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The Australian Mathematical Society

Gazette

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The *Gazette* publishes items of the following types:

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

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Notes for contributors

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Deadlines for submissions to 41(1), 41(2) and 41(3) of the *Gazette* are 1 February, 1 April and 1 June 2014.

Volume 40 Number 5 2013

Editorial

David Yost and I began our joint editorship of the Gazette at the beginning of 2013. The mathematical focus in 2013 in Australia and internationally has been 'Mathematics of Planet Earth'. As observed by Professor Geoff Prince in his AMSI Director's report the MPE website has had 50,000 visitors from 150 countries and AMSI ran or sponsored 17 MPE scientific events with 200 international speakers.

Professor Nalini Joshi, Chair of the National Committee of Mathematical Sciences, addresses in this issue the London Mathematical Society report 'Advancing Women in Mathematics: Good Practice in UK University Departments'. In this context she asks departments to consider their hiring and recruitment strategies, professional development, work–life balance, governance, policies and grievances. Her report is a timely reminder that one must have a package of policies and procedures to address this issue appropriately.

It is reported in the AustMS News section that the Council received a request from the Women in Mathematics Special Interest Group to receive annual funding to establish Travel Grants for Women in Mathematics and Grants for Carers. It approved initial annual funding of $6400 for the first of these and $1600 for the second. The Special Interest Group also flagged a proposal to seek funding from the Society, AMSI and relevant universities to establish an annual Advocate for Women in Mathematics, to give talks and facilitate forums related to mathematics in three cities around Australia.

Professor Peter Forrester, President of the Australian Mathematical Society, referred to speeches by University of Sydney Vice Chancellor Michael Spence who made a call for the mathematics community to 'recapture the imagination of the people' and by Mary O'Kane, NSW Chief Scientist, who appealed for a broad-minded approach to our annual meeting, in which mathematics applied to engineering, computer science and technology would be represented in special sessions. It is an ongoing issue how to make the Australian Mathematical Society and its Annual Meetings more attractive to Australian mathematicians.

In the AustMS News it is reported that members at the Annual General Meeting supported moving the Society's Annual Meeting to early December from 2016 and seeking to increase the number of joint meetings (for example with ANZIAM, with the Combinatorial Mathematics Society of Australasia and with foreign mathematical societies). It was confirmed that the fifty-eighth Annual Meeting of the Society will be held at the University of Melbourne from Monday 8 December to Friday 12 December 2014, jointly with the New Zealand Mathematical Society as the 8th Australia-New Zealand Mathematics Convention.

We are delighted to note that Terry Speed has been honoured with Australia's highest award for excellence in science, the Prime Minister's prize for Science.

In this issue Peter Johnston presents data relating to students who completed Honours in Mathematics during 2012. The data are part of an ongoing project for the AustMS.

Angelo Di Pasquale, the Australian IMO Team Leader, reports in this issue on the 54th International Mathematical Olympiad held in Santa Marta, Colombia. Angelo observed that a total of 527 high school students from 97 countries participated. Each country sends a team of up to six students, a Team Leader and a Deputy Team Leader. The Australian team was outstanding. They finished equal 15th in the unofficial country rankings with one gold medal, two silver medals and three bronze medals. Of particular note was the performance of Alex Gunning, Year 10, Glen Waverley Secondary College, Victoria who received full marks on five of the six problems, and finished 8th in the individual rankings. Congratulations also to Australia's Deputy Team Leader, Ivan Guo. He was the proposer of what was selected as problem 2 on the IMO papers. It is a rare honour to have one of your problems selected.

Irina Dumitrescu and Olivia Smith report on the three-day conference 'Optimisation in Industry' which attracted people from around Australia and the world, from industry, academia, government and IBM to discuss the applications of mathematical optimisation techniques to industrial problems.

Phil Schultz has reviewed two books for us in this issue. They are *The Golden Ticket: P, NP, and the Search for the Impossible* by Lance Fortnow and *The Unravelers: Mathematical Snapshots*, edited by J.-F. Dars, A. Lesne and A. Papillaut. The mathematical contributors included Michael Atiyah, Jean-Pierre Bourgignon, Pierre Cartier, Yvonne Choquet-Bruhat, Alain Connes, Pierre Deligne, David Eisenbud, Mikhail Gromov, Victor Kac, Maxim Kontsevich, Bao Châo Ngô, Jacques Tits, and Minoru Wakimoto.

Finally, Ivan Guo has again prepared for us a diet of interesting, entertaining and challenging problems in the Puzzle Corner.

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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*

As I write, it is day 2 of the 57th annual meeting of AustMS, hosted by the University of Sydney.

In the opening addresses by the University of Sydney Vice Chancellor Professor Michael Spence, and New South Wales Chief Scientist and Engineer Professor Mary O'Kane, there was both some championing of our cause, and the issuing of some challenges. Thus it was pleasing to have highlighted the worrying trend of opting out of mathematics at high school and its obvious conflict with the push for STEM (Science, Technology, Engineering and Mathematics) literacy as a core outcome in general schooling.

As a challenge, Vice Chancellor Spence made a call for the mathematics community to 'recapture the imagination of the people', while Chief Scientist and Engineer O'Kane appealed for a broad-minded approach to our annual meeting, in which mathematics applied to engineering, computer science and technology would be represented in special sessions.

Indeed, ways to meet these challenges are being implemented by AustMS and our partners at AMSI. Programs are in place to bring out to Australia special international lecturers (Stephen Boyd, Akshay Venkatesh, Claus Ringel and Sommer Gentry are current examples); modern media is used to publicise local achievements (e.g. the YouTube interview of the most recent AustMS medal recipient, Craig Westerland); there are special sessions at the annual meeting on Maths of Planet Earth following the success of the mid-year conference on that theme, which in turn brought together many mathematical scientists from outside of academia. New ideas are being mooted. Council member Kate Smith-Miles suggested holding a combined AustMS/ANZIAM meeting as a way to further facilitate a broad outlook, and AMSI director Geoff Prince is seeking ways to have publicised the tribute paid by 2012 AustMS medallist Stephen Keith in his lecture on day 1 of the annual meeting to his school maths teacher for his mathematical achievements.

In the lead-up to the annual meeting, Council meets to discuss various planning and policy issues. Undoubtedly the most robust debate centred around the request from the ANZAMP (Mathematical Physics) Special Interest Group to become a Division of the Society. In 2011 ANZAMP's status as a Special Interest Group was approved by Council, after requesting the immediate status of a Division. Presently the only Division of AustMS is ANZIAM, which has around 220 members. Much of the debate centred around the meaning of a Division in terms of representing numbers of the AustMS membership, and in the end Council decided that a

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threshold of around 80 Ordinary Members would be required. Earlier, I had read out my President's report. I noted that in my President's column, published in the *Gazette* in July, I highlighted that many future challenges of our discipline require a unified, collective response, and that much effort had been made within AustMS over many years to unite different interest groups and to represent our membership base in a fair, nonpartisan way. I commented that by its very name, a Division is not speaking on behalf of the unified body, and so I am not at all in favour of supporting any moves for a new Division within AustMS.

The lead-up to the annual meeting saw two other notable events. One was the Early Career Workshop, held in the Blue Mountains, and the other was the Women in Mathematics dinner. Apart from some stress caused by unpredictable public transport troubles, I heard nothing but rave reviews of the Early Career Workshop, both from the viewpoint of the participants, and presenters. From this coming February in Rotorua, the workshop will alternate between the AustMS and ANZIAM meeting, with two workshops being held in even years, and a short workshop not requiring overnight accommodation in odd years. I got to attend the Women in Mathematics dinner, an initiative of former AustMS President Nalini Joshi. I was quite blown away by the amount of energy that is being harnessed in a positive and inclusive manner, and found the Q&A session with Natashia Boland and Sommer Gentry inspiring for all.

Next year will see the ICM in South Korea. For a number of years it was AustMS policy to make a bid for the 2018 ICM. However, after some preliminary investigations it became apparent that this intention was premature, and that a longer time frame for preparation would be required. AustMS together with AMSI have set aside funds to support up to three early career researchers to attend the 2014 ICM, and who furthermore harbour the desire to work towards a future Australian bid. One hurdle to be overcome is the disappointment caused by the release of the speakers for the 2014 ICM — there is not a single Australian among them, notwithstanding IMU guidelines that require the Program Committee to take into account geographical/regional distribution.

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

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

The deadline for submission of solutions for Puzzle Corner 35 is 1 February 2014. The solutions to Puzzle Corner 35 will appear in Puzzle Corner 37 in the May 2014 issue of the *Gazette*.

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

Row of reciprocals

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

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

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

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This puzzle corner is also featured on the Mathematics of Planet Earth Australia website http://mathsofplanetearth.org.au/

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

Pebble placement

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

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

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

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

Flawless harmony

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

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

Balancing act

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

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

Solutions to Puzzle Corner 33

Many thanks to everyone who submitted. The $50 book voucher for the best submission to Puzzle Corner 33 is awarded to Joe Kupka. Congratulations!

Same sum

Let S be a set of 10 distinct positive integers no more than 100. Prove that S contains two disjoint non-empty subsets which have the same sum.

Solution by Shaun De Roza: First we note that S has $2^{10} - 2 = 1022$ different subsets, excluding the empty set and S itself. Since each number is no more than 100, any subset of S has a sum of no more than 1000. So we have 1022 possible subsets with less than 1000 possible sums. Thus by the pigeonhole principle, two different subsets must have the same sum.

Finally, if the two sum-sharing subsets have common elements, we can simply remove these to form two distinct subsets with the same sum, as required.

Knights and knaves

In the following problems, knights *always tell the truth and* knaves *always lie.*

(i) *There is a queue of people, each of whom is either a knight or a knave. It is known that there are more knights than knaves. Apart from the first person, every person points to someone in front of them in the queue and declares the status of that person (being a knight or a knave). Is it possible for a bystander to determine the actual status of everyone in the queue?*

(ii) *There is a group of people, each of whom is either a knight or a knave. Each person makes the following two statements: 'All my acquaintances know each other', and 'Among my acquaintances, the number of knights is no more than the number of knaves.' We assume that knowing is mutual. Prove that the number of knaves in the group is no more than the number of knights.*

Solution by Joe Kupka: (i) Suppose a person X declares the status of the person Y. If the declaration is 'knight', then X and Y must have the same status. If the declaration is 'knave', then X and Y must have opposite status. Either way, the status of X is determined by the status of Y.

Now for any person X_1, there exist a unique sequence of people

$$X_1 \to X_2 \to X_3 \to \cdots \to F$$

such that each person declares the status of the next. Here F represents the person at the front of the queue, who is the only one not making any declarations. From the earlier arguments, we see that the status of X_1 is determined by the status of X_2, which is determined by the status of X_3 and so on. Hence the status of X_1 is uniquely determined by the status of F. Since the choice of X_1 was arbitrary, we see that everyone's status is determined by F.

So there are two opposite possibilities, depending on the status of F. We must either have a knights and b knaves, or b knights and a knaves, for some a and b which depend on the declarations. But since there are more knights than knaves, the larger of a and b must correspond to the number of knights, eliminating one of the possibilities. Therefore everyone's status can be uniquely determined.

(ii) From the first statement, we can conclude that:

(A) If a knight knows two people, then those two people also know each other.

So amongst the knights, 'knowing' is an equivalence relation. Thus we can partition the knights into knight groups $C_1, C_2, \ldots, C_k$, so that each knight knows everyone in his own knight group, but no-one from the other knight groups.

For each $i = 1, \ldots, k$, define the knave group D_i to be the set of knaves who knows at least one knight from C_i. Again by (A), everyone in $C_i \cup D_i$ must know each other. From the second statement, we can conclude that:

(B) Each knave knows strictly more knights than knaves.

In particular, each knave must know at least one knight and thus belongs to some knave group D_i. Although a knave may belong to multiple knave groups.

Now let m be the largest integer between 0 and k such that

$$\left|\bigcup_{i=1}^{m} C_i\right| \geq \left|\bigcup_{i=1}^{m} D_i\right|. \tag{1}$$

Note that if $m = 0$, then $\bigcup_{i=1}^{m} C_i$ and $\bigcup_{i=1}^{m} D_i$ are empty sets. If $\bigcup_{i=1}^{m} D_i$ contains all the knaves, then (1) implies that the number of knights is greater than or equal to the number of knaves and we are done.

For the sake of contradiction, suppose there exists a knave V who does not belong to $\bigcup_{i=1}^{m} D_i$. We may relabel the knave groups so that V belongs to say, the knave groups $D_{m+1}, \ldots, D_n$. In particular, this means that the set of knights V knows is given exactly by $\bigcup_{i=m+1}^{n} C_i$, while the set of knaves V knows contains $\bigcup_{i=m+1}^{n} D_i \setminus \{V\}$. Applying (B), we must have

$$\left|\bigcup_{i=m+1}^{n} C_i\right| \geq \left|\bigcup_{i=m+1}^{n} D_i\right|. \tag{2}$$

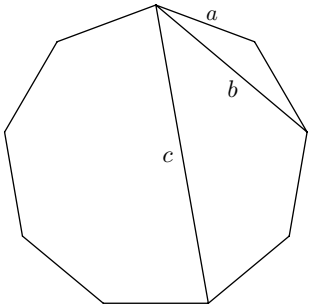
Finally, combining (1) and (2), as well as using the fact that the knights groups C_i are pairwise disjoint, we have

$$\left|\bigcup_{i=1}^{n} C_i\right| = \left|\bigcup_{i=1}^{m} C_i\right| + \left|\bigcup_{i=m+1}^{n} C_i\right| \geq \left|\bigcup_{i=1}^{m} D_i\right| + \left|\bigcup_{i=m+1}^{n} D_i\right| \geq \left|\bigcup_{i=1}^{n} D_i\right|.$$

Since $n > m$, this contradicts the maximality of m. Therefore $\bigcup_{i=1}^{m} D_i$ must contain all the knaves in the first place, completing the proof.

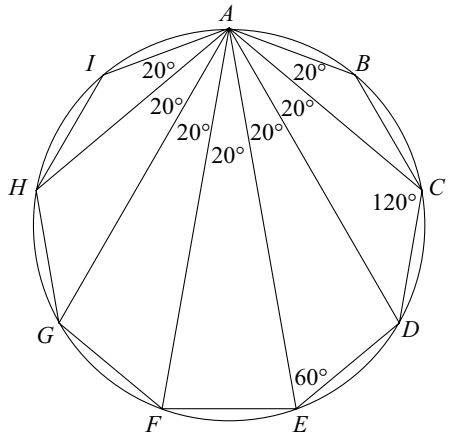
Diagonal difference

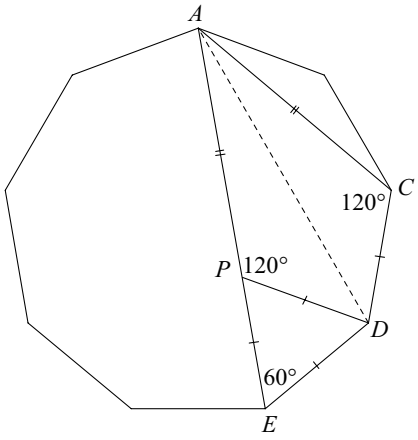
In a regular nonagon, prove that the length difference between the longest diagonal and the shortest diagonal is equal to the side length. In other words, prove $c-b=a$ in the diagram below.



Solution by Dave Johnson: Label the vertices of the regular nonagon clockwise from A to I as shown in the diagrams to follow. It is well known that each angle of a regular nonagon is 140°. By inscribing it in a circle, we see that the sides BC, CD, DE, EF, FG, GH and HI all subtend equal angles at A. So these angles must all be $140°/7 = 20°$. By looking at the isosceles triangles ABC and AEF, we can easily deduce that

$$\angle ACD = 140° - 20° = 120° \quad \text{and} \quad \angle AED = 140° - \frac{180° - 20°}{2} = 60°.$$





Now reflect the triangle ACD about the line AD to obtain the triangle APD. Since $\angle PAD = \angle CAD = \angle EAD = 20°$, the point P must lie on AE. Furthermore, since $\angle EPD = 180° - 120° = 60° = \angle DEP$, triangle CPD must be equilateral. Therefore, the required diagonal difference is given by

$$AE - AC = AE - AP = PE = DE,$$

which is indeed the side length of the nonagon.

Scissors and shapes 2

Edward is playing with scissors again. At each move, he chooses a polygon in front of him, and cuts it into two polygons with a single straight cut. Starting with a single rectangle, determine the minimal number of cuts required to obtain, among other shapes, at least 106 polygons with exactly 22 sides.

Solution: For a polygon with s sides, let us define its *score* by $s-3$. In particular, any triangle has a score of zero while other polygons have positive scores. If there are P polygons with a total of S sides, the *total score* is given by $S-3P$.

Now consider how a straight cut can affect the total score.

- If the cut joins two vertices, then S increases by 2, P increases by 1 and the score decreases by 1.
- If the cut joins one vertex and one edge, then S increases by 3, P increases by 1 and the score stays the same.
- If the cut joins two edges, then S increases by 4, P increases by 1 and the score increases by 1.

The initial state of a single rectangle has a total score of 1. The final state, which contains 106 polygons with 22 sides as well as other polygons, must have a score of at least

$$106 \times (22-3) = 2014.$$

Since the total score increases by at most 1 each cut, we need at least 2013 cuts.

Finally, we show that 2013 cuts are sufficient. The first 22-gon can be made from the starting rectangle using 18 cuts. The other 22-gons can be made from triangles, each requiring 19 cuts. In total, $18+105\times 19 = 2013$ cuts are used. Therefore the answer is indeed 2013.

Perfect recovery

There are n distinct non-negative integers written on the board. Jack memorises these numbers before erasing them and replacing them with the $\binom{n}{2}$ pairwise sums. Now Jill enters the room and studies the sums on the board. Find all positive integers n for which it is possible for Jill to recover the original n integers uniquely.

Solution: Denote the initial set of n distinct non-negative integers by $A = \{a_1, a_2, \ldots, a_n\}$. Suppose that there exists a different set of n distinct non-negative integers $B = \{b_1, b_2, \ldots, b_n\}$ such that the $\binom{n}{2}$ pairwise sums of B are identical to the pairwise sums of A. We shall prove that this is only possible if n is a power of 2.

Define the polynomials

$$P(x) = x^{a_1} + x^{a_2} + \cdots + x^{a_n} \quad \text{and} \quad Q(x) = x^{b_1} + x^{b_2} + \cdots + x^{b_n}.$$

Note the identity

$$P(x)^2 = \sum_{i=1}^{n} x^{2a_i} + 2\sum_{i<j} x^{a_i+a_j} = P(x^2) + 2\sum_{i<j} x^{a_i+a_j}.$$

From the earlier condition on A and B, we have the following equality

$$P(x)^2 - P(x^2) = 2\sum_{i<j} x^{a_i+a_j} = 2\sum_{i<j} x^{b_i+b_j} = Q(x)^2 - Q(x^2).$$

Hence the polynomial $P(x)^2 - Q(x)^2 - P(x^2) + Q(x^2)$ is identically zero.

But since A and B are different sets, the polynomial $P(x) - Q(x)$ is not identically zero. Also since $P(1) - Q(1) = n - n = 0$, we see that $x - 1$ is a factor of $P(x) - Q(x)$. This motivates writing $P(x) - Q(x)$ in the form of

$$P(x) - Q(x) = (x-1)^k R(x),$$

where $k \geq 1$ and $R(1) \neq 0$. Applying this to the polynomial $P(x)^2 - Q(x)^2 - P(x^2) + Q(x^2)$, we have

$$\begin{aligned} &P(x)^2 - Q(x)^2 - P(x^2) + Q(x^2) \\ &\quad = (P(x) + Q(x))(x-1)^k R(x) - (x^2-1)^k R(x^2) \\ &\quad = (x-1)^k((P(x) + Q(x))R(x) - (x+1)^k R(x^2)). \end{aligned}$$

Hence $(P(x) + Q(x))R(x) - (x+1)^k R(x^2)$ is also identically zero. But if we substitute $x = 1$ and use the fact that $R(1) \neq 0$, it implies

$$2nR(1) - 2^k R(1) = 0 \quad \Longrightarrow \quad n = 2^{k-1}.$$

Therefore n must be a power of 2.

It remains to construct examples of A and B with identical pairwise sums in the case of $n = 2^m$. Consider the set of numbers $S = \{0, 1, \ldots, 2^{m+1} - 1\}$ in binary. We may partition S into two sets of size 2^m according to the parity of digit sums. Let the set with even digit sums be A and the set with odd digit sums be B. For example, when $n = 2^3$, we have

$$\begin{aligned} A &= \{0000,\ 0011,\ 0101,\ 0110,\ 1001,\ 1010,\ 1100,\ 1111\}, \\ B &= \{0001,\ 0010,\ 0100,\ 0111,\ 1000,\ 1011,\ 1101,\ 1110\}. \end{aligned}$$

Now for any two elements $x, y \in A$ (with even digit sums), consider the right-most digit which have different values in x and y. Swapping that digit between x and y while preserving the other digits, we arrive at two new numbers w and z which belong to B (with odd digit sums). For example, comparing the elements $x = 0011$ and $y = 1001$ from A, the right-most digit with different values is the third digit. Swapping the third digit, we arrive at $w = 0001$ and $z = 1011$ which are elements of B. Furthermore we must have that $x + y = w + z$.

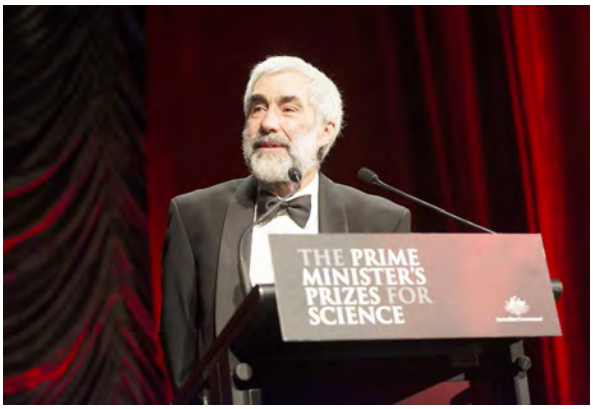
It is clear the map $(x, y) \to (w, z)$ is a bijection which preserves $x + y = w + z$. Therefore A and B, as constructed, must have identical pairwise sums. It is not possible to uniquely recover either from the pairwise sums.

In conclusion, it is always possible to recover the original set from the pairwise sums if and only if n is not a power of 2.

Ivan is a PhD student in the School of Mathematics and Statistics at The University of Sydney. His current research involves a mixture of multi-person game theory and option pricing. Ivan spends much of his spare time playing with puzzles of all flavours, as well as Olympiad Mathematics.

Professor Terry Speed
Prime Minister's Prize for Science

Terry Speed from the Walter and Eliza Hall Institute for Medical Research has been honoured again. After being elected as a Fellow of the Royal Society in May this year, as reported for example in the *Gazette* 40(3), p. 172, he has now received the $300 000 Prime Minister's Prize for Science, for a life's work using mathematics and statistics to address real world issues.



Prime Minister's Prizes for Science

The Prime Minister's Prizes for Science were presented by the Prime Minister assisted by the Hon Bob Baldwin, Parliamentary Secretary to the Minister for Industry, at the Prize Dinner in the Great Hall of Parliament House on Wednesday 30 October.

For some years now, Terry has been well known for the application of statistics to problems in genetics and molecular biology. The increasingly vast amount of data in these areas has required new methods of analysis, leading to the birth of the field of BioInformatics, and contributing to a revolution in medical research.

His previous honours include

- 2012 Victoria Prize for Science and Innovation
- 2010 appointment as Emeritus Professor, University of California, Berkeley
- 2003 Australian Government Centenary Award Medal
- 2003 Moyal Medal, Macquarie University
- 2002 Pitman Medal, Statistical Society of Australia
- 2001 Fellow, Australian Academy of Science
- 1990 Fellow, American Association for the Advancement of Science
- 1989 Fellow, American Statistical Association

For the full citation, see http://www.scienceinpublic.com.au/prime-ministers-prize/2013-science#more-16229.

The 54th International Mathematical Olympiad, Santa Marta, Colombia

Angelo Di Pasquale*

The 54th International Mathematical Olympiad (IMO) was held 18–28 July in Santa Marta, Colombia. This is the second country in South America to have hosted an IMO.[1] A total of 527 high school students from 97 countries participated.

Each country sends a team of up to six students, a Team Leader and a Deputy Team Leader. At the IMO the Team Leaders, as an international collective, form what is called the *Jury*. This Jury was chaired by Maria Falk de Losada.[2]

The first major task facing the Jury is to set the two competition papers. During this period the Leaders and their observers are trusted to keep all information about the contest problems completely confidential. The local Problem Selection Committee had already shortlisted 27 problems from 149 problem proposals submitted by 50 of the participating countries from around the world. During the Jury meetings, four of the shorlisted problems had to be discarded from consideration due to being too similar to material already in the public domain. A proposal by UK Leader Geoff Smith, was tried this year. The proposal stipulated that all four major areas of algebra, combinatorics, geometry and number theory be represented among the two easy and two medium problems. The idea being that since the two difficult problems are usually quite inaccessible to most contestants, then at least the four more accessible problems would provide a balanced contest. In hindsight this worked quite well, and may well be tried again next year. Eventually, the Jury finalised the exam questions and then made translations into all the more than 50 languages required by the contestants.

The six questions are described as follows.

1. An easy but novel number theory problem proposed by Japan.
2. A medium combinatorial geometry problem proposed by Australia. This problem requires no technical background whatsoever, only a couple of simple original ideas.

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This article will also be published in Mathematical Contests 2013, The Australian Scene (to appear in 2014) and World Federation of National Mathematics Contests (about to appear).

[1] Argentina hosted the IMO in 1997 and in 2012.

[2] It is noteworthy that three generations of a single family were involved in the successful running of this year's IMO. As mentioned Maria Falk de Losada, amongst other things, chaired the Jury meetings. Her daughter, Maria Elizabeth Losada, played key roles on the Organising Committee. And Maria Elizabeth's 12-year-old daughter, Isabella Mijares, helped out by being a microphone runner for some of the Jury meetings.

3. A difficult classical geometry problem proposed by Russia.
4. A very easy classical geometry problem proposed by South Africa.
5. A medium functional inequality proposed by Bulgaria. One is required to investigate a function that is simultaneously super-additive and sub-multiplicative.
6. This very difficult but most beautiful combinatorial number theory problem was proposed by Russia. It asked one to count the number of permutations of the remainders modulo n in a circle which satisfy a certain arithmetical property. The various solutions to this problem basically amount to a short professional mathematical paper.

These six questions were posed in two exam papers held on Tuesday 23 July and Wednesday 24 July. Each paper had three problems. The contestants worked individually. They were allowed $4\frac{1}{2}$ hours per paper to write their attempted proofs. Each problem was scored out of a maximum of seven points.

For many years now there has been an Opening Ceremony prior to the first day of competition. Following the formal speeches there was the parade of the Teams, flanked by Colombian dancers. At the conclusion of the Opening Ceremony the 2013 IMO was declared open.

After the exams the Leaders and their Deputies spent about two days assessing the work of the students from their own countries, guided by marking schemes that had been agreed to earlier. A local team of markers called *Coordinators* also assessed the papers. They too were guided by the marking schemes but are allowed some flexibility if, for example, a Leader brings something to their attention in a contestant's exam script which is not covered by the marking scheme. The Team Leader and Coordinators have to agree on scores for each student of the Leader's country in order to finalise scores.

Question 4 turned out to be very easy as expected. It averaged 5.4 points. Being hard to train for, question 2 mixed things up somewhat. No country achieved a team perfect score for this question. Yet for some students, this was the only question they could solve. As expected, question 6 was very difficult, averaging just 0.3 points. Only seven students scored full marks on this question.

There were 278 (=52.8%) medals awarded, a little more generous than usual. The distributions[3] being 141 (=26.8%) Bronze, 92 (=17.5%) Silver and 45 (=8.5%) Gold. No student achieved the perfect score of 42. However, two students, Yutao Liu of China and Eunsoo Jee of South Korea jointly topped the IMO with outstanding scores of 41 points each. The medal cuts were set at 31 for Gold, 24 for Silver and 15 for Bronze. These awards were presented at the Closing Ceremony. Of

[3]The total number of medals must be approved by the Jury and should not normally exceed half the total number of contestants. The numbers of gold, silver and bronze medals must be approximately in the ratio 1:2:3.

those who did not get a medal, a further 141 contestants received an Honourable Mention for solving at least one question perfectly.[4]

Congratulations to the Australian IMO team on their outstanding performance this year. They finished equal 15th in the unofficial country rankings with a clean sweep of medals. Their solid performance gained one gold medal, two silver medals and three bronze medals. Of particular note is the performance of Alex Gunning, Year 10, Glen Waverley Secondary College, Victoria. He received full marks on five of the six problems, and finished 8th in the individual rankings. To put this achievement in perspective, only five other Australians have ever finished in the top 10 at the IMO.[5] Furthermore, he was one of only seven contestants who achieved a perfect score on the most difficult problem 6. With two members of this year's Team eligible for selection for the 2014 IMO Team, things are looking good.

Congratulations also to Australia's Deputy Leader, Ivan Guo. He was the proposer of what was eventually selected as problem 2 on the IMO papers. It is a rare honour to have one of your problem proposals make it onto the IMO. Australia has had a very good run in recent years, now having had three problems on the IMO in the last five years.

The 2013 IMO was organised by the Colombian Mathematics Olympiad, along with the generous support of the University Antonio Nariño.

Venues for future IMOs have been secured up to 2018 as follows: 2015, Thailand; 2016, Hong Kong; 2017, Brazil; 2018, Romania.

The 2014 IMO is scheduled to be held July 3-13 in Cape Town, South Africa.

Much of the statistical information found in this report can also be found at the official website of the IMO (www.imo-official.org).

IMO Papers

Day 1, Tuesday 23 July 2013

Problem 1. Prove that for any pair of positive integers k and n, there exist k positive integers $m_1, m_2, \ldots, m_k$ (not necessarily different) such that

$$1 + \frac{2^k - 1}{n} = \left(1 + \frac{1}{m_1}\right)\left(1 + \frac{1}{m_2}\right) \cdots \left(1 + \frac{1}{m_k}\right).$$

Problem 2. A configuration of 4027 points in the plane is called *Colombian* if it consists of 2013 red points and 2014 blue points, and no three of the points of the configuration are collinear. By drawing some lines, the plane is divided into

[4]Fourteen contestants managed the feat of what might be called a 'double honourable mention'. They did not get a medal, but solved two questions perfectly, with no marks on any other question.

[5]These are: Andrew Hassell (7th in 1985), Ben Burton (8th in 1992), Geoffrey Chu (4th in 1999), Peter McNamara (10th in 2001) and Andrew Elvey Price (10th in 2009).

several regions. An arrangement of lines is *good* for a Colombian configuration if the following two conditions are satisfied:

- no line passes through any point of the configuration;
- no region contains points of both colours.

Find the least value of k such that for any Colombian configuration of 4027 points, there is a good arrangement of k lines.

Problem 3. Let the excircle of triangle ABC opposite the vertex A be tangent to the side BC at the point A_1. Define the points B_1 on CA and C_1 on AB analogously, using the excircles opposite B and C, respectively. Suppose that the circumcentre of triangle $A_1B_1C_1$ lies on the circumcircle of triangle ABC. Prove that triangle ABC is right-angled. *(The* excircle *of triangle ABC opposite the vertex A is the circle that is tangent to the line segment BC, to the ray AB beyond B, and to the ray AC beyond C. The excircles opposite B and C are similarly defined.)*

Language: English *Time: 4 hours and 30 minutes*
Each problem is worth 7 points

Day 2, Wednesday 14 July 2013

Problem 4. Let ABC be an acute-angled triangle with orthocentre H, and let W be a point on the side BC, lying strictly between B and C. The points M and N are the feet of the altitudes from B and C, respectively. Denote by ω_1 the circumcircle of BWN, and let X be the point on ω_1 such that WX is a diameter of ω_1. Analogously, denote by ω_2 the circumcircle of CWM, and let Y be the point on ω_2 such that WY is a diameter of ω_2. Prove that X, Y and H are collinear.

Problem 5. Let $\mathbb{Q}_{>0}$ be the set of positive rational numbers. Let $f\colon \mathbb{Q}_{>0} \to \mathbb{R}$ be a function satisfying the following three conditions:

(i) for all $x, y \in \mathbb{Q}_{>0}$, we have $f(x)f(y) \geq f(xy)$;

(ii) for all $x, y \in \mathbb{Q}_{>0}$, we have $f(x + y) \geq f(x) + f(y)$;

(iii) there exists a rational number $a > 1$ such that $f(a) = a$.

Prove that $f(x) = x$ for all $x \in \mathbb{Q}_{>0}$.

Problem 6. Let $n \geq 3$ be an integer, and consider a circle with $n + 1$ equally spaced points marked on it. Consider all labellings of these points with the numbers $0, 1, \ldots, n$ such that each label is used exactly once; two such labellings are considered to be the same if one can be obtained from the other by a rotation of the circle. A labelling is called *beautiful* if, for any four labels $a < b < c < d$ with $a + d = b + c$, the chord joining the points labelled a and d does not intersect the chord joining the points labelled b and c. Let M be the number of beautiful labellings, and let N be the number of ordered pairs (x, y) of positive integers such that $x + y \leq n$ and $\gcd(x, y) = 1$. Prove that

$$M = N + 1.$$

Language: English *Time: 4 hours and 30 minutes*
Each problem is worth 7 points

Results

Mark distribution by question

Mark	Q1	Q2	Q3	Q4	Q5	Q6
0	118	229	438	82	235	481
1	96	32	10	16	84	15
2	9	65	15	14	33	6
3	6	33	16	14	11	6
4	14	22	0	2	0	2
5	3	12	3	5	10	6
6	5	16	4	9	19	4
7	276	118	41	385	135	7
Total	527	527	527	527	527	527
Mean	4.1	2.5	0.8	5.4	2.5	0.3

Some country scores

Rank	Country	Score
1	China	208
2	South Korea	204
3	USA	190
4	Russia	187
5	North Korea	184
6	Singapore	182
7	Vietnam	180
8	Taiwan	176
9	UK	171
10	Iran	168
11	Canada	163
11	Japan	163
13	Israel	161
13	Thailand	161
15	Australia	148

Rank	Country	Score
16	Ukraine	146
17	Mexico	139
17	Turkey	139
19	Indonesia	138
20	Italy	137
21	France	136
22	Belarus	134
22	Hungary	134
22	Romania	134
25	Netherlands	133
26	Peru	132
27	Germany	127
28	Brazil	124
29	India	122
30	Croatia	119

Australian scores at the 2013 IMO

Name	Q1	Q2	Q3	Q4	Q5	Q6	Score	Award
Alexander Chua	7	3	0	7	1	0	18	Bronze
Alex Gunning	7	7	2	7	7	7	37	Gold
Jason Kwong	7	7	0	7	7	0	28	Silver
Seyoon Ragavan	7	7	0	7	1	0	22	Bronze
Rachel Wong	7	1	0	7	3	0	18	Bronze
Jonathan Zheng	7	3	1	7	7	0	25	Silver
Totals	42	28	3	42	26	7	148	
Australian Average	7.0	4.7	0.5	7.0	4.3	1.2	24.7	
IMO Average	4.1	2.5	0.8	5.4	2.5	0.3	15.6	

The medal cuts were set at 31 for gold, 24 for silver and 15 for bronze.

Distribution of awards at the 2013 IMO

Country	Total	Gold	Silver	Bronze	H.M.
Argentina	46	0	0	1	1
Armenia	88	0	1	1	4
Australia	148	1	2	3	0
Austria	77	0	1	1	2
Azerbaijan	73	0	0	2	3
Bangladesh	60	0	0	3	1
Belarus	134	1	2	3	0
Belgium	82	0	1	2	2
Bolivia	5	0	0	0	0
Bosnia & Herzegovina	56	0	0	1	4
Brazil	124	0	3	1	2
Bulgaria	101	0	1	2	3
Canada	163	2	2	2	0
Chile	35	0	0	1	2
China	208	5	1	0	0
Colombia	77	0	0	2	2
Costa Rica	59	0	0	1	5
Croatia	119	2	0	2	2
Cuba	11	0	0	0	1
Cyprus	52	0	0	1	3
Czech Republic	108	1	0	3	2
Denmark	31	0	0	0	3
Ecuador	45	0	0	1	2
El Salvador	14	0	0	0	2
Estonia	67	0	0	2	3
Finland	46	0	1	0	0
France	136	0	2	4	0
Georgia	75	0	0	2	4
Germany	127	0	2	4	0
Greece	101	0	2	1	3

Distribution of awards at the 2013 IMO (continued)

Country	Total	Gold	Silver	Bronze	H.M.
Honduras	0	0	0	0	0
Hong Kong	117	0	1	5	0
Hungary	134	0	2	4	0
Iceland	27	0	0	0	2
India	122	0	2	3	0
Indonesia	138	1	1	4	0
Iran	168	2	3	1	0
Ireland	33	0	0	0	4
Israel	161	1	3	2	0
Italy	137	1	2	1	2
Japan	163	0	6	0	0
Kazakhstan	116	0	1	4	1
Kosovo	25	0	0	0	3
Kyrgyzstan	36	0	0	1	2
Latvia	47	0	0	1	3
Liechtenstein	15	0	0	1	0
Lithuania	78	0	0	3	3
Luxembourg	25	0	0	1	0
Macedonia (FYR)	34	0	0	1	1
Malaysia	117	0	2	3	0
Mexico	139	0	3	3	0
Moldova	71	0	0	2	4
Mongolia	84	0	0	3	3
Montenegro	1	0	0	0	0
Morocco	17	0	0	0	1
Netherlands	133	0	2	3	1
New Zealand	77	0	0	2	3
Nicaragua	22	0	0	0	3
Nigeria	18	0	0	1	0
North Korea	184	2	4	0	0
Norway	36	0	0	1	1
Pakistan	25	0	0	0	3
Panama	19	0	0	0	2
Paraguay	38	0	0	2	1
Peru	132	0	3	2	1
Philippines	72	0	0	3	2
Poland	79	0	1	1	3
Portugal	111	1	0	4	1
Puerto Rico	14	0	0	0	1
Romania	134	0	3	3	0
Russia	187	4	2	0	0
Saudi Arabia	84	0	0	4	0
Serbia	112	1	1	2	2
Singapore	182	1	5	0	0
Slovakia	112	0	1	3	2
Slovenia	34	0	0	0	4

Distribution of awards at the 2013 IMO (continued)

Country	Total	Gold	Silver	Bronze	H.M.
South Africa	64	0	0	2	3
South Korea	204	5	1	0	0
Spain	63	0	0	2	3
Sri Lanka	65	0	0	1	4
Sweden	62	0	1	1	2
Switzerland	88	0	0	3	2
Syria	14	0	0	0	1
Taiwan	176	2	4	0	0
Tajikistan	65	0	0	1	4
Thailand	161	1	4	1	0
Trinidad & Tobago	16	0	0	0	1
Tunisia	49	0	0	1	3
Turkey	139	1	2	3	0
Turkmenistan	78	0	0	4	1
Uganda	1	0	0	0	0
Ukraine	146	1	3	1	1
United Kingdom	171	2	3	1	0
United States of America	190	4	2	0	0
Uruguay	7	0	0	0	0
Venezuela	9	0	0	0	1
Vietnam	180	3	3	0	0
Total (97 teams, 527 contestants)		**45**	**92**	**141**	**141**

NB: Not all countries sent a full team of six students.

Higher Degrees and Honours Bachelor Degrees in mathematics and statistics completed in Australia in 2012

Peter Johnston*

This report presents data relating to students who completed Honours or Higher Degrees in mathematics during 2012. The data are part of an ongoing project for the Australian Mathematical Society and should be read in conjunction with previous reports [1]–[13] covering the period 1993–2011.

This year represents the second occasion that data has been reported for two year coursework masters degrees with classifications (similar to existing Honours degrees). The University of Melbourne is the only university to offer such degrees in place of the traditional Honours degree, although some other universities are expected to follow this model. In the discussions that follow, these data have been merged together and will be referred to simply as 'Honours', although the completions for the two degrees are presented in separate tables. As time goes on, and more universities offer coursework masters degrees of this type, the two data sets will be differentiated and displayed as separated entities (backdated to 2010).

Appendix 1 presents data for students completing Honours degrees in 2012, at all Universities in Australia. Within each institution, the data are broken down into male and female students and into the three traditional areas of Mathematics: Pure; Applied and Statistics. There is also the general category 'Mathematics' for institutions that do not differentiate between the conventional areas. Finally, there is an 'Other' category for newer areas of mathematics such as Financial Mathematics. Each category is further broken down into grades of Honours awarded. Appendix 2 presents the coursework masters degrees awarded by the University of Melbourne in 2012. Appendices 1 and 2 combined show that in 2012 there were 176 Honours completions in Australia, with 113 (64%) receiving First Class Honours (compared with 116 out of 157 (74%) in 2011 and 112 out of 145 (77%) in 2010). This represents a significant decrease in the fraction of First Class degrees awarded.

Figure 1 presents the total number of students completing Honours degrees in Mathematics over the period 1959–2012. It shows that in 2012 there was a further increase in the number of Honours completions. The figure also shows the numbers of male and female students who completed Honours over the same time period. For last year, the number of male students has increased over the previous year with 130 completions (123 in 2011), while the number of female students also increased to 46 (compared to 34 in 2011).

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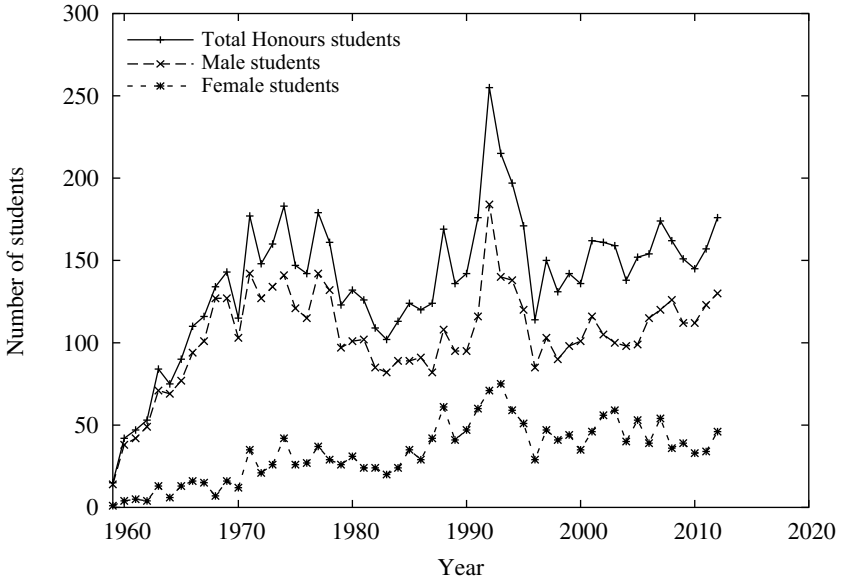

Figure 1. Number of Honours degrees completed in mathematics and statistics, 1959–2012.

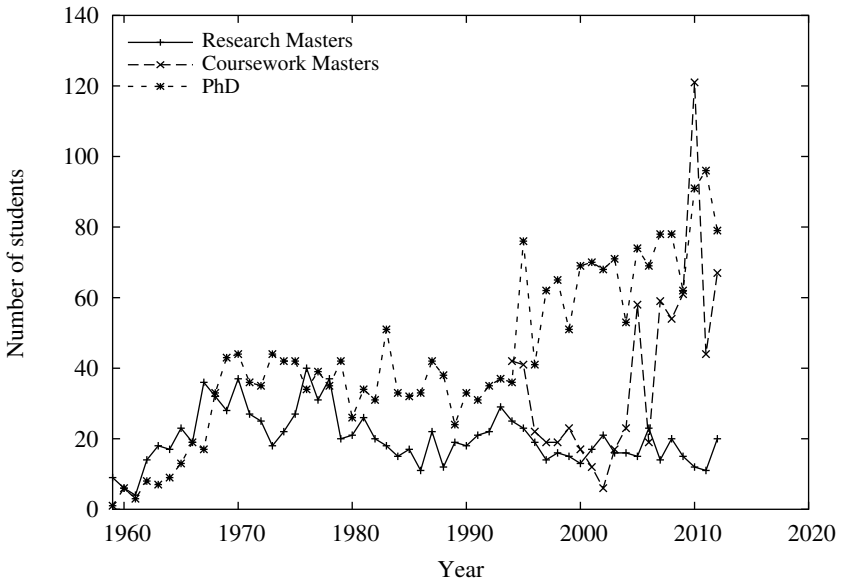

Figure 2. Number of research higher degrees completed in mathematics and statistics, 1959–2012.

Appendix 3 presents the data for Higher Degree completions in 2012. The data are broken down into Coursework Masters, Research Masters and PhD degrees, with the latter two divided into the three typical areas of Mathematics. These data are also represented in Figure 2, as part of the overall Higher Degree data

for the period 1959–2012. The figure shows that:

(i) There was a considerable drop in the number of PhD completions compared with the previous two years. In 2012, there were 79 PhD completions (down from 96 in 2011), of which 48 were by male students and 31 by female students. This represents a large drop in the number of male students (down from 65 in 2011) while the number of female students remained steady (31 in 2011).

(ii) The number of Research Masters completions (20) has increased markedly, up from 11 in 2011.

(iii) There were more coursework masters completions (67) in 2012, than in 2011 (44), but that is considerably fewer than in the previous year (121 in 2010).

For those who are interested in the finer details, the raw data are available directly from me. Simply send me an e-mail. I have an Excel spreadsheet containing the complete data for 2012 as well as spreadsheets containing cumulative data from 1959 for Honours, Research Masters and PhD degrees.

I would like to thank the many people who took the time and effort to collect this data and forward it to me. This year I received 34 out of a possible 38 responses to requests for data, which is a very good response rate. Finally, if, having read this report, you would like to contribute missing data for 2012, I would be happy to add it to the data.

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Appendix 1. Number of Honours degrees completed in mathematics and statistics, 2012

Uni.	Sex	Maths			Pure			Applied			Statistics			Other			Honours
		I	IIA	IIB	III	I	IIA	IIB	III	I	IIA	IIB	III	I	IIA	IIB	III	Total
ACU	M																	0
	F																	0
ADF	M									1								1
	F																	0
ANU																		0
																		0
BOU	M																	0
	F																	0
CDU	M																	0
	F																	0
CQU	M																	0
	F																	0
CSU	M																	0
	F																	0
CUT																		0
																		0
DKU	M																	0
	F																	0
ECU	M																	0
	F										1							1
FDU	M	2	1		1													4
	F	1																1
GFU	M									1								1
	F																	0
JCU	M																	0
	F																	0
LTU	M											1		1		2		4
	F					1								1	1			3
MDU	M																	0
	F																	0
MNU	M					6	1			5	2	1		2	2			19
	F						1			2		1						4
MQU	M	2																2
	F																	0
QUT	M									4		2		1	1			8
	F																	0
RMT	M													1	1			2
	F									1	1							2
SCU	M																	0
	F																	0
SUT	M																	0
	F																	0
UAD	M									1								1
	F					1				1				2				4
UBR	M																	0
	F																	0
UCB																		0
																		0
UMB	M																	0
	F																	0

Appendix 1. (continued)

Uni.	Sex	Maths				Pure				Applied				Statistics				Other				Honours
		I	IIA	IIB	III	I	IIA	IIB	III	I	IIA	IIB	III	I	IIA	IIB	III	I	IIA	IIB	III	Total
UNC	M													1								1
	F																					0
UNE	M																					0
	F																					0
UNS	M					5					1											6
	F					1								1	1				1			4
UQL	M					6	4			6		1										17
	F					1																1
USA	M									3	1											4
	F									1	1											2
USN	M					3	1			6	3	1		5	1							20
	F					2				2				2	1							7
USQ	M	1																				0
	F																					0
UTM	M					2				4												6
	F									1												1
UTS	M																		1			1
	F		1																1			2
UWA	M					3						1										4
	F													1	1							2
UWG	M					2						1						4	1			8
	F					1					1							3	1			6
UWS	M														1							1
	F																					0
VUT																						0
																						0
Totals		6	2	1	0	34	7	0	0	39	11	9	0	18	10	2	0	7	5	0	0	151

Appendix 2. Number of two year coursework masters degrees (with classifications) completed in mathematics and statistics, 2012

Uni.	Sex	Pure				Applied				Statistics				Other				Total
		I	IIA	IIB	III	I	IIA	IIB	III	I	IIA	IIB	III	I	IIA	IIB	III	
UMB	M	3		1	2	4	2			1	1	2	2	1				19
	F					1		2				1	1			1		6
Totals		3	0	1	2	5	2	2	0	1	1	3	3	1	0	1	0	25

Appendix 3. Number of research higher degrees completed in mathematics and statistics, 2012

Uni.	Sex	Coursework Masters	Research Masters Pure	Research Masters Applied	Research Masters Statistics	Research Masters Total	PhD Pure	PhD Applied	PhD Statistics	PhD Total
ACU	M					0				0
	F					0				0
ADF	M				1	1		1		1
	F				1	1				0
ANU						0				0
						0				0
BOU	M					0		1		1
	F					0				0
CDU	M					0				0
	F					0				0
CQU	M					0				0
	F					0				0
CSU	M					0				0
	F					0				0
CUT						0				0
						0				0
DKU	M					0				0
	F					0				0
ECU	M				1	1				0
	F				1	1			1	1
FDU	M					0				0
	F					0				0
GFU	M					0				0
	F					0				0
JCU	M					0				0
	F					0				0
LTU	M	2			1	1	1			1
	F	2				0	2	1	2	5
MDU	M					0				0
	F					0				0
MNU	M		1	1		2		1		1
	F				2	2	1	1		2
MQU	M					0	2	1		3
	F					0		2		2
QUT	M			1		1		3	2	5
	F					0		1	2	3
RMT	M					0				0
	F					0		1	1	2
SCU	M					0				0
	F					0				0
SUT	M					0				0
	F					0				0
UAD	M		1			1	3	1	1	5
	F					0				0
UBR	M					0				0
	F					0		1		1
UCB						0				0
						0				0
UMB	M		1	2		3	3	6	3	12
	F					0		2		2

Appendix 3. (continued)

Uni.	Sex	Coursework Masters	Research Masters Pure	Research Masters Applied	Research Masters Statistics	Research Masters Total	PhD Pure	PhD Applied	PhD Statistics	PhD Total
UNC	M					0				0
	F					0				0
UNE	M	8				0				0
	F	2				0				0
UNS	M	9				0	2			2
	F	6				0		1		1
UQL	M	6				0		2		2
	F	8				0				0
USA	M					0		2		2
	F					0				0
USN	M		1	1		2	3	4	1	8
	F					0			1	1
USQ	M					0			1	1
	F					0				0
UTM	M					0				0
	F		1	1		2		2		2
UTS	M	1				1	1	1		2
	F	1				1				0
UWA	M	5				0	1	1		2
	F	3				0	1	2		3
UWG	M	11				0	2	1		3
	F	3				0		1	2	3
UWS	M					0				0
	F					0				0
VUT						0				0
						0				0
Totals		67	5	6	7	20	22	40	17	79

Optimisation in Industry

Melbourne, 5–7 June 2013

Irina Dumitrescu* **and Olivia Smith****

In early June this year, people came together from around Australia and the world, from industry, academia, government and IBM to discuss the applications of mathematical optimisation techniques to industrial problems.

The three-day event pulled together people with incredibly deep knowledge of different areas, including the mathematical details of optimisation, the use of these techniques in full-scale industrial problems, and a variety of industries, including transportation, mining and logistics.

The speakers were selected from across a range of sectors and gave some fantastic talks. The first day was focused on setting the scene and giving everyone the flavour of industrial optimisation research. The morning started with impressive keynotes by Dr Brenda Dietrich, IBM Fellow and Vice President, who spoke about the growth and directions of business analytics, and John Gaffney of VicRoads who told us about the use of instrumentation and controls in order to improve the flow along the M1 to above world-class standards.

The keynotes set a very high standard, which was maintained throughout the conference. The rest of Day 1 included case studies by brilliant speakers: Professors Natashia Boland and Martin Savelsbergh from the University of Newcastle, Dr Gaurav Singh from CSIRO, Dr Philip Kilby from NICTA, and Dr David Jensen and Dr Irvin Lustig from IBM Research USA.

For the second and third days, a selection of speakers from around the world went into more detail about projects and research questions. These projects were in areas such as the Hunter Valley Coal Chain, Norwegian trains, less-than-truckload carriers, emergency evacuation, tax collection, mine production planning, LNG, hospital occupancy and supply chain emissions. Some featured talks included Dr Irvin Lustig describing the life cycle of an optimisation project, and a presentation by Mr Robert Robinson from Linfox about the problems they face and what they have not seen in off-the-shelf software. All presentations were followed by animated discussions.

This workshop was a great opportunity to mix with people from different sectors and allowed us all to learn from each other. We would like to take this opportunity to thank everyone who helped put it together. Special thanks must go to the speakers, who all gave entertaining and informative talks, which were accessible and interesting to a very broad audience, as well as the whole organisational committee, in particular, to Professor Andrew Eberhard from RMIT and to Dr Irina Dumitrescu from IBM Research - Australia.

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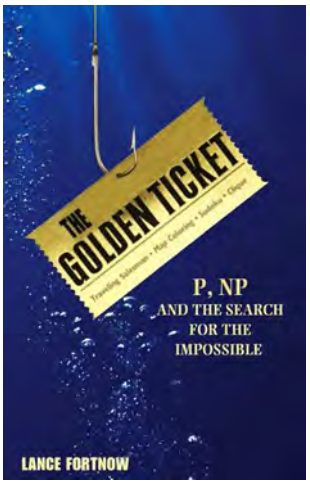
Book Reviews

The Golden Ticket: P, NP, and the Search for the Impossible

Lance Fortnow
Princeton University Press, 2013, ISBN 978-0-691-15649-1

In the 1930s, Kurt Gödel and Alan Turing proved two unsolvability results that changed the face of mathematics forever. Gödel's theorem was syntactic: he showed that in any consistent formal theory strong enough to contain elementary number theory, there are propositions that can be neither proved nor disproved. Turing's theorem was semantic: he proved that in any reasonable model of computation there is no algorithmic procedure to solve Hilbert's *Entscheidungsproblem*, that is, to decide whether a statement of a first-order logic is valid in every structure satisfying the axioms.



Gödel's result led to unexpected developments in pure mathematics, for example independence results in set theory, algebra, topology, analysis and combinatorics.

Turing's result had similarly far-reaching consequences in applied mathematics, because it turned out to have economic and military implications.

The 40 years beginning in 1945 were those of the Cold War. Applied mathematicians in the sphere of the Soviet Union and those in the West worked independently of each other in the area of Operations Research, but not surprisingly came up with similar ideas. What evolved on both sides of the Iron Curtain in the 1970s was the notion of algorithmic complexity. Consider for example the problem of finding a clique of maximal size in a finite simple graph. The problem can be expressed as the disjunction of finitely many conjunctions of propositions stating that there is an edge between two vertices, so it is an instance of the Entscheidungsproblem involving a single binary relation. Since the graphs at issue are finite, any such instance can be solved by exhaustive enumeration. But what is at stake here is the 'cost' of the calculation, i.e. the number of elementary operations needed to solve an instance of given size. Even to determine by enumeration whether a graph with 100 vertices has a clique of size 50 is beyond the reach of computers today and in the foreseeable future. Other problems of a similar nature occur in graph theory, as well as in network design including the traveling salesman problem, partitioning sets into subsets with given properties, data storage and retrieval, biology including matching genome strings, number theory including factoring integers, economics including investment decisions and medicine including compatible kidney exchanges with multiple donors.

What ensued was a classification of finite combinatorial problems into a spectrum of types. The set of problems of a given type is parametrised by 'size', which we may take to be a positive integer n, representing the amount of data needed to describe a particular instance. At the hard end of the spectrum are the *perebor* problems, an adjective the Russians used to denote problems requiring brute force search. The solution of such a problem of size n has a cost which is of the order of C^n, where C is a positive integer independent of n.

At the easy end of the spectrum are the problem types for which the solution cost of a problem of size n is of the order of n^C. The latter problems are said to be in the class P, which stands for polynomial complexity. Floating between these two extremes are problems whose cost as a function of size n lies between polynomial and exponential in n. I say floating, because the solution cost depends on the choice of algorithm and even the software and hardware of the device used to compute the solution. A prominent example is linear programming: while it is known that there are instances of Dantzig's Simplex Algorithm not in P, Khachiyan showed in 1979 by the ellipsoidal method that the linear programming problem itself is in P. For another example, it was not until 2002 that Agrawal, Kayal and Saxena found an algorithm which demonstrated that the problem of deciding primeness of an integer is in P.

The most important type within this spectrum is denoted NP, which stands for *non-deterministic polynomial*. These are problems, first described by Steve Cook in 1971, for which if a solution of an instance is proposed, the problem of deciding whether it is indeed a solution is in the class P. Thus $P \subseteq NP$ and the P versus NP problem is to determine whether this inclusion is proper. This is the fourth of the Clay Institute Millennium Problems, the only one of real interest to non-mathematicians. The point is that while it is (comparatively) easy to determine whether a class of problems is in P by finding an algorithm, it is difficult to prove that an NP problem is not in P.

In 1971 Cook and in 1972 Richard Karp in the USA, and at about the same date, Leonid Levin in the USSR found a special subclass of NP problems now known as *NP-complete*. These have the crucial property that any problem in NP can be reduced to an NP-complete problem. Thus if any NP-complete problem can be shown to be in the class P, then all NP problems are in P. The first NP-complete problem discovered both by Cook and Levin was the 3-satisfiability problem. This is a special case of the Entscheidungproblem which asks for an algorithm to decide whether it is possible to assign truth values to n propositions P_i so that a given conjunction of statements, each of which is a disjunction of three of the P_i or their negations $\neg P_i$, at least one of which is P_i, is true.

Other examples of NP-complete problems which are easier to describe (but not to solve) include deciding whether a graph has a Hamiltonian circuit, the clique problem of deciding whether a graph contains a clique of size k, the vertex cover problem of deciding whether a graph has a vertex cover of size k and the partition problem of deciding whether a finite set of positive integers can be partitioned into two subsets with equal sums.

It was only in the late 1980s that it came to light that Gödel in a 1956 letter to von Neumann discussed the satisfiability problem and formulated the P *v* NP problem in different terminology, suggesting that equality was within the realm of possibility.

I come now to the book under review. The author, Lance Fortnow, is a distinguished computer scientist at the Georgia Institute of Technology, and a specialist in computational complexity. His book is aimed at a lay audience with some experience in computation and networks. It is intended to outline the nature, history and importance of the P *v* NP problem. It contains no mathematical theory, but much discussion of algorithmic complexity and the intrinsic limits of computation. The 'Golden Ticket' of the title has two meanings; firstly it refers to a problem based on a Roald Dahl story, in which a wealthy man indulges his daughter whose wish is to win a competition of a chocolate bar manufacturer who has inserted a golden ticket into exactly one package. The millionaire buys the entire production and employs a team of workers to open every packet until they find the golden ticket. Of course this is not a decision problem and is solved in at most $n-1$ steps of a simple algorithm.

The second reference for the Golden Ticket is as a metaphor for the possible equality of P and NP. Fortnow outlines a possible scenario in which a mathematician wins a Fields Medal for a method to solve NP problems efficiently, whereupon various teams of computer scientists continually improve her algorithm until eventually a PhD student cracks the barrier by finding an algorithm in P. After several legal battles over copyright, the World Trade Organisation determines that the result is so important to human welfare that it belongs in the public domain. Fortnow continues with his fantasy by outlining how the algorithm is used to find a cure for cancer, a method to schedule major league baseball, and so on. All of this is almost believable, but I draw the line at the next step envisaged: Fortnow guesses that the Clay Foundation is forced to withdraw the remaining Millenium Problems, because they would all fall to the $P = NP$ result! Finally, however, Fortnow admits that most computer scientists suspect that $P \neq NP$, and that the resolution of the problem is far in the future.

While avoiding proofs and details of algorithms, Fortnow makes interesting observations on dealing with hard problems in operations research and cryptography by approximate methods and parallel and quantum computing. To summarise, this book is a lively popularisation of the P *v* NP problem for non-specialists, which could also be a suitable introduction to a serious study of the subject, such as the definitive 1979 text *Computers and Intractability* by M.R. Garey and D.S. Johnson, and to more recent research.

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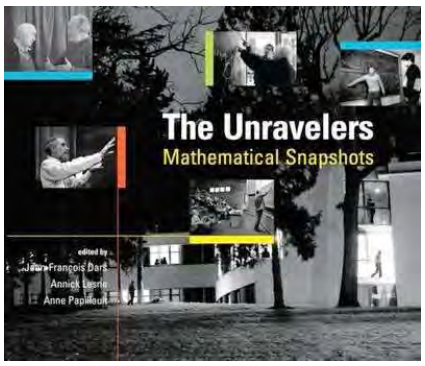
The Unravelers: Mathematical Snapshots

J.-F. Dars, A. Lesne and A. Papillaut (Eds), V. Méla (Trans)
A.K. Peters, 2008, ISBN-13: 978-1-56881-441-4

The Institut des Hautes Études Scientifiques, modelled on the Princeton Institute of Advanced Studies, was founded in 1958 by businessman and mathematical physicist Léon Motchane. Situated in bucolic environs in the village of Bures-sur-Yvette, 15 km south-east of Paris, the IHES allows mathematicians and theoretical physicists to immerse themselves in research without administrative and teaching duties. In recent years, theoretical biologists have been added to the list. The early years of the Institute were fashioned by the strong personalities of Alexandre Grothendieck, René Thom and Dennis Sullivan. More recently, it has hosted a roll-call of winners of Fields and Einstein medals, and Abel, Crafoord and Wolf Prizes.

While nonresidential, it provides a nurturing atmosphere accommodating the habits and working hours of everyone, from owls to fowls. The lecture halls and seminar rooms are old-fashioned enough to provide immense triptych blackboards as well as electronic projectors and the cafeteria is apparently all you would expect from a French Institute.



In 2006, the IHES invited a team of documentary filmmakers, one of them a mathematician, to visit the Institute and over the course of a year, to photograph the members and visitors. The photographs are exceptional, providing a penetrating view of scholars at work in their offices, walking in the woods, interacting at the blackboards or performing solo or ensemble music. Each batch of photos is accompanied by a text written by its subjects. There was no restriction, apart from length, on these contributions. They include reminiscences, tributes to previous Institute members, reflections on the nature and practice of mathematics, and even poems. Most are enlightening, some are banal, but none is pretentious. While the Prologue by the editors and many of the contributions were written in French, the English translations, by Vivienne Méla, are skillful; for example the choice of title in my opinion is better than the English cognate of the French title, *Les Déchiffreurs*.

The mathematical contributors to this book encompass a host of distinguished scholars, including Michael Atiyah, Jean-Pierre Bourgignon, Pierre Cartier, Yvonne Choquet-Bruhat, Alain Connes, Pierre Deligne, David Eisenbud, Mikhail Gromov, Victor Kac, Maxim Kontsevich, Bao Châo Ngô, Dennis Sullivan, Jacques Tits, and Minoru Wakimoto. In addition, there are scores of lesser-known scholars

including post-docs and other mathematicians on the threshhold of their careers. In particular, two Australians are included, the theoretical physicist Dirk Kreimer and the mathematical biologist Henry Tuckwell. The kitchen and domestic staff, so responsible for the smooth running of the Institute, are not neglected in the photographs.

Among the texts, I was particularly struck by Connes' description of his very personal relationship with mathematics; by Paolo Almeida's remarks, entitled 'Structured Fury', on the initial conflict but eventual synthesis of intuition and rigour in mathematical activity; and by the account by Cecile DeWitt, a member of the Administrative Council of IHES, of the founding of the Institute. A memorable account by Cartier concerns his dramatic visit to Poland with Laurent Schwartz, Marcel Berger and Alain Guichardet on the eve of Jaruzelski's 1981 putsch.

This book is a fitting celebration of the first 50 years of the IHES, and a captivating answer to the question: what is it that mathematicians do?

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Nalini Joshi*

Advancing Women In Mathematics?

The London Mathematical Society (LMS) published the report *Advancing Women in Mathematics: Good Practice in UK University Departments* in February this year.[1] This report is only one facet of many actions being carried out world-wide on behalf of women scientists and mathematicians and I would like to ask you to consider whether similar actions are needed in Australia.

To whet your appetite, consider some of the questions that are quoted below from a questionnaire that departments can use to assess their practices, which was prepared by Professor Rachel Kuske.[2] This, and many other resources can be found at the website titled 'Diversity in the Mathematics and Scientific Community',[3] which grew out of a Banff Research Station Workshop on supporting diversity in mathematics. I quote one question from each of the first five major headings (in italics) in the questionnaire:

- *Hiring and Recruitment Strategies*: What specific efforts do you make to ensure a diverse pool of candidates for 1. temporary positions, 2. tenure-track positions, 3. senior hires? Are they successful?
- *Professional Development*: How do you mentor junior faculty when new? Over time? Define mentoring.
- *Work-life balance*: What is your policy on family leave and are people using it?
- *Governance*: Is there committed leadership on diversity issues at the Department level?
- *Policies and grievances*: Is there an Ombudsperson/Ombudscommittee available to all?

I did not know the answers to all of the above questions for my School or University. Do you?

There are also many personal reflections and descriptions of experiences by leading women in mathematics and statistics. I refer you to three recent articles by Professors Nancy Reid 'The whole women thing', Louise M. Ryan 'Reflections on Diversity' and Mary E. Thompson 'Reflections on women in statistics in Canada',

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[1] A copy of this report can be downloaded from a link at http://www.lms.ac.uk/women/good-practice-scheme

[2] http://mathdiversity.wesleyan.edu/dept_quest.pdf

[3] http://mathdiversity.wesleyan.edu

which are to appear in a book to be published by the Council of Presidents of Statistical Societies.[4]

In 1999, the LMS established a Women in Mathematics committee. Its aims and concerns were focussed on 'the loss of women from mathematics, particularly at the higher levels of research and teaching, and at the disadvantages, and missed opportunities that this represents for the advancement of mathematics'.[5] The committee's role was to bring about suggestions and policies to stem this loss. The 2010 International Review of Mathematical Sciences in the UK (commissioned by the EPSRC) highlighted the need for 'urgent action' on this front.[6]

In the period between these two events, the UK Scientific Women's Academic Network (SWAN) formulated a Charter of Principles for its Athena Project to 'advance the representation of women in science, engineering and technology'.[7] In 2005, it launched the Charter, which comprises six principles aimed at organisations. More than half of the higher education organisations in the UK that are active in Science, Technology, Engineering, Mathematics and Medicine areas have joined the Charter. The accompanying Athena SWAN awards recognise good practice by organisations and departments and are awarded at three levels: bronze, silver, and gold. They received a huge impetus from the announcement by the UK Chief Medical Officer that the National Institute for Health Research would only expect to shortlist a school for funding if it holds a Silver Athena SWAN award.

To consider whether similar actions may be needed in Australia, I had a look at AMSI's 2013 discipline profile of the mathematical sciences.[8] This profile reports undergraduate and higher degree student numbers, as well as staff numbers at different levels by gender from surveys of member institutions (reported on the census date in Semester I, 2012). Longer time-period data for completion of honours and higher degrees completed in mathematics and statistics are also included for the period 1959–2011.

This report shows that approximately 33.8% of all undergraduate students enrolled in a mathematics subject at an AMSI member institution on the Semester 1 2012 census date were female.[9] At honours level in mathematical sciences, approximately 23.9% of all domestic students are female, whilst at the PhD level,

[4]The book *Past, Present and Future of Statistical Science*, celebrates the Council's 50th anniversary and is to be published by Chapman and Hall, 2014. Preliminary versions of these articles can be read at http://www.math.mcgill.ca/copss/Contributions/Reid.pdf, http://www.math.mcgill.ca/copss/Contributions/Thompson.pdf and http://www.math.mcgill.ca/copse/Contributions/Ryan.pdf.

[5]*Advancing Women in Mathematics: Good Practice in UK University Departments*, LMS, 2013, p.7

[6]quoted on p. 7 *ibid.*

[7]http://www.athenaswan.org.uk/content/history-and-principles

[8]http://www.amsi.org.au/index.php/publications-mainmenu/amsi-publications/148-publications/advocacy/1029-discipline-profile-of-the-mathematical-sciences-2013

[9]Table 2.2.1.3, Discipline Profile of the Mathematical Sciences, AMSI, 2013 http://www.amsi.org.au/index.php/publications-mainmenu/amsi-publications/148-publications/advocacy/1029-discipline-profile-of-the-mathematical-sciences-2013.

the proportion of female domestic students drops to 17.8%.[10] In the mathematical workforce at an AMSI member institution, the proportion of female staff members starts at 48% for casual staff, 38% at Level A, 34% at Level B/C and drops to 14% at Level D/E.[11]

Corresponding statistics for the UK can be found in the LMS report mentioned at the beginning of this column. These figures are drawn for all institutions in the UK and therefore are calculated with respect to much larger populations. These show[12] that 42% of all undergraduate students in the mathematical sciences are female, while 19% of all PhD students are female. Both of these percentages are higher than the Australian ones quoted above.

With respect to staff, the percentage of lecturers/senior lecturers in the UK who are female is 29%, whilst the corresponding percentage of Professors is 6%. These are not directly comparable to the figures given above for Australia, because academics at Levels C and D in Australia overlap with both Senior Lecturers and Readers in the UK. However, if we infer the same percentages for Level B/C as the Lecturer/Senior Lecturer in the UK setting, the UK percentage of females (29%) appears to be lower than the corresponding percentage (34%) for Australia. If we infer the percentage for Level D/E as the same as that for Professor in the UK setting, the UK percentage of females (6%) is much lower than the corresponding percentage (14%) for Australia.

In the UK, there is a dramatic difference between the percentage of female students in the mathematical sciences pipeline (42%) and the percentage at the top level of academic employment (6%), but the percentage of female students at both undergraduate level and PhD level appear to be higher than the corresponding numbers in Australia. The corresponding change in the pipeline in Australia is less dramatic (from 33.8% to 14%, based on available figures), however, the beginning of the pipeline is narrower, with lower female undergraduate percentages. Nevertheless, there is still a distinct loss of mathematical talent along the way.

Look around you. How many female professors (or equivalent level) of mathematics, statistics or mathematical education work at your institution?

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

[10] Table 3.3.3.3, *ibid.* Note that the reported percentages differentiated between domestic and international students, and no overall percentages were available.
[11] Figure 3.1.1, *ibid.*
[12] Figure 1, p. 11, Advancing Women in Mathematics: Good Practice in UK University Departments, LMS, 2013.

Research
Australian Mathematical Sciences Institute

AMSI-Mahler Lecture Tour

Professor Akshay Venkatesh

Professor of Mathematics, Stanford University

Akshay Venkatesh's current research interests are in the fields of counting, equidistribution problems in automorphic forms and number theory, in particular representation theory, locally symmetric spaces and ergodic theory.

In 2008 Akshay won the SASTRA Ramanujan Prize for outstanding contributions to areas of mathematics influenced by the genius Srinivasa Ramanujan.

See www.amsi.org.au/Venkatesh for lecture dates

Tour starts 23 September 2013

Professor Kurt Mahler made major contributions to Australian Mathematics from his arrival in the 1960s, until his death in 1988. The Mahler Lectureship is awarded biannually to a distinguished mathematician. Find out more at **www.austms.org.au/The+Mahler+Lectureship**

AMSI
AUSTRALIAN MATHEMATICAL SCIENCES INSTITUTE

AustMS
AUSTRALIAN MATHEMATICAL SOCIETY

Mathematics of Planet Earth 2013 AUSTRALIA

Visit: www.amsi.org.au/Venkatesh

AMSI News

Geoff Prince*

The AMSI year in review

As this is the last *Gazette* of 2013, I thought you might like to see the AMSI year in hindsight.

Mathematics of Planet Earth 2013 has been our largest sustained theme program to date, one truly worthy of the national mathematical sciences institute.

- AMSI led the Australian effort in the international year of MPE www.mope.org.au with 18 partner organisations. It has been one of the largest national MPE efforts.
- Our MPE website has had 50 000 visitors from 150 countries to date (mid-October).
- We ran or sponsored 17 MPE scientific events with 200 international speakers.
- MPE was opened by Ian Chubb, the MPE Australia Patron, followed by the first of the international Simons Foundation lecture series (the Simon Levin Public Lecture).
- The MPE Conference in July attracted more than 100 delegates, opened by Ian Chubb and with dinner speaker, Alex Zelinsky, Chief Defence Scientist. Strong participation from ABS, BoM, Geoscience Australia, DSTO and CSIRO made the event an outstanding success.

Accelerate Australia was held on 6 February at the National Convention Centre, Canberra in support of AMSI Intern http://amsiintern.org.au/.

- Keynote by Arvind Gupta, delivering an inspiring address on Mitacs Accelerate.
- Other speakers included Ian Chubb, Aidan Byrne, Eileen Doyle, Leonie Walsh, and Patricia Kelly.
- The internship showcase featured a variety of industry internship projects.
- Meetings with ministers, shadow ministers and the ARC, resulted in an application, with the Business Higher Education Round Table, to the ARC for an Industrial Research Training Centre to supply 150 interns over three years.
- AMSI Intern has now placed over 80 interns and is supported by the Australian Industry Group, the CRC Association and BHERT. The program has been praised by the Chief Scientist as a 'shining example'.
- Placements with Melbourne Storm, NBN Co., Planet Innovation, CSL, municipal councils.

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Membership growth

- University of Newcastle moved from associate to full membership.
- Griffith University and the University of Tasmania have joined AMSI's associate membership.
- DSTO is joining in 2014.
- We now have 35 members — 11 full, 18 associate universities, 7 societies and government agencies.

Access Grid Room network

- National Seminar Series established with AustMS, ANZIAM, SSAI, ANZMP and ASOR http://www.amsi.org.au/index.php/research-mainmenu/national-seminar-series.
- Short courses and honours courses delivered nationally http://www.amsi.org.au/index.php/research-mainmenu/access-grid/agabout.

Schools

Our work in Australian schools continues to grow in influence with grants for teacher PD in clusters of schools in metropolitan and regional Australia. Our national curriculum work has set a gold standard.

- *Supporting Australian Mathematics* — materials for middle and senior years launched in July. It includes videos giving context to the curriculum: www.amsi.org.au/mathsdelivers.
- Buckland Foundation, Victorian and Commonwealth governments and Boeing funding to deliver Professional Development for mathematics teachers in school clusters nationally.
- In conjunction with our members and BHP-Billiton we submitted an application (under consideration) for an Australian Mathematics and Science Partnership Project grant, *Choose Maths*, to create a professional identity for those working in and with the mathematical sciences.

Research and higher education

- 120 registrations for the 2013 AMSI Summer School, held at the University of Melbourne, including *Letters & Numbers* quiz night hosted by Board member Lily Serna. Sponsorship by AustMS and ANZIAM.
- 50 Vacation Research Scholarships awarded to undergraduates in 2013/14.
- 2013 Graduate Winter School at the University of Queensland.
- 2013 BioInfoSummer held at the University of Adelaide and sponsored by EMBL and BioPlatforms Australia.
- 20 scientific workshops held around Australia.
- AMSI–ANZIAM Lecturer Stephen Boyd (Stanford).
- Mahler Lecturer Akshay Venkatesh (Stanford) supported by AMSI.
- See http://www.amsi.org.au/index.php/higher-education/about.

Advocacy and engagement

AMSI continues to be the principal public voice for the mathematical sciences. We maintain high-level contacts with government and stakeholder groups and we are routinely invited to provide submissions and policy advice. Our annual discipline

profile and policy documents are influential and widely quoted. See http://www.amsi.org.au/index.php/publications-mainmenu.

The organisation

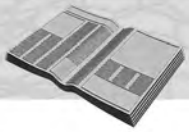
We have grown significantly over the last 18 months with new staff in all portfolio areas and new external members on the AMSI Board. AMSI has a new Research and Higher Education Committee which coordinates programs and policy. See www.amsi.org.au. Two of our former staff were recognised this year, Michael Evans was awarded an AMSI Distinguished Service Medal for his outstanding work in school education and Jan Thomas was awarded an Order of Australia Medal for her services to the mathematical sciences.

Challenges ahead

Retention of students into intermediate and advanced school mathematics subjects and then onto university continues to be the most significant challenge. However, we have put it on the agendas of the Chief Scientist and Australian governments. As part of the STEM discipline group the mathematical sciences have a high profile and this is a first step to substantive policy measures. Related to this is the appalling statistic that more than 30% of Australian secondary maths classes are without a qualified maths teacher and we must all, not just AMSI, continue to bring this to light. Women and girls are significantly under-represented throughout the education and career pipeline, and in this matter every mathematical scientist must reflect on their role.

Finally, and particularly for the AMSI director, there is the opportunity to engage with the new federal government to seek fresh policy measures for our perennial challenges.

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.



News

General News

Maths major at SCU

Southern Cross University now offers a major in Mathematics, as part of a Science degree. This offer is a progression from offering Mathematics retraining for teachers (starting 2012) and from offering Mathematics for Engineering (which began just this year, 2013). The contact person for this is Dr Geoff Woolcott.

Several grants for mathematics and science education have been awarded to SCU this year through the Federal Department of Innovation, the Office of Learning and Teaching or through the Australian Mathematics and Science Partnership Program. One of the aims of such projects is to have mathematicians work more closely with mathematics educators.

