ASC/NZSA 2006

This joint conference of the Statistical Society of Australia Inc (SSAI) and the New Zealand Statistical Association (NZSA) was held in Auckland from July 3 to 6. Top-class keynote speakers led a rich programme of 48 invited talks, 150 contributed talks and 16 poster sessions for the 290 participants. See more programme details at www.statsnz2006.com.

Photos: Harold Henderson and Rod Ball

The dance of mathematics

At first glance, a connection between Scottish Country Dancing and complex mathematics is not immediately obvious. Anna Meyer investigates.

Developed in the 18th century, Scottish Country Dancing is believed to be derived from English country dancing, brought to Scotland by the gentry who had enjoyed it while on holiday. In this social form of dance that predates modern ballroom dancing, groups of couples follow precise, progressive footwork patterns, accompanied by different types of music.

In a classic example of the subtle relationship between maths and art, Rod Downey, a Professor of Mathematics at Victoria University and the first Maclaurin Fellow of the NZIMA, uses his mathematical work as inspiration for the dances he writes and performs as part of his favourite hobby.

Professor Downey's research involves understanding algorithmic processes, a discipline that has applications in many areas, particularly computer science. "An algorithm is a recipe for doing something," he explains. "There are a lot of theorems you can prove, but if you want to implement them in some form, say on a computer, you need an algorithm, so the computer can execute them in little steps. For example, when you turn your computer on, sitting behind there are algorithms. I guess you could call it on the borderline between mathematics and computer science."

Look closer, and it becomes clear that Scottish country dances bear a striking resemblance to algorithms – indeed, to mathematics as a whole. Dances are written as a series of logical steps that participants must follow sequentially, and numbers are everywhere – in the number of couples, the precise formations they dance, and how the dance steps relate to the timing of the music.

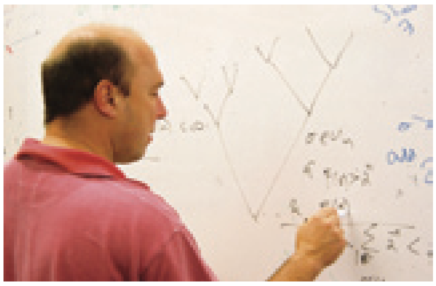
"When you devise dances, you have to think about things moving in space, visualise what's going on," Professor Downey explains. "With a lot of the mathematics I do, you have to do the same kind of thing. I do phrasing and patterns in dances rather similarly to doing proofs – it's just that it's a little bit easier."

Mathematicians, he believes, actually make some of the best choreographers. "It's noticeable that a lot of the best dance devisors down through the years have actually been mathematicians. For example, Hugh Foss was one of the original devisors of modern dances, and he was a well-known mathematician who worked at Bletchley Park, decoding."

Professor Downey began dancing on the suggestion of his wife, Kristin, who had learned the hobby while living in Singapore. "I played a lot of sport when I was young, and I kept on getting injured, so my wife said "why don't you come along and see what it's like?" I went along and I liked it."

Now a qualified teacher, he has written a book of new dances, The Cane Toad Collection, and is working on a second one. Dance titles that include They Stole My Wife From Me Last Night, Jill's Dental Jig, and Buttermilk Falls, reflect the fact that the dances are full of personality and interest.

When not at work or involved in dancing, Professor Downey can often be found indulging in his other favourite hobby – surfing at Makara Point or in the Wairarapa. This, however, does not have a maths basis. "That's purely just for pleasure," he says.



Robert Downey
Photo: Myles Herschell, drawn from Revisioning Science, a photo-essay project developed by Massey University and funded by the Government's Science and Technology Promotion Fund.

> **Black holes are where God divided by zero.**
> *Steven Wright*

MATHEMATICAL EVENTS

4-6 December 2006, Hamilton
NZ Mathematics Colloquium
Contact: Stephen Joe, Mathematics Department, University of Waikato, stephenj@math.waikato.ac.nz

8-13 January 2007, Bay of Islands
NZIMA Summer Workshop on partial differential equations: Analysis, applications and inverse problems www.math.auckland.ac.nz/~fox/SummerWorkshop.html

28 January to 1 February, Fremantle, WA
ANