicalSciencesAndTheirValueForTheDutchEconomy2014.pdf. Page numbers refer to this report, downloaded on 01 August 2014.

has 1023 categories of occupation in its latest classification[3]. In order to increase accuracy, the Deloitte report relied on the mathematical intensity of more refined categories of occupations calculated in their earlier UK report.

These jobs are distributed across 39 industry groups in the Netherlands. By assessing the fraction of time relying on or spent on mathematical sciences, the Deloitte study calculated the mathematical sciences intensity per industry. It is interesting to note that this intensity ranges from 0% to 47% (p. 12). The top two industries ranked by intensity are information (e.g. software coding and maintenance) and IT services (e.g. data storage). Banks and other financial services were rated at around 23%, while the oil industry and car manufacturing came out at around 14%. (See Figure 2 on p. 12.)

The resulting calculations of economic impact are astonishing. (See p. 14.) The direct impact of mathematical sciences employment on the Dutch economy is estimated to be €71B in gross value added (GVA). The indirect effect, arising from procurement of goods and services by mathematically intensive parts of industries from other industries amounts to €37B in GVA. The induced effect, i.e., impact of household spending resulting from direct and indirect effects of mathematical sciences jobs, amounts to an additional €51B in GVA. The industry with highest direct impact is Banking, that with highest indirect impact is renting and trading in real estate, while that with highest induced impact is IT services.

So the total impact of mathematical sciences on the Dutch economy is almost €160B, which amounts to 30% of national GVA, and accompanying this figure is over 2.25M jobs, which is almost 26% of all jobs in the Netherlands (p. 15).

The report goes on to describe the relationship between mathematical ability of a nation's population and its economic competitiveness and explains how the absence of fostering mathematical talent weakens national competitiveness. Wouldn't it be great to have such a study for Australia that we can show to our government?

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

[3] See ANZSCO v.1.2 http://www.abs.gov.au/ausstats/abs@.nsf/mf/1220.0

AMSI News

Geoff Prince*

AMSI's Career campaign — Maths Ad(d)s and a new website

Maths Ad(d)s is an annual AMSI publication aimed at creating a professional identity for working mathematicians and statisticians. This year we have ramped up our careers awareness campaign by emailing the latest and 17th edition of Maths Ad(d)s to most of the country's secondary schools. The Australian Association of Mathematics Teachers (AAMT) sent their members a letter from me to every school family containing a link to Maths Ad(d)s and our new careers site careers.amsi.org.au. I also asked the AAMT members to brief their school's careers advisors on the use of Maths Ad(d)s. We have, as usual, provided all of AMSI's university members with hard copies of Maths Ad(d)s for their Open Days and their own students. I want to thank La Trobe for their work over so many years in compiling the ads and writing the commentaries. *And in a first the Education Minister, Christopher Pyne, wrote a strong letter of support which appears inside the front cover.*

BioInfoSummer 2014 at Monash University, 1–5 December

It is absolutely true that biology is being revolutionized by mathematics, statistics and computer science. With this will come the challenge to mainstream biology of new disciplines such as systems biology and bioinformatics. Mathematics experienced something similar when computer science came of age. BioInfoSummer started 10 years ago and it is a more exciting event than ever with more than 200 attendees expected at Monash this December. It is exactly the right place to go for mathematical scientists who see their future interacting with biology without the protective clothing. The web page is www.amsi.org.au/BIS.

Heads up for 2014–2015 Vacation Research Scholarships and the Summer School

Last year, AMSI offered a record 55 six-week vacation scholarships to mainly third-year students. They provide a wonderful start to the postgraduate experience in maths and stats and now is the time that we should be spruiking the opportunity to our current undergraduates. Please point them to last year's remarkable reports on the VRS page of AMSI's new Higher Education pages at www.amsi.org.au. Applications can be made online now.

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

The 2015 AMSI Summer School is being held at the University of Newcastle (see our ad in this issue).

Attention: Changes to Workshop applications

There have been changes to the rules and rounds for applications to AMSI, AustMS and ANZIAM for workshop funding — don't be caught out — go to the new Research pages at www.amsi.org.au. In particular, we are now insisting on greater national attendance coverage and details of measures to be taken to improve female participation.

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

Research & Higher Education

Australian Mathematical Sciences Institute

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

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News

General News

Georgina Sweet Australian Laureate Fellowship to Kate Smith-Miles

Sixteen new Australian Laureate Fellows were recently announced by the ARC. Amongst the recipients was one mathematician: Professor Kate Smith-Miles of Monash University was awarded a Georgina Sweet Laureate Fellowship for her project 'Stress-testing algorithms: generating new test instances to elicit insights'.

Full details of the awards are available at http://www.arc.gov.au/media/major_announce.htm#FL14_bios.

Women in Mathematics funding opportunities

The Women in Mathematics Special Interest Group of the Australian Mathematical Society is pleased to announce two new funding opportunities.

Both Awards are funded by the Australian Mathematical Society (AustMS) and are an initiative of the AustMS Women in Mathematics Special Interest Group (WIMSIG), which administers them. Awards are determined on a competitive basis by a selection committee of distinguished mathematicians, appointed by the Executive Committee of WIMSIG. Applications can be made at any time. Selection rounds begin on 1 April and 1 October each year.

AustMS WIMSIG Cheryl E. Praeger Travel Awards

Travelling for conferences and research visits is vital for an academic career. The AustMS WIMSIG Cheryl E. Praeger Travel Awards are designed to provide full or partial support for Australian female mathematicians to attend conferences or to visit collaborators, with approximately four Domestic Travel Awards and two International Travel Awards awarded annually. By having more women attend conferences, we also increase the size of the pool from which speakers at subsequent conferences may be drawn, and thus address the persistent problem of the scarcity of women speakers at some conferences.

Applications, using the application form and accompanied by a CV and other supporting documentation as detailed in the rules, should be sent to the Selection Committee via the email address praegertravelawards@austms.org.au. How to apply: http://www.austms.org.au/Praeger+Travel+Awards.

AustMS WIMSIG Anne Penfold Street Awards

A potential major obstacle for academics when travelling for conferences or research visits is to ensure that their family responsibilities are taken care of while they are away. The AustMS WIMSIG Anne Penfold Street Awards provide additional financial support to Australian mathematicians for their caring responsibilities, while they travel for conferences or research visits to collaborators, with approximately four Awards awarded annually. The potential uses of these Awards include, but are not limited to, short-term childcare or professional carers for elderly relatives. These Awards are open to both female and male mathematicians.

Applications, using the application form and accompanied by a CV and other supporting documentation as detailed in the rules, should be sent to the Selection Committee via the email address streetawards@austms.org.au. How to apply: http://www.austms.org.au/Street+Awards.

ANU Council approves new building for MSI

The Australian National University Council has approved a new model for capital works investment worth $75 million to enable the construction of two buildings, one of which will bring together the Mathematical Sciences Institute and the College of Engineering and Computer Science. For further details, see http://maths.anu.edu.au/about-us/news/anu-council-approves-new-building-msi.

Maths in the media

More interesting reflections on secondary mathematics education appear in http://www.theage.com.au/national/education/the-statistical-problem-of-greedy-pigs-20140728-3cpk8.html.

Completed PhDs

Australian National University

- Dr Li Chen, *Quasi Riesz transforms, Hardy spaces and generalized sub-Gaussian heat kernel estimates*, supervisor: Thierry Coulhon.

Griffith University

- Dr Hamid Shoberi-Nejad, *Modelling the economic impact of extreme events on critical infrastructure systems in Australian industries: risk analysis case study in finance and tourism*, supervisor: Anand Tularam.

Macquarie University

- Dr Anthony Wong, *Modern harmonic analysis: singular integral operators, function spaces and applications*, supervisor: Xuan Thinh Duong.

Monash University

- Dr David Robert, *Analytic and numerical studies of envelope solitons in geophysical flows*, supervisor: Simon Clarke.

University of Melbourne

- Dr Daniel Harvey, *On treewidth and graph minors*, supervisors: David Wood and Sanming Zhou.