Launch of MAXIMA

On 25 September, Monash University launched a new initiative called MAXIMA: the Monash Academy for Cross & Interdisciplinary Mathematical Applications. MAXIMA aims to harness the mathematical talent pool found in various faculties across Monash into a single (virtual) entity, and provide a shop-front for interdisciplinary researchers and industry partners wishing to collaborate with mathematically trained researchers to tackle significant problems with a mathematical underpinning. MAXIMA focuses on supporting collaborative research, facilitating consulting work, providing education and training opportunities for students, as well as outreach activities to showcase the importance of mathematics to school children and teachers. For more details about MAXIMA, please visit monash.edu/maxima or contact the Director of MAXIMA, Professor Kate Smith-Miles (kate.smith-miles@monash.edu).

Magma to become more widely available

The Computational Algebra Group at the University of Sydney (http://magma.maths.usyd.edu.au/group/) has concluded an agreement with the US-based Simons Foundation (http://www.simonsfoundation.org) that will make their computer algebra system Magma more widely available in the United States. The Agreement came into effect on 1 August 2013 and will run for three years.

Mathematics in the media

Stephanie Pradier from AMSI recorded a piece on the importance of mathematics for the Radio National Program Ockham's Razor which was aired on Sunday 20 October. The podcast can be downloaded at the ABC Radio National website (http://www.abc.net.au/radionational/programs/ockhamsrazor/maths-is-everywhere/5028094).

Terry Speed from the Walter and Eliza Hall Institute appeared on the Channel 10 program The Project on Wednesday 30 October (http://tenplay.com.au/channel-ten/the-project/2013/10/30).

Dr Jonathan Keith from Monash gained media attention for his work on tracking the spread of the red imported fire ant which is causing problems in Queensland's Lockyer Valley vegetable growing region (http://www.abc.net.au/pm/content/2013/s3825745.htm).

Professor Paul Cally from Monash wrote a piece for The Conversation on solar flares (http://theconversation.com/a-solar-magnetic-reversal-means-theres-no-need-to-flip-out-yet-17136).

Associate Professor Steven Siems from Monash gained media attention for his collaboration with the University of Southern Queensland and the Bureau of Meteorology to improve forecasting and warning of severe storms (http://www.thesatellite.com.au/news/weather-warning/1962592/).

Conference in honour of Cheryl Praeger

The Second International Conference on Permutation groups and Transitive graphs was held in Kunming China, 3–9 September, in honour of Cheryl Praeger's 65th birthday.

Completed PhDs

La Trobe University

- Dr Amanda Joy Shaker, *Combining dimension reduction methods*, supervisors: Luke Prendergast and Robert Staudte.

Monash University

- Dr Santiago Barrera Acevedo, *Perfect sequences and arrays of unbounded lengths and sizes over the basic quaternions*, supervisor: Thomas Hall.
- Dr Pallavi Devidas Govekar, *Three dimensional cloud and dynamical structure of southern hemisphere extra-tropical cyclones in observations and in a model*, supervisor: Christian Jakob.
- Dr Louise Wilson, *The spatial and temporal characteristics of rainfall in south-eastern Queensland*, supervisors: Michael Manton and Steven Siems.
- Dr Ying Oon Tan, *Option pricing with a natural equivalent martingale measure for log-symmetric Levy price processes*, supervisors: Kais Hamza and Fima Klebaner.

Queensland University of Technology

- Dr Elliot Carr, *Exponential integrators and a dual-scale model for wood drying*, supervisors: Ian Turner, Patrick Perré and Vo Anh. Winner of an Outstanding Doctoral Thesis Award.

- Dr Brodie Lawson, *Cell migration and proliferation on homogeneous and nonhomogeneous domains: modelling on the scale of individuals and populations*, supervisors: Graeme Pettet and Daniel Mallet.
- Dr Jacqueline Horne, *Mathematical modelling of soft callus formation in early murine bone repair*, supervisors: Graeme Pettet, Daniel Mallet and Scott McCue.
- Dr Steven Psaltis, *Multicomponent charge transport in electrolyte solutions*, supervisors: Troy Farrell and Geoffrey Will.
- Dr Mike Hou-Ning Hsieh, *Mathematical modelling of controlled drug release from polymer microspheres: incorporating the effects of swelling, diffusion and dissolution via moving boundary problems*, supervisors: Scott McCue, Timothy Moroney and Graeme Pettet.
- Dr Steven Dargaville, *Mathematical modelling of LiFePO4 cathodes*, supervisors: Troy Farrell and Ian Turner.
- Dr Trisilowati, *Mathematical modelling of tumour growth and interaction with host tissue and the immune system*, supervisors: Daniel Mallet and Scott McCue.

University of Ballarat

- Dr Nargiz Sultanova, *Aggregrate subgradient smoothing methods for large scale nonsmooth nonconvex optimization and applications*, supervisors: Adil Bagirov, Andrew Barton and David Yost.

University of New South Wales

- Siti Amirah Abd Rahman has had her PhD recommended, *Freight train scheduling on a single line network*, supervisor: Gary Froyland.
- Andrew Chernih completed his PhD, *Multiscale Wendland radial basis functions and applications to solving partial differential equations*, supervisors: Ian Sloan, Rob Womersley and Q Thong Legia.

University of South Australia

- Dr Jing Huang, *Forecasting wind and solar energy on short time scales*, supervisors: Malgorzata Korolkiewicz and John Boland.
- Dr Saba Majeed, *New duality results for separable optimization problems in infinite dimensions: applications to optimal control theory*, supervisors: Regina Burachik and Yalcin Kaya.
- Dr Mohammed Rizvi, *New optimality conditions for nonlinear multiobjective optimization problems and new scalarization techniques for constructing pathological Pareto fronts*, supervisors: Yalcin Kaya and Regina Burachik.
- Dr Nahid Banihashemi, *Inexact restoration and adaptive mesh refinement for constrained optimal control*, supervisors: Yalcin Kaya and Regina Burachik.
- Dr Timofei Bogomolov, *Trading strategies used by hedge funds*, supervisors: John van der Hoek, Petko Kalev (School of Commerce) and Robert Elliott (U Calgary).

University of Western Australia

- Dr Brian Corr, *Estimation and computation with matrices over finite fields*, supervisors: Cheryl Praeger and Akos Seress. (Brian will be continuing in Perth for a few months on an AustMS Lift-off Fellowship.)

University of Wollongong

- Dr Luke Sciberras, *Propagation of nonlinear optical beams in finite liquid crystal cells*, supervisors Annette Worthy, Noel Smyth (University of Edinburgh, Scotland UK) and Tim Marchant.

Awards and other achievements

Flinders University

The Academy of Sciences of the Czech Republic has awarded Dr Jaroslav (Jerry) Kautsky the 2013 Bernard Bolzano Honorary Medal for Merit in Mathematical Sciences. The medal was presented to Jerry on October 18, 2013 at JK80, an informal seminar to honour his upcoming birthday, at the Institute of Information Theory and Automation (UTIA) in Prague.

The Bernard Bolzano Honorary Medal is named after the Prague mathematician Bernardus Placidus Johann Nepomuk Bolzano (1781–1848), well known for his influence on modern analysis. Since 1995, the Bolzano Medal has been awarded to distinguished mathematicians who have contributed considerably to the development of their research field, and who have fruitfully collaborated with researchers in the Czech Republic. Jerry is now in the distinguished company of such previous winners as Kazimierz Kuratowski, Jaroslav Kurzweil, Czeslaw Olech, Sergei L. Sobolev, Jindrich Necas, Gene H. Golub, Ivo Babuška, David E. Edmunds, Jean Mawhin, Michal Křížek and Gilles Godefroy.

Monash University

Dr Norman Do received a 2013 Young Tall Poppy Science Award, at a ceremony at Bio21 hosted by the Australian Institute of Policy and Science on 3 October. Norm's award acknowledges the outstanding contributions he has made in his career so far, not just as a mathematician, but as a mathematical communicator. He is involved in many outreach activities (IMO training, mentoring talented secondary students, Maths of Planet Earth school resource writing, etc.).

University of Ballarat

Associate Professor Adil Bagirov has won an ARC Discovery grant to continue his research on Global and non-smooth optimisation problems. Fellow investigators are Professor Juan Enrique Martinez Legaz of the Autonomous University of Barcelona and Prof Emilio Carrizosa of the University of Sevilla.

UNSW Canberra

Jason Sharples and his colleague Rick McRae from the ACT Emergency Services Agency have been short-listed as one of the three finalists for the 2013 Australian Museum Eureka Prize for Environmental Research.

University of South Australia

Dr Peter Pudney won the 2013 Unsung Hero of South Australian Science Communication.

University of Sydney

- Leon Poladian is one of the investigators on an Office of Learning and Teaching grant for Enhancing the Training of Mathematics and Science Teachers for the project 'Inspiring mathematics and science in teacher education'.
- Sheehan Olver received an International Research Collaboration Award to support a visit by Professor Peter Miller (University of Michigan) on a project entitled 'Numerical methods for inverse-scattering and stability of nonlinear waves'.

University of Wollongong

- Awards: National Office for Learning and Teaching (OLT) Citation for Outstanding Contributions to Student Learning for 2013.
- Dr Caz Sandison: For outstanding dedication to developing and implementing innovative curriculum that influences and motivates students of all levels and backgrounds to learn mathematics.
- Dr Caz Sandison was also part of a successful OLT project led by Prof Merrilyn Goos and Prof Joseph Grotowski at the University of Queensland, titled 'Inspiring mathematics and science in teacher education'.

Appointments, departures and promotions

Macquarie University

In view of the strong field of applicants for the Lectureship position in the Mathematics Department, Macquarie University agreed to offer Lectureships to the top two candidates. Both candidates have now accepted.

- Dr Richard Garner (currently in Computing at Macquarie and earlier from St John's College, University of Cambridge) joined the Department on 15 August. Richard holds an ARC Research Fellowship (and is a CI on another grant), and it has been agreed that he will continue in this research-only role until the conclusion of the Fellowship at the end of 2015.
- Dr Ji Li (Sun Yat-sen University, Guangzhou, China) will join the Department on 15 January 2014 in the role of Lecturer with regular allocation of research and teaching duties.

Monash University

- Dr Jussi Toivanen commenced as Research Fellow with the School on 19 August on a fixed-term contract for 10 months. Jussi's research interests are in Fire models, Numerical modelling of physical systems and high-performance computing. Jussi's supervisor is Professor Michael Reeder.
- Dr Huseyin Acan commenced as Research Fellow with the School on 2 September on a two-year fixed-term contract. Huseyin's research interests are in probabilistic combinatorics, random graphs and random combinatorial structures, asymptotic enumeration. Huseyin's supervisor is Professor Nicholas Wormald.
- Dr James Wurster commenced as a Research Fellow with the School on 16 September on a three-year fixed-term contract. His research interests are in computational astrophysics. His research interests also include star formation, and he is running simulations of star formation in molecular clouds. James' supervisor is Dr Daniel Price.
- Dr Jennifer Fletcher commenced as a Research Fellow with the School on 23 September on a two-year fixed-term contract. Jennifer's areas of interest include the physics and modelling of cumulus convection; understanding and modelling cloud feedbacks on climate; tropical meteorology. Jennifer's supervisor is Professor Christian Jakob.

Queensland University of Technology

- Dr Chris Drovandi, Statistical Science, has been appointed as Lecturer.
- Dr Joanne Hall, Decision Science, has been appointed as Lecturer.
- Dr Petrus van Heister, Applied and Computational Mathematics, has been appointed as Lecturer.
- Dr Stephen Sugden, Applied and Computational Mathematics, has been appointed as Lecturer.
- Dr Wouter Koolen, Machine Learning, has been appointed as QUT Vice-Chancellor Research Fellow.
- Associate Professor Matthew Simpson has been appointed as Associate Professor (Level D).
- Dr Douglas Stebila has been appointed as Senior Lecturer (Level C).

Swinburne University of Technology

Dr Ant Edwards has been appointed as a Lecturer, Level B, in Mathematics Education, commencing October 2013. Dr Edwards received his MMath degree in Mathematics from the University of Warwick (UK) in 2007, and a PhD in Mathematics Education from Loughborough University (UK) in 2011. Since 2010, he has managed the University of York's Maths Skills Centre. His research areas include undergraduate mathematical cognition, the role of examples in learning and teaching tertiary mathematics, and students' engagement with online learning resources.

University of Adelaide

- Dr Pedram Hekmati has been promoted to Lecturer (level B).

University of NSW

- Josef Dick has been promoted to Associate Professor with effect from January 2014.
- Catherine Greenhill has been promoted to Associate Professor with effect from January 2014.
- Jake Olivier has been promoted to Associate Professor with effect from January 2014.

UNSW Canberra

- Jason Sharples was promoted to Senior Lecturer from 1 July 2013.
- Dr Colin Simpson has joined the School of Physical, Environmental and Mathematical Sciences (UNSW Canberra) as a Postdoctoral Fellow. Colin will work as part of an ARC funded project involving coupled fire-atmosphere modelling of extreme bushfire dynamics.

University of Sunshine Coast

- Dr Robert McDougall has been appointed as Lecturer in Mathematics in the School of Science, Education and Engineering.

University of Sydney

- Anne Thomas left on 31 August to take up an appointment at the University of Glasgow.
- Brendan Creutz, John Enyang, Ivan Guo, Justin Koonin, and Takuya Matsumoto have completed their research positions.

University of WA

- Dr Neil Gillespie finished in his position as a Research Associate on 13 September 2013 and will be taking up a position at the University of Glasgow.
- In September, Joanna Fawcett started a two-year position as Research Associate, funded by an Australian Research Council Discovery Project grant awarded to John Bamberg, Alice Devillers, and Cheryl Praeger.

Conferences and Courses

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

ARC Centre of Excellence for Climate System Science Annual Workshop

Date: 10–13 November 2013
Venue: Cumberland Resort, Lorne, Victoria
Web: http://www.climatescience.org.au/2013-annual-workshop

DELTA 2013

Date: 24–29 November 2013
Venue: The Pavillion, Kiama, NSW
Web: www.delta2013.net

For more information, please see the conference website, or *Gazette* 40(1), p. 74.

Recent Developments of Nonlinear Partial Differential Equations

Date: 25–29 November 2013
Venue: Australian National University
Web: http://maths.anu.edu.au/events/recent-developments-nonlinear-pdes

For more information, please see the conference website, or *Gazette* 40(4), p. 285.

NSW–ACT 2013 ANZIAM meeting

Date: 27–28 November
Venue: University of Sydney
Web: http://www.maths.usyd.edu.au/u/olver/conferences/ANZIAM/

The plenary speakers are

- Nalini Joshi (The University of Sydney),
- Stephen Roberts (Australian National University),
- Ngamta Thamwattana (The University of Wollongong).

Contact the organiser (Sheehan Olver, sheehan.olver@gmail.com) or visit the website for further information.

2nd Annual Meeting of the Australian and New Zealand Association of Mathematical Physics (ANZAMP)

Date: November 27–29 2013
Venue: Mooloolaba on the Sunshine Coast
Web: http://www.anzamp.austms.org.au/meetings/current/abstract

We are delighted that the following Keynote Speakers will be attending:

- Peter Forrester (The University of Melbourne),
- Vladimir B. Matveev (Université de Bourgogne, France),
- John Roberts (The University of New South Wales),
- Robert Thompson (The University of Otago, New Zealand).

We now call for participating delegates to submit abstracts for their presentations. The online submission form is available at the website.

For anyone who has not yet registered and would still like to do so, please see www.maths.uq.edu.au/cmp/Workshops/ANZAMP2013/ANZAMP_2013.html for details. Delegates are encouraged to finalise bookings for their accommodation and travel as soon as possible.

ACWO2013: The 6th Australia-China Workshop on Optimization: Theory, Methods and Applications

Date: 28–30 November 2013
Venue: University of Ballarat
Web: http://www.ballarat.edu.au/schools/school-of-science-and-technology/research/conferences-and-workshops/the-6th-australia-china-workshop-on-optimization-theory,-methods-and-applications

For more information, please see the conference website, or *Gazette* 40(4), p. 286.

EMAC 2013: 16th Engineering Mathematics and Applications Conference

Date: 1–4 December 2013
Venue: Queensland University of Technology, Brisbane
Web: www.emac2013.com.au

Update: EMAC2013 will be held at the Science and Engineering Centre, QUT. We are very keen to make this a truly cross-disciplinary experience and want as many engineers to attend as possible. We would welcome staff and students who use mathematics in their engineering and scientific research to consider attending and presenting work at EMAC2013.

The conference features talks on any kind of mathematics/statistics applied in engineering, but we often see mathematics and statistics applied in biomedical engineering, electrical engineering, robotics, chemical engineering, computational fluid dynamics, environmental engineering, financial engineering, production planning, biology. Topics such as non-linear systems, operations research, optimisation, stochastic and statistical modelling, differential equations, dynamical systems, engineering mathematics education, and integer programming, quality control, regularly arise in EMAC talks and papers. As with other recent EMAC conferences, presenters will again be able to submit papers (following the conference conclusion) for refereeing and possible inclusion in the electronic supplement of the ANZIAM Journal.

The conference organising committee thank the following sponsors for their support:

- QUT Mathematical Sciences School,
- The Australian Mathematical Sciences Learning and Teaching Network (AMSLaTNet),
- Australian Scientific & Engineering Solutions (ASES),
- QUT Applied & Computational Mathematics Discipline,
- UQ Mathematics and Physics,
- Merlo Coffee.

For details, please see the conference website, or *Gazette* 40(2), p. 148–149.

MODSIM2013: International Congress on Modelling and Simulation

Date: 1–6 December 2013
Venue: Adelaide Convention Centre, South Australia
Web: http://mssanz.org.au/modsim2013

For more information, please see the website, or *Gazette* 40(2), p. 149.

Complex Analysis and Differential Geometry

Date: 2–5 December 2013
Venue: University of New England, Armidale, NSW
Web: http://turing.une.edu.au/~ssii/

Registration is available at the website; further details may be found there, and also at *Gazette* 40(4), p. 287.

BioInfoSummer: AMSI Summer Symposium in Bioinformatics

Date: 2–6 December 2013
Venue: University of Adelaide
Web: http://www.maths.adelaide.edu.au/biosummer2013/

Further details may be found at the website, and also at *Gazette* 40(4), p. 287. Note the correction to the venue here.

37ACCMCC: 37th Australasian Conference on Combinatorial Mathematics and Combinatorial Computing

Date: 9–13 December 2013
Venue: University of Western Australia
Web: http://37accmcc.wordpress.com
Contact: Director: Professor Gordon Royle (37accmcc at uwa.edu.au)

For more information, please see the conference website, or *Gazette* 40(2), p. 149.

Mathematical Modelling and Numerical Solutions

Date: 9 or 16 December 2013
Venue: Wagga Wagga, NSW
Web: http://www.amsi.org.au/index.php/events-mainmenu/forthcoming-events/

This event will be advertised on the website soon.

Limits to Growth

Date: 11–12 December 2013
Venue: University of New South Wales
Web: http://mathsofplanetearth.org.au/events/limits-to-growth-beyond-the-point-of-inflexion/

The School of Mathematics and Statistics at UNSW is hosting a full-day symposium on Limits to Growth on 11 December 2013 at Parade Theatre, NIDA, Sydney. This will be followed by a Question and Answer session on the evening of

the 12 December 2013 at UNSW. The event is part of this year's Mathematics of Planet Earth. The focus of the event will be to address key questions: Is economic growth forever sustainable? What impact would a stagnant or declining population have on GDP? Can mathematical models guide policy makers in answering these questions? What is the strategic plan for planet Earth?

A little over forty years ago, an international team led by Donella Meadows, Dennis Meadows, Jørgen Randers, and William Behrens III carried out a major study of growth in five key areas: population, agricultural production, natural resources, industrial production, and pollution. The team concluded that, if current trends continued, limits to growth would be realised within one hundred years with a sudden and uncontrollable decline in population and industrial capacity. Many of the projections on resources and pollution proved to be incorrect, with technological advances reversing trends. However the central (mathematical) result, that continued exponential growth is not sustainable indefinitely, is indisputable, and we have now entered an era, beyond the point of inflexion, where the rate of population growth is slowing.

The Limits to Growth symposium on Wednesday 11 December will feature a range of prominent keynote speakers, including:

- Professor Graciela Chichilnisky, Professor of Economics, Columbia University, architect of the carbon credit emissions trading market underlying the Kyoto Protocol;
- Graeme Maxton, Economist, Fellow of the International Club of Rome, author of The End of Progress;
- Professor Jørgen Randers, Professor of Climate Strategy, BI Norwegian Business School, co-author of *Limits to Growth* and author of *2052*;
- Professor Peter Victor, Professor in Environmental Studies, York University, author of *Managing without Growth*;
- Ross Gittins AM, Economics Editor, *Sydney Morning Herald*;
- Professor Clive Hamilton AM FRSA, Professor of Public Ethics, Centre for Applied Philosophy and Public Ethics, author of *Growth Fetish*;
- Ken Henry AC, Economist, Former Secretary of the Department of Treasury;
- Brian Pink, The Australian Statistician, Head of the Australian Bureau of Statistics.

Several of the speakers will participate in a public panel discussion and Q&A event on Thursday 12 December in UNSW's Leighton Hall, facilitated by Ticky Fullerton (journalist for the ABC and presenter of The Business). Info and bookings: http://mpel2g.net/.

2014 AMSI Summer School

Date: 6 January to 31 January 2014
Venue: Mathematical Sciences Institute at the Australian National University
Web: http://maths.anu.edu.au/events/2014-amsi-summer-school-mathematical-sciences

Online registration is now open. The first round of registration closed on 2 November. Registrations will still be accepted, subject to availability of places and financial support. Registration closes on 30 November. Please try to register as early as possible.

We will be presenting the following courses:

- Finite element method;
- Statistical inference;
- Bioinformatics;
- Differential geometry;
- K theory;
- Introduction to conformal field theory and string theory for mathematicians;
- Hydrodynamic stabilitiy;
- High dimensinal data.

For more information, including detailed course descriptions, see the website.

Sydney Random Matrix Theory Workshop

Date: 13–16 January 2014
Venue: The University of Sydney
Web: http://www.maths.usyd.edu.au/u/olver/conferences/RMT.html

This workshop is on recent and future advances in the analysis, computation and application of random matrices. Random matrix theory is an active and vibrant field with exciting recent theoretical developments in universality, and deep connections with many different areas of mathematics: free probability, integrable systems, orthogonal polynomials and stochastic differential equations.

In the last few years, powerful computational tools have been developed, allowing for a deeper understanding of random matrices. Random matrices are also becoming increasingly important in applications, including statistics and wireless. The workshop will provide a valuable forum for interaction between the many subareas of random matrices.

The workshop aims to bring together experts on a huge variety of random matrc theory topics — computational methods, free probability, Riemann–Hilbert problems and applications.

Confirmed speakers include:

- Professor Pavel Bleher (IUPUI);
- Professor Dr Folkmar Bornemann (TU Munich);
- Dr Tom Claeys (UC Louvain);
- Associate Professor Ioana Dumitriu (U Washington);
- Professor Alan Edelman (MIT);
- Professor Alexander Its (IUPUI);
- Professor Arno Kuijlaars (KU Leuven);
- Professor Kenneth McLaughlin (University of Arizona);
- Professor Peter Miller (University of Michigan);

- Dr Tom Trogdon (NYU);
- Assist. Professor Raj Rao Nadakuditi (University of Michigan);
- Dr Nicholas Witte (University of Melbourne).

The workshop will be open to all, with student attendance strongly encouraged, and will provide a valuable opportunity for world-class researchers in random matrix theory to interact with Australian academics. It will also help to establish Australia as a major hub for research in this exciting field.

NZMRI Summer School on Operator Algebra

Venue: Te Anau, New Zealand
Date: 13–17 January 2014
Web: http://www.maths.otago.ac.nz/nzmri14/

The School will start with talks by Vaughan Jones (Vanderbilt University, Berkeley) and Aidan Sims (University of Wollongong) titled 'What is a von Neumann algebra' and 'What is a C*-algebra'. The main speakers will be Ruy Exel (Universidade Federal de Santa Catarina), Jesse Peterson (Vanderbilt University), Sorin Popa (University of California at Los Angeles) and Aidan Sims.

Please see the website for more information.

ANZAMP Symposium on probability in statistical mechanics

Date: Friday 17 January 2014
Venue: AMSI Access Grid Room, The University of Melbourne
Web: http://www.ms.unimelb.edu.au/~degier/index.php?page_ref_id=361

Program
• 10–11am: Rick Kenyon (Brown University), 'Limit shapes for random surfaces'
• 11:30am–12:30pm: Wendelin Werner (ETH Zurich), 'Phase transitions and conformal invariance within planar fractal carpets'

Participation is free. If you plan to attend please register by sending an email to jdgier@unimelb.edu.au. Note that this event will also be broadcast over AGR as part of the AMSI/ANZAMP National Seminar Series. Further details will follow.

From Random Walks to Lévy Processes conference

Date: 25–30 January 2014
Venue: Australian National University (Kioloa Coastal Campus)
Web: http://maths.anu.edu.au/events/kioloa-conference-random-walks-l%C3%A9vy-processes/

This five-day conference aims to provide a unique opportunity for Australian researchers, practitioners and students to hear, meet and mingle with some of the most prominent international and Australian researchers currently working in Lévy processes or closely related areas.

Lévy processes are stochastic processes on the Euclidean space, stochastically continuous and with stationary independent increments. They were introduced by

Paul Lévy in the 1930s as a generalisation of both Brownian motion and random walks, and vigorous theoretical development involving some of the most prominent mathematicians and probabilists to this day. Most recently, a need for modelling jumps, extremes and in general heavy-tailed behaviour of naturally occurring distributions has led to a redoubled effort in the theory, and extensive development of practical applications of Lévy processes.

Confirmed speakers include:

- Professor Jean Bertoin (University of Zurich, Switzerland);
- Professor Andreas Kyprianou (Bath, UK);
- Professor Ron Doney (Manchester, UK);
- Professor Philip Griffin (Syracuse, USA);
- Professor Alex Novikov (UTS, Sydney);
- Professor Fima Klebaner (Monash University, Melbourne);
- Dr Victor Rivero (CIMAT, Mexico).

KOZWaves: The first international Australasian conference on wave science

Date: 27–29 January 2014
Venue: Newcastle City Hall, NSW
Web: http://carma.newcastle.edu.au/meetings/kozwaves/

KOZWaves will be the first international Australasian conference on wave science. It will provide a forum for contemporary research on wave science to be disseminated between the different branches of wave theory and its applications.

It will promote interdisciplinary collaborations between Australasian wave scientists, and also with leading international researchers.

The overarching aim of KOZWaves is to accelerate research progress in the various application areas of wave science conducted in Australasia, by sharing recent research advances and exploiting the mathematical connection between the different types of wave phenomena.

KOZWaves will focus, in particular, on development of theoretical and numerical tools to analyse waves. This will result in more accurate predictions of wave behaviours, and understanding how to control the unique properties of waves for our benefit.

Confirmed speakers include:

- Professor Alex Babanin (Swinburne University of Technology, Australia);
- Professor Kenneth Golden (University of Utah, USA);
- Dr Paul Martin (Colorado School of Mines, USA);
- Professor Graeme Milton (University of Utah, USA);
- Professor Alexander Movchan (Liverpool University, UK);
- Dr Vincent Pagneux (University of Le Mans, France.);
- Dr Richard Porter (University of Bristol, UK);
- Dr Anne-Sophie Bonnet (ENSTAParistech, France);
- Professor Vernon Squire (University of Otago, New Zealand);
- Professor Peter Wadhams (University of Cambridge, UK).

Mathematics in Industry Study Group

Date: 28 January – 1 February 2014
Venue: Queensland University of Technology
Web: http://mathsinindustry.com/

Please see the website for more information.

Call for abstracts: Fluids in New Zealand 2014

Date: 29–31 January 2014
Venue: University of Auckland, New Zealand
Web: homepages.engineering.auckland.ac.nz/~jden259/FiNZ2014

For more information, please see the conference website, or *Gazette* 40(4), p. 288.

ANZIAM 2014

Date: 2–6 February 2014
Venue: Millennium Hotel, Rotorua, New Zealand
Web: http://anziam2014.auckland.ac.nz

Early-bird registration is available until 15 December 2013.

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

Invited speakers:

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

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

Early Career Workshop

Date: 7 February 2014
Venue: Rotorua, New Zealand
Web: http://www.math.canterbury.ac.nz/ANZIAM_ECW_2014/

ANZIAM and AustMS are organising a free workshop for early career academics to be held straight after the ANZIAM meeting in Rotorua on 7 February 2014. Please encourage your PhD students, postdocs and early career colleagues to come along. For details see the webpage.

Registration is through the usual ANZIAM conference registration process. Contact Roslyn Hickson (Roslyn.Hickson@newcastle.edu.au) if you would like more information.

ECW organising committee: Richard Brown, Roslyn Hickson and Alex James.

Geometric Invariance and Nonlinear Partial Differential Equations

Date: 9–14 February 2014
Venue: Coastal Campus of the ANU (Edith and Joy London Estate), Kioloa, NSW
Web: http://maths.anu.edu.au/events/geometric-invariance-and-nonlinear-partial-differential-equations

Under the sponsorship of ANU and AMSI, this conference is the second major event in the ANU Mathematical Sciences Institute 2013 Special Year on Nonlinear Partial Diferential Equations. The aim of the meeting is to bring together Australian and international researchers in geometric aspects of nonlinear PDE with particular emphasis on: geometric flows and their applications; affine, conformal,complex and convex geometric structures as well as problems arising from Lie group invariances.

All members of the Australian Mathematical Society are invited to participate. For further details together with accommodation and registration arrangements, see the webpage.

Big Day In for Vacation Scholars

Date: 11–12 February 2014
Venue: Law building, University of NSW
Web: http://www.amsi.org.au/index.php/events-mainmenu/forthcoming-events/165-events/science-events-2013/1078-amsi-vacation-research-scholarships-summer-2013-14

GAGTA8: Geometric and Asymptotic Group Theory with Applications

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

This 2014 edition of the highly successful conference series, GAGTA (Geometric and Asymptotic Group Theory with Applications) will take place in Newcastle Australia.

GAGTA is a series of conferences organised periodically, since 2005, by researchers in Group Theory all over the world.

This five-day conference will bring together the world's leading researchers in geometric and asymptotic group theory. The program will include informal discussions, networking and collaboration, and opportunities for younger researchers to present their work.

GAGTA conferences are devoted to the study of a variety of areas in Geometric and Combinatorial Group Theory, including asymptotic and probabilistic methods, as well as algorithmic and computational topics involving groups.

In particular, areas of interest include group actions, isoperimetric functions, growth, asymptotic invariants, random walks, algebraic geometry over groups, algorithmic problems and their complexity, generic properties and generic complexity, and applications to non-commutative cryptography.

Speakers include:

- Kate Juschenko (Northwestern, USA);
- Olga Kharlampovich (Hunter College, USA);
- Alexei Miasnikov (Stevens Institute of Technology, USA);
- Sarah Rees (Newcastle Upon Tyne, UK).

Workshop in Harmonic Analysis and its Applications

Date: 21–25 July 2014
Venue: Macquarie University

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

The main themes of the workshop will include:

- Dyadic and multiparameter harmonic analysis;
- Analysis on manifolds;
- Function spaces;
- Singular integrals;
- Weighted inequalities;
- Applications of harmonic analysis and related topics such as wavelets.

Registration details and website to be released shortly.