- Dr Sophie Dickson, *Robust airline scheduling and disruption management*, supervisors: Heng-Soon Gan, Natashia Boland and Mark Wallace.
- Dr Simon Villani, *Critical dense polymers on the strip and cylinder*, supervisor: Paul Pearce.
- Dr Michael Payne, *Combinatorial geometry of point sets with collinearities*, supervisors: David Wood and Sanming Zhou.

University of New South Wales

- Dr Robyn Margaret Stuart, *Metastable sets in open dynamical systems and substochastic Markov chains*, primary supervisor: Gary Froyland.
- Dr Stephen James Sanchez, *The p-negative type behaviour of finite metric spaces*, primary supervisor: Ian Doust.
- Dr Natalya Levenkova, *Applications of graph theory to real-world networks*, primary supervisor: Catherine Greenhill.
- Dr Ilya Tregubov, *The shallow water equations on the unit sphere with scattered data*, primary supervisor: Thanh Tran.

University of Queensland

- Dr Amir Moghaddam, *An integrable and exactly solvable non-hermitian BCS Hamiltonian and generalised exclusion statistics*, supervisors: Jon Links and Phillip Isaac.
- Dr Frank Wrathmall, *Existence results for nonlinear ordinary differential equations: boundary value problems*, supervisor: Bevan Thompson.
- Dr Yawei Song, *Existence results for boundary value problems for ordinary differential equations and difference equations*, supervisor: Bevan Thompson.

University of Southern Queensland

- Dr Fadhel Jasim Mohammed, *Modelling dispersion in turbulent boundary layers using centre manifold techniques*, supervisors: Dmitry Strunin and Thanh Tran-Cong.

University of Sydney

- Dr Garth Tarr, *Quantile based estimation of scale and dependence*, supervisors: Neville Weber and Samuel Mueller.

University of Western Australia

- Dr Shreya Bhattarai, *Interpolation in Riemannian manifolds*, supervisor: Lyle Noakes.
- Dr Wen Chen, *Numerical methods for fractional Black–Scholes equations and variational inequalities governing option pricing*, supervisor: Song Wang.
- Dr Donny Lesmana, *Numerical method for nonlinear partial differential equations and inequalities arising from option valuation under transaction costs*, supervisors: Song Wang and Les Jennings.

University of Wollongong

- Dr Hul Li, *Twisted topological graph algebras*, supervisors: David Pask and Aidan Sims.

Awards and other achievements

Griffith University

- Dr Tularam is now a lifetime member of Association of Global Groundwater Scientists (India).

Monash University

- The ARC recently announced the award of a Georgina Sweet Laureate Fellowship to Professor Kate Smith-Miles.
- Dr Simon Campbell has been awarded the Astronomical Society of Australia's Louise Webster Prize for Outstanding Research by an 'early career' Post Doctoral researcher. Simon won this award for his *Nature* paper 'Sodium content as a predictor of the advanced evolution of globular cluster stars' (see http://www.nature.com/nature/journal/vaop/ncurrent/full/nature12191.html). For further information, please visit: http://adsabs.harvard.edu/abs/2013Natur.498..198C.
- *Grants.* Congratulations to Professor Kate Smith-Miles for her successful ARC linkage application. Professor Kate Smith-Miles was awarded $421 276 for her project entitled 'Faster, cheaper, better: mathematical advances for improved design and scheduling of robotic instrumentation'.

University of Queensland

- Dr Eric Swartz and Dr Padraig Ó Catháin have been awarded a UWA Research Collaboration Award for a joint project investigating combinatorial designs and finite geometries.

University of Sydney

- Nalini Joshi has been awarded the Hardy Fellowship for 2015 by the London Mathematical Society.

University of Western Australia

- The London Mathematical Society has elected Professor Cheryl Praeger to Honorary Membership of the Society. An announcement can be found at http://www.lms.ac.uk/membership/honorary-members.

University of Wollongong

- Distinguished Professor Noel Cressie was awarded the 2014 Pitman Medal at a ceremony held at the 2014 Australian Statistical Conference in Sydney on 10 July. The Statistical Society of Australia awards this gold medal, the Pitman Medal, at most once annually, in recognition of outstanding achievement in, and contribution to, the discipline of Statistics.