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 Tarje Bagheer; University of Copenhagen, Denmark; 14 February 2012 to 13 February 2014; UMB; Craig Westerland

Dr Cathryn Birch; University of Leeds, UK; 5 November 2013 to 20 December 2013; deep tropical convection; MNU; Michael Reeder

Toralf Burghoff; University of Jena, Germany; 2 April 2013 to 31 March 2014; UOM; Kostya Borovkov

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 Arjeh Cohen; Eindhoven University of Technology; 1–13 November 2013; MAGMA; USN; John Cannon

Prof Robert Coquereaux; Centre de Physique Theorique; 4–17 November 2013; Pure; USN; Ruibin Zhang

Prof Jean Pierre Crouzeix; University Blaise Pascal, France; optimization; 3–23 February 2014; UBR; Julien Ugon

Prof Aris Daniilidis; University of Chile, Santiago; optimization; 28 November to 9 December 2013; UBR; Alex Kruger

A/Prof Oleg Lisovyi; Laboratoire de Mathematiqes et Physique Theorique; 13 November to 18 December 2013; Painleve theory; USN; Nalini Joshi

Prof Marco Lopez; University of Alicante; optimization; 30 October to 21 November 2013; UBR; Alex Kruger

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

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

Prof Hu Shao; China University of Mining and Technology; optimization; 15 November to 15 December 2013; UBR; Zhiyou Wu

Prof Meir Shillor; University of Oakland, USA; optimization; 6–26 January 2014; UBR; David Gao

Sara Taskinen; University of Jyväskylä, Finland; January to December 2013; robust multivariate analysis and applications in ecology; UNSW; David Warton

Prof Michel Thera; University of Limoges, France; optimization; 11–20 November 2013; UBR; Alex Kruger

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

Binzhou Xia; Peking University; 1 September 2012 to 20 March 2014; UWA; Cai Heng Li

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

Nominations sought for the 2014 AustMS Medal

The Medal Committee for the 2014 Australian Mathematical Society Medal is now seeking nominations and recommendations for possible candidates for this Medal, which will be awarded to a member of the Society, under the age of forty, for distinguished research in the Mathematical Sciences.

For further information, please contact (preferably by email) the Chair of the 2014 Medal Committee, Professor K.A. Smith-Miles, School of Mathematical Sciences, Monash University, PO Box 28M, Victoria 3800 (kate.smith-miles@monash.edu). Nominations should be received by 30 May 2014.

The other three members of the 2014 Medal Committee are Professor J.A. Filar (Outgoing Chair), Professor N.C. Wormald (Incoming Chair) and Dr L. Ward (one year).

See http://www.austms.org.au/AMSInfo/medal.html for a list of past AustMS Medal winners.

Rules for the Australian Mathematical Society Medal

1. There shall be a Medal known as 'The Australian Mathematical Society Medal'.
2. (i) This will be awarded annually to a Member of the Society, under the age of 40 on 1st January of the year in which the Medal is awarded, for distinguished research in the Mathematical Sciences. The AustMS Medal Committee may, in cases where there have been significant interruptions to a mathematical career, waive this age limit by normally up to five years.
   (ii) A significant proportion of the research work should have been carried out in Australia.
   (iii) In order to be eligible, a nominee for the Medal has to have been a member of the Society for the calendar year preceding the year of the award; back dating of membership to the previous year is not acceptable.
3. The award will be approved by the President on behalf of the Council of the Society on the recommendation of a Selection Committee appointed by the Council.
4. The Selection Committee shall consist of three persons each appointed for a period of three years and known as 'Incoming Chair', 'Chair' and 'Outgoing Chair' respectively, together with a fourth person appointed each year for one year only.
5. The Selection Committee will consult with appropriate assessors.
6. The award of the Medal shall be recorded in one of the Society's Journals along with the citation and photograph.

7. The Selection Committee shall also prepare an additional citation in a form suitable for newspaper publication. This is to be embargoed until the Medal winner has been announced to the Society.
8. One Medal shall be awarded each year, unless either no one of sufficient merit is found, in which case no Medal shall be awarded; or there is more than one candidate of equal (and sufficient) merit, in which case the committee can recommend the award of at most two Medals.

Nominations sought for the 2014 George Szekeres Medal

The Medal Committee for the 2014 George Szekeres Medal is now seeking nominations and recommendations for possible candidates for this Medal. The George Szekeres Medal is awarded for outstanding research achievement for work done substantially in Australia. It is awarded only in even-numbered years.

Nominations, to be sent to the Committee Chair, should include: (a) an extended citation, not more than two pages in length, arguing the case for awarding the Medal to the nominee; (b) a shorter citation, of not more than 100 words, which may be used to report the candidate's achievements in the event that the nomination is successful; (c) a full list of publications of the candidate, with the most significant (up to a maximum of 20) marked by an asterisk; (d) a curriculum vitae of the candidate's professional career, highlighting any achievements which add support to the nomination; and (e) the names of between three and six suitable referees, along with a brief statement as to their appropriateness.

Nominations close on 30 May 2014.

For further information, please contact (preferably by email) the Chair of the 2014 George Szekeres Medal Committee, Professor J.H. Rubinstein (Rubin@ms.unimelb.edu.au).

Other members of the 2014 George Szekeres Medal Committee are Professor A.J. Guttmann (Outgoing Chair), Professor P.G. Hall (Incoming Chair) and Professor A.L. Carey.

See http://www.austms.org.au/The+George+Szekeres+Medal for a list of past winners of the Medal.

Rules for the George Szekeres Medal of the AustMS

Rule 1. The award is for a mathematical scientist who is a member of the Australian Mathematical Society and normally resident in Australia.

Rule 2. The medal may, in exceptional circumstances, be shared by at most two candidates.

Rule 3. The Medal is awarded every two years.

Rule 4. (i) The award is for a sustained outstanding contribution to research in the mathematical sciences. The candidate should have been resident in Australia when the bulk of the work was completed.

(ii) The successful candidate will have an excellent record of promoting and supporting the discipline, through activities such as extensive graduate student supervision, outstanding contributions to leadership in the Australian Mathematical Society, or other activities which have materially promoted the mathematical sciences discipline within Australia.

Rule 5. (i) The George Szekeres Medal can be awarded to a recipient of the Australian Mathematical Society Medal, provided that the sustained outstanding contribution to research in Rule 4(i) is subsequent to the work for which the Australian Mathematical Society Medal was awarded.

(ii) The George Szekeres Medal cannot be awarded to the same person on more than one occasion.

Nominations sought for the 2014 Gavin Brown Prize

The 2014 Gavin Brown Prize Selection Committee is now seeking nominations and recommendations for possible candidates for this prize, to be awarded for an outstanding and innovative piece of research in the mathematical sciences published by a Member or Members of the Society. The award will be for a single article, monograph or book consisting of original research, and published in the nine calendar years preceding the year of the award.

To be eligible for the award of the Gavin Brown Prize, a publication must have at least one author who meets the following conditions:

(i) he/she must be a member of the Society, and must have been a member of the Society for the calendar year at the time of publication of the paper (back-dating of membership is not allowed);

(ii) he/she must be normally resident in Australia, and must have been normally resident in Australia at the time when the research was carried out.

In the case of publications with multiple authors, the prize will be shared by all authors. The existence of authors who do not meet the conditions above will not preclude this award, although the Selection Committee may take it into account in assessing the achievement of the author(s) who do meet those conditions.

The Selection Committee may deem a publication ineligible if an author has previously received an award from the Australian Mathematical Society for a body of research which included the publication in question.

A publication may be nominated for the award by any member of the Society who is not an author of that publication.

Nominators should provide a brief (1–2 pages) summary of what makes the nominated publication important and original, with appropriate references to prior or subsequent work in the field. These should be sent by email to the Chair of the selection committee, and all nominations should be received via email by 30 May 2014.

The Selection Committee may consult with appropriate external assessors.

For further information, please contact by email, the Chair of the 2014 Gavin Brown Prize Selection Committee, Professor N.S. Trudinger, Centre for Mathematics and its Applications, Australian National University, ACT 0200 (Neil.Trudinger@anu.edu.au).

The other members of the 2014 AustMS Gavin Brown Prize Selection Committee are

Outgoing Chair: Professor P.G. Hall
Incoming Chair: Professor J.M. Borwein
One-year member: Dr C.M. O'Keefe.

Special Interest Meetings

Applications are now considered twice a year, at the start of June and the start of December. The next two closing dates are 4 December 2013 and 6 June 2014. Applications are now required at least three months in advance of the meeting rather than at least six months.

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, Associate Professor Peter Stacey, Department of Mathematics and Statistics, La Trobe University, Victoria 3086 (Secretary@austms.org.au).

News from the Annual General Meeting

The Society's 57th Annual Meeting was held recently at the University of Sydney. The Director, Associate Professor Laurentiu Paunescu, his team of local organisers and the Program Committee, led by the Vice-President (Annual Conferences), were responsible for a very successful conference.

The following matters from the meeting are provided here for the information of those who could not attend. The draft minutes of the AGM will be placed in the members' section of the Society's website.

(1) Council has conferred Honorary Membership of the Society on Professor C.E. Praeger AM FAA FAustMS, in recognition of her outstanding work for the Society and for mathematics in Australia, Professor J.H. Rubinstein FAA FAustMS, in recognition of his outstanding work for the Society and for mathematics in Australia and Dr A.A.T. Howe, in recognition of his outstanding work for the Society as Treasurer for 20 years.

(2) The Australian Mathematical Society Medal for 2013 was awarded to Dr Craig Westerland of the University of Melbourne.

(4) The Gavin Brown Prize for 2013 was not awarded. Following recommendations from the Prize Committees for 2011, 2012 and 2013, Council resolved to change the rules for the Gavin Brown Prize so that articles are eligible

if they are published in the nine calendar years preceding the year of award rather than the preceding six years. It also resolved that, henceforth, in each year the prize will be for publications in any area of the mathematical sciences. The membership of the Prize Committee will therefore be changed to mirror that of the Society's two Medal Committees.

(5) The 2013 B.H. Neumann Prize was awarded to Adrian Dudek of the Australian National University for his talk entitled 'Primes in short intervals'. Five student talks were given honourable mentions. These were talks by Alex Amenta (Australian National University), Stephen McCormick (Monash University), John Nakhoul (University of Sydney), Matthew Tam (University of Newcastle) and TriThang Tran (University of Melbourne).

(6) The Early Career Workshop, organised by Natalie Thamwattana, Andrew Francis and Norman Do on 28–29 September, was a great success. Next year there will be two workshops, one in February immediately following the ANZIAM meeting in Rotorua, New Zealand and the other in December preceding the Society's meeting in Melbourne. To even out gaps between workshops, there will henceforth be two workshops in even years and a short workshop, not requiring overnight accommodation, in odd years.

(7) It was confirmed that the fifty-eighth Annual Meeting of the Society will be held at the University of Melbourne from Monday 8 December to Friday 12 December 2014, jointly with the New Zealand Mathematical Society as the 8th Australia-New Zealand Mathematics Convention, with Associate Professor P.T. Norbury as Director.

It was provisionally determined that the fifty-ninth Annual Meeting of the Society will be held at Flinders University from Monday 28 September to Thursday 1 October 2015 with Associate Professor V. Ejov as Director.

(8) Members at the Annual General Meeting supported moving the Society's annual conference to early December from 2016 and seeking to increase the number of joint meetings (for example with ANZIAM, with the Combinatorial Mathematics Society of Australasia and with foreign mathematical societies).

(9) Following the constitutional changes approved by members, Council resolved to remove the restriction that free membership of the Society would be available to undergraduate students only in exceptional circumstances.

(10) Council revisited its decision, made last year, to discontinue the Society's Program Review Scheme and decided to collaborate with AMSI in the development of a revised scheme.

(11) Council established a working party, chaired by the President, to review the funding of Special Interest Groups and Divisions.

(12) Council received a request from the ANZAMP Special Interest Group to become a Division of the Society. Council decided that a threshold of roughly 80 Ordinary Members of the Society should be a requirement for the establishment of a Division and further decided that the membership requirements of any other Divisions should match those of ANZIAM. ANZIAM currently requires that its members should be members of the Society unless they are

not normally resident in Australia, in which case they should be members of a society with which the Society maintains a reciprocity agreement. It was noted that ANZIAM is considering requiring its non-resident members to be reciprocal members of the Society and it was agreed that if Council approves this change then it will apply to all Divisions.

(13) Council received a request from the Women in Mathematics Special Interest Group to receive annual funding to establish Travel Grants for Women in Mathematics and Grants for Carers. It approved initial annual funding of $6400 for the first of these and $1600 for the second.

The Special Interest Group also flagged a proposal to seek funding from the Society, AMSI and relevant universities to establish an annual Advocate for Women in Mathematics, to give talks and facilitate forums related to mathematics in three cities around Australia. Council agreed in principle to contribute an annual amount of $2000 to such a scheme but deferred a final decision until it receives a detailed scope and full budget.

(14) Following a recommendation from Steering Committee, Council established a working party to seek ways of extending our membership base, including improving the retention of members.

(15) To avoid requiring a service from meeting organisers and thus attracting GST, Council changed some of its conference support rules from rules to requests. It was also decided to require applications at least three months before the meeting rather than at least six months.

(16) AMPAI resolved that, for a fee to be set by AMPAI after consultation with CUP, the author of any article to be published in the Society's journals be offered the choice to make the article freely available. This option would not be offered to an author of an article until it had been accepted for publication.

Amendments to the Consitution

In a postal ballot conducted on 2 September 2013, members agreed to change paragraphs 3, 4, 7, 8, 10, 11, 12, 13, 14, 15, 25, 33, 35, 37, 40, 45, 46, 47, 55, 56, 57, 58, 59, 65, 66, 67, 68, 71, 72, 74, 76, 77, 81, 82, 83, 84, 85, 90 and 92 of the Society's Constitution. There were 308 validated votes of which 301 were in favour of the amendments, 6 were against and 1 was informal.

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

ANU:	K. Wicks	Swinburne Univ. Techn.:	J. Sampson
Aust. Catholic Univ.:	B. Franzsen	Univ. Adelaide:	T. Mattner
Bond Univ.:	N. de Mestre	Univ. Ballarat:	D. Yost
Central Queensland Univ.:	*Vacant*	Univ. Canberra:	P. Vassiliou
Charles Darwin Univ.:	I. Roberts	Univ. Melbourne:	B. Hughes
Charles Sturt Univ.:	P. Charlton	Univ. Newcastle:	J. Turner
CSIRO:	C. Bengston	Univ. New England:	G. Schmalz
Curtin Univ.:	J. Simpson	Univ. New South Wales:	C. Tisdell
Deakin Univ.:	L. Batten	Univ. Queensland:	H.B. Thompson
Edith Cowan Univ.:	U. Mueller	Univ. South Australia:	K. White
Flinders Univ.:	R.S. Booth	Univ. Southern Queensland:	T. Langlands
Griffith Univ.:	A. Tularam	Univ. Sunshine Coast:	P. Dunn
James Cook Univ.:	S. Belward	Univ. Sydney:	P. Kim
La Trobe Univ.:	K. Seaton	Univ. Tasmania:	B. Gardner
Macquarie Univ.:	R. Street	Univ. Technology Sydney:	E. Lidums
Monash Univ.:	A. Peres	Univ. Western Australia:	T. Blackwell
Murdoch Univ.:	M. Lukas	Univ. Western Sydney:	R. Ollerton
Queensland Univ. Techn.:	G. Pettet	Univ. Wollongong:	J. McCoy
RMIT Univ.:	Y. Ding	UNSW Canberra:	H. Sidhu
Southern Cross Univ.:	G. Woolcott	Victoria Univ.:	A. Sofo

Publications

The Journal of the Australian Mathematical Society

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

The ANZIAM Journal

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

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

Bulletin of the Australian Mathematical Society

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

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

The Australian Mathematical Society Lecture Series

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

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

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