- Dr Ngamta (Natalie) Thamwattana has received the 2014 Vice Chancellor's award for research excellence for emerging researchers.
- Professor Jacqui Ramagge has received the 2014 Vice Chancellor's award for outstanding contribution to University of Wollongong research culture.

Appointments, departures and promotions

Australian National University

Arrivals

- Mr Chen Xi commenced 25 August 2014.
- Professor Andrew Vince commenced 2 August 2014.
- Dr Chen Xuzhong commenced 4 August 2014.
- Dr Feida Jiang commenced 10 June 2014.
- Hoel Queffelec commenced 1 September 2014.
- Puthan Viswanathan commenced 1 September 2014

Federation University Australia

- On 15 August, Dr Sona Taheri commenced as a Postdoctoral Fellow, Operational Research, working with Associate Professor Adil Baghirov.
- A/Prof Zhiyou Wu has resigned, and will take a position at Chongqing Normal University. She will remain an Honorary Research Associate of Federation University Australia.

Griffith University

- Post Doc from Iran Dr Hoda Rahmati — Modelling migration due to water and food stress.

Monash University

- Dr Julie Clutterbuck commenced as ARC Future Fellow/Senior Lecturer. Julie is interested in partial differential equations relating to geometric and physical situations. In particular, the equations governing the shape of capillary surfaces, the interface between a liquid and another immiscible fluid; curvature flows, in which a shape evolves according to its curvatures; and eigenvalue estimates, where the geometry of an object determines properties such as the diffusion of heat through it.

Queensland University of Technology

- Dr Catherine Penington joined our department as a research associate in July 2014.
- Dr Peter van Heijster was promoted to Senior Lecturer in August 2014.
- Professor Matthew Simpson was promoted to Professor in August 2014.

Swinburne University of Technology

- Dr Stephen Bedding and Dr Md Samsuzzoha have been appointed as lecturers level B in the Department of Mathematics. They will be commencing in their new positions as of the beginning of Semester 2 (4 August).

University of Melbourne

Departed staff

- Dr Heather Lonsdale
- A/Prof Ray Watson
- Mr Steve vander Hoorn
- Dr Geoffrey Decrouez
- Dr Paul Sobaje
- Dr Gwenael Joret

Promotions

- Dr Andrew Bedini has been promoted to Research Fellow Level B.

University of New England

- Stephen McCormick has been appointed as Postdoctoral Fellow. His research interests are in the field of geometric analysis and mathematical general relativity.
- Dr Vasileios Giagos has been appointed as Lecturer in Statistics.

University of New South Wales

Appointments

- Dr Chris Tisdell has been appointed Associate Dean (Education) within The Faculty of Science.
- Dr Libo Li commenced as a lecturer in Statistics in May. Libo has his PhD from the University of Sydney and has held postdocs at Universite d'Evry Val d'Essonne, France, and Ritsumeikan University, Japan.
- Dr Justin Wishart has accepted a fixed-term lectureship in Statistics for three years starting in July. Justin has a PhD from the University of Sydney, and has held a postdoc at the University of Melbourne.
- Dr Quoc Thong Le Gia has accepted a fixed-term lectureship in Applied Mathematics for three years starting in July. Thong has a PhD from Texas A&M University and has held a postdoc at UNSW.
- Dr Shev MacNamara has accepted a fixed-term lectureship in Applied Mathematics for three years starting in July. Shev has a PhD from the University of Queensland, and has held postdocs at Uppsala University, Sweden, Oxford University, UK, and was a Fullbright Scholar at MIT.
- Nick Fewster has accepted a fixed-term position for one year with the School as an Associate Lecturer.

Postdocs

- Dr Alan McCarthy began a postdoc with Professor Wolfgang Schief, starting in July. Alan has a PhD from University College Cork, Ireland.
- Dr Linh Nguyen began a postdoc with Professor Jeya Jeyakumar, starting in May. Linh has a PhD from the University of Pau & CNRS, France.
- Dr Boris Lerner began a postdoc with Dr Daniel Chan, starting in August. Boris has a PhD from UNSW.
- Dr Collette Kerry began a postdoc with Dr Moninya Roughan, starting in August.

University of Western Australia

- Winthrop Professor Song Wang left the School on 18 July 2014.

University of Wollongong

- Dr Kai Du has been appointed as Lecturer in Pure Mathematics. His research area is backward stochastic partial differential equations.

New Books

University of Adelaide

Koch, I. (2014). *Analysis of Multivariate and High-Dimensional Data*. Cambridge University Press, New York.

University of Newcastle

Borwein, J., van der Poorten, A., Shallit, J. and Zudilin, W. (2014). *Neverending Fractions: An Introduction to Continued Fractions* (Australian Mathematical Society Lecture Series **23**). Cambridge University Press.

University of New South Wales

Del Moral, P. and Vergé, C. (2014). *Modèles et Méthodes Stochastiques. Une Introduction avec Applications* (Math. Appl. **75**). Springer. http://link.springer.com/book/10.1007%2F978-3-642-54616-7 (online).

Conferences and Courses

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

Robust Statistics and Extremes

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

For more information, please see the website, or *Gazette* 41(3), pp. 199–200.

Number Theory Down Under

Date: 24–25 October 2014
Venue: The University of Newcastle
Web: http://carma.newcastle.edu.au/meetings/ntdu/

Phylomania 2014

Date: Wednesday 5 November to Friday 7 November 7 2014
Venue: University of Tasmania
Web: http://www.maths.utas.edu.au/phylomania/phylomania2014.htm

Phylogenetics is concerned with the problem of reconstructing the past evolutionary history of organisms from molecular data, such as DNA, or morphological characters. There is ongoing interest in the further development of the mathematics that underlies computational phylogenetic methods. Hidden from view, in the software packages used by biologists, are algorithms performing statistical inference using Markov models on binary trees. The mathematics involved represents a unique confluence of probability theory, discrete mathematics, statistical inference, algebraic geometry, and group theory. There are many important theoretical problems that arise, such as statistical identifiability of models, consistency and convergence of methods. These problems can only be solved using a multidisciplinary approach. Phylomania brings together phylogenetic researchers with a strong theoretical leaning, with the aim of discussing some of the more pressing problems.

Organisers: Barbara Holland, Jeremy Sumner.

Alexander Rubinov Memorial Lecture

Date: 6 November 2014
Venue: Federation University Australia
Web: http://federation.edu.au/faculties-and-schools/faculty-of-science-and-technology/school-of-engineering-and-information-technology/research/ciao/rubinov-lectures

Professor Rubinov (1940–2006) was the Founding Director of CIAO, the Centre for Informatics and Applied Optimization, at the (then named) University of Ballarat. Under his leadership, CIAO became an extremely successful centre of both national and international repute, recognised especially for its theoretical and applied research in the sophisticated sphere of global and non-smooth optimization.

Since 2008, the University has held an annual public lecture in his memory. This year it will be delivered by Professor Geoff Prince from AMSI.

Further information: email h.wade@federation.edu.au, phone (03) 5327 6314.

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

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

The Mathematical Sciences Institute will host a three-day workshop on more effective use of visualisation in mathematics, physics, and statistics, from the perspectives of education, research and outreach. This is the second EViMS meeting, following one held in Newcastle, Australia in November 2012. Our aim for the workshop is to help mathematical scientists understand the opportunities, risks and benefits of visualisation, in research and education, in a world where visual content and new methods are becoming ubiquitous.

Invited speakers include:

- Christoph Bandt (University of Greifswald, Germany)
- Jonathan Borwein (CARMA, University of Newcastle, Australia)
- Judy-anne Osborn (University of Newcastle, Australia)
- Elena Prieto (University of Newcastle, Australia)
- Andrei Tetenov (Gorno-Altaysk State University, Russia)
- Andrew Vince (University of Florida, USA)
- Elias Wegert (TU Bergakademie, Freiberg, Germany)

New Directions in Fractal Geometry workshop

Date: 24–28 November 2014
Venue: Australian National University, Kioloa Coastal Campus
Web: http://maths.anu.edu.au/events/new-directions-fractal-geometry

A collection of world experts in the field of fractal geometry to will come together to discuss some emerging hot topics. There will be plenty of opportunities for graduate students and young researchers to interact with more experienced people and learn about fruitful research areas:

- Geometry and topology of fractals
- Fractals in computation and numerical analysis
- Fractal transformations, tiling and numeration
- Fractal functions with emphasis on wavelets

There will be a focus on applications including:

- Antenna design
- Design of materials with specific properties
- Fractal scanners
- Image compression and recognition

Sequences and Their Applications (SETA) 2014

Date: 24–28 November 2014
Venue: University of Melbourne
Web: people.eng.unimelb.edu.au/udaya/seta14/

The international conference on Sequences and Their Applications (SETA) is a biannual conference series devoted to the mathematical theory of sequences used in wireless communications, cryptography and their applications. This is a premier conference for researchers working in mathematics, communication and computer science in the specific area of pseudorandom sequences. The conference provides a forum for the research communities of these domains, and covers all of the fundamental, computational and implementation aspects of these fields. The SETA proceedings will be published by Springer.

CTAC 2014

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

For more information, please see the website, or *Gazette* 41(3), p. 200.

BioInfoSummer 2014

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

For more information, please see the website, or *Gazette* 41(3), pp. 200–201.

Australasian Applied Statistics Conference

Date: 1–5 December 2014
Venue: Port Lincoln Hotel, Eyre Peninsula
Web: http://www.aasc.org.au/

This is an excellent opportunity to liaise with fellow statisticians within the agricultural, biological and environmental sciences and to keep abreast of the most recent developments in statistics within this context.

The theme of AASC '14 is 'Frontiers in Statistics and Biology — call for closer collaboration'. An exciting group of invited speakers will help explore this theme in various contexts. Plenary speakers are:

- Professo Peter Diggle (University of Lancaster)
- Professor Brian Cullis (University of Wollongong)
- Professor Roger Payne (VSN Inc)

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

Please make sure that you register during the earlybird registration period, which ends on Friday 24 October. All registration will close on Monday 10 November.

For more information, please see the website, or *Gazette* 41(3), p. 201.

International mathematical conference at the University of Goroka, PNG

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

For more information, please see the website, or *Gazette* 41(3), pp. 201–202.

Differential Geometry, Lie theory and Complex Analysis

Date: 5–7 December 2014
Venue: La Trobe University
Web: www.latrobe.edu.au/mathematics-and-statistics

This workshop is aimed at sharing ideas and discussion of recent results in differential geometry, Lie theory and complex analysis. The workshop will cover a wide area of pure mathematics, from Lie groups and algebras and their cohomology to the geometry of homogeneous spaces, to complex, Kähler and CR-geometry and to geometric methods in complex analysis of several variables. The main focus of the workshop is the study of objects with symmetry, which find applications in a wide range of areas, from geometry to complex analysis.

This workshop is planned to be a satellite workshop of the 8th AustMS/NZMS Convention and is planned to be held in the three days before the start of the Convention. The workshop will provide early career researchers and the students with a valuable forum to showcase and obtain feedback on their work from leading researchers in the field and gain insights into the open challenges.

8th Australia–New Zealand Mathematics Convention

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

For more information, please see the website, or *Gazette* 41(3), pp. 202–203.

Applied Statistics and Public Policy Analysis Conference

Date: 11–12 December 2014
Venue: Charles Sturt University
Web: www.csu.edu.au/faculty/business/comp-math/home

Applied statistics plays a vital role in the analysis and evaluation of public policies in various fields including social sciences, economics, health sciences, population studies etc. This workshop will promote research collaborations and exchange ideas between academics and researchers doing research in applied statistics and public policy and those doing research in computational statistics and data analysis methods, and establish connections between researchers at tertiary institutions and working in industry in Australasia.

2015 AMSI Summer School

Date: 5–29 January 2015
Venue: University of Newcastle
Web: http://www.amsi.org.au/ss

The AMSI Summer School is an exciting opportunity for mathematical sciences students from around Australia to come together over the summer break to develop their skills and networks.

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

The annual AMSI vacation schools and scholarships are funded jointly by the Department of Education and the Australian Mathematical Sciences Institute.

Mathematics in Industry Study Group (MISG) 2015

Date: 27–31 January 2015
Venue: Queensland University of Technology
Web: http://mathsinindustry.com/

Problems solved by one of the world's longest running mathematics think tanks, in a five-day intensive workshop. The MISG provides a structure for your business to access knowledge from over 100 world leading applied mathematicians, statisticians and physical scientists. MISG researchers can assist in the development of new technologies, add competitive value to existing technologies, provide the tools to analyse your current data, underpin service industries, and provide the expertise to monitor, predict and solve the quantitative technical challenges that face your business.

ANZIAM 2015

Date: 1–5 February 2015
Venue: Gold Coast
Web: http://anziam15.com/

Registration for the ANZIAM 2015 conference is now open. For a complete description of the conference dates, venue, invited speakers, registration details and the please see the conference website. There is an associated one-day workshop on mathematical biology on 6 February 2015 at QUT in Brisbane.

Algebraic, Number Theoretic and Graph Theoretic Aspects of Dynamical Systems

Date: 2–6 February 2015
Venue: University of New South Wales
Web: http://web.maths.unsw.edu.au/~jagr/ADS_NT_GT.html

Arithmetical dynamical systems, that is dynamical systems generated by iterations of rational functions over fields of number-theoretic interest, have seen a significant explosion of work in recent years but still many algebraic, number theoretic and graph theoretic problems remain wide open. The interest in such dynamical systems comes also from connections that have been forged with many different areas of pure and applied mathematics.

The purpose of this workshop will be to further explore the complex algebraic and number theoretic behaviour, as well as to gain a better understanding of the structure of functional graphs of arithmetical dynamical systems.

South Pacific Continuous Optimization Meeting (SPCOM) 2015

Date: 8–12 February 2015
Venue: University of South Australia
Web: carma.newcastle.edu.au/meetings/spcom/

List of plenary speakers:

- Heinz Bauschke
- Frédérick Bonnans
- Radu Boţ
- Vaithilingam Jeyakumar
- José Mario Martínez
- Helmut Maurer
- Boris Mordukhovich
- Jong Shi Pang

- Terry Rockafellar
- Claudia Sagastizábal
- Stephen Simons
- Xiao Qi Yang

Symmetries and Spinors: Interactions Between Geometry and Physics

Date: 13–17 April 2015
Venue: University of Adelaide, Conference Room 7.15
Web: www.iga.adelaide.edu.au/workshops/April2015/

The interplay between physics and geometry has lead to stunning advances and enriched the internal structure of each field. This is vividly exemplified in the theory of supergravity, which is a supersymmetric extension of Einstein's relativity theory to the small scales governed by the laws of quantum physics. Sophisticated mathematics is being employed for finding solutions to the generalised Einstein equations and in return, they provide a rich source for new exotic geometries. This workshop aims to bring together leading experts in this highly active research area and furnish a fertile ground for future collaborations and for making new discoveries.

ICIAM mini-symposium

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

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

Vale

Michael Deakin

With regret we inform members of the death on Tuesday 5 August of Michael Deakin of Monash University. A tribute to his work, particularly in education, appears at http://www.theage.com.au/national/education/the-wonderful-function-of-michael-deakin-20140825-3eabx.html.

Michael regularly attended ANZIAM conferences and always gave interesting talks on 'everyday' mathematical topics, right up until last year's conference in Newcastle where he spoke about 'The ellipsing pendulum'. The citation when Michael was presented with a BH Neumann award in 2003 can be found at http://www.amt.edu.au/bhndeakin.html.

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.

Dr Joel Andersson; Royal Institute Tech, Stockholm; 1–31 October 2014; pure; USN; Leo Tzou

Prof Pere Ara; Universitat Autònoma de Barcelona; 2–14 November 2014; noncommutative algebra; UWS; Roozbeh Hazrat

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

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

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

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

Prof Timofei Dokchitser; Bristol University; 1 October to 15 December 2014; MAGMA; USN; John Cannon

Dr Tom Fisher; Trinity College, Cambridge; 25 August to 1 October 2014; MAGMA; USN; John Cannon

Prof Luc Frappat; Laboratoire d'Annecy-le-Vieux de Physique Théorique; 24 October to 16 November 2014; pure; USN; Alexander Molev

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

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

Prof Terry Gannon; University of Alberta; 31 October to 10 November 2014; ANU; Scott Morrison

Moshe Haviv; The Hebrew University of Jerulsalem; 28 July to 2 September 2014; statistics; UOM; Peter Taylor

Prof Derek Holt; University of Warwick; 28 September to 5 December 2014; MAGMA; USN; John Cannon

Dr Xiuling Hu; Jiangsu Normal University China; September 2013 to October 2014; QUT

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

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

Yangjin Kim; 12 January to 26 February 2015; applied; USN; Peter Sehoon Kim

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

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

Prof Jun Ma; Macquarie University; 1 August to 30 September 2014; UNSW; Spiro Penev

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

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

Dr Pol Naranjo Barnet; Interdisciplinary Higher Education Centre (CFIS), Spain; 20 August to 11 November 2014; UMB; Lawrence Reeves

Prof Somyot Plubtieng; Naresuan University, Thailand; December 2014; optimisation; FedUni; Alex Kruger

Dr Anita Ponsaing; LPTHE - CNRS - University of Paris 6; 19 August to 9 September 2014; UMB; Jan de Gier

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

Dr Eric Ragoucy-Aubezon; Theoretical Physics Laboratory; 24 October to 3 December 2014; pure; USN; Alexander Molev

Dr Natalia Rozhkovskaya; 1–26 November 2014; pure; USN; Alexander Molev

Professor Matías Salibián-Berrera; The University of British Columbia; 7–28 September 2014; ANU; Alan Welsh

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

Dr Ed Smith; Imperial College London; mid-August to mid-October 2014; non-equilibrium molecular dynamics calculations; SUT

Prof Mihai Tibar; Lile University 1; 25 November to 12 December 2014; pure; USN; Laurentiu Paunescu

A/Prof Teruhisa Tsuda; Hitotsubashi University, Tokyo; 14 to 25 September 2014; applied; USN; Nalini Joshi

A/Prof Jerome Vetois; Univeristte de Nice; 14 October to 7 December 2014; pure; USN; Florica Cirstea

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

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

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

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

A/Prof Jingjing Wu; University of Calgary, Canada; 11 July to 14 September 2014; stats; USN; Samuel Mueller

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

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

Prof Konstantin Zarembo; Nordita Stockholm; 1 October to 12 November 2014; ANU; Vladimir Bazhanov

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

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

Special Interest Meetings

Applications for funding Special Interest Meetings are now considered twice a year, at the start of June and the start of December. The next two closing dates are 28 November 2014 and 5 June 2015.

If funding is being sought from both AustMS and AMSI, a single application should be made at http://www.amsi.org.au/component/content/article/881.

If funding is not being sought from AMSI, please use the application form available at http://www.austms.org.au/Special+Interest+Meetings and send it to the secretary at Secretary@austms.org.au.

Lift-off Fellowships

Members are reminded of the Society's Lift-off Fellowships which provide short-term support, including living expenses and travel grants, for students who have recently submitted for examination a PhD thesis in the mathematical sciences.

The fellowship rules, application form and details of past fellowship holders can be found at http://www.austms.org.au/Lift-Off+Fellowship+information.

Special General Meeting

The Society's Annual General Meeting will be held on Thursday 11 December at the University of Melbourne. Immediately preceding the Annual General Meeting will be a Special General Meeting to consider changes to the Society's constitution.

The Special Meeting is required because since 1991 the Society's constitution has not been consistent with the ACT Associations Incorporation Act 1991. In particular, the Act requires constitutional changes to be approved by a Special Resolution at a general meeting of the Society whereas the Society's constitution has also allowed such changes to be approved by a postal ballot of members. For this reason the ACT Office of Regulatory Services did not approve the constitutional changes agreed to by members in a postal ballot conducted on 2 September 2013. These changes will therefore be put to the Special Meeting, as will further changes to make the constitution consistent with the Act. It is also anticipated that Council will propose to the Special Meeting a change in the Society's financial year, to enable the annual conference to be held in December on a regular basis.

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

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

Membership and Correspondence

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

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: Professor John Loxton
University of Western Sydney, Penrith, NSW 2751, 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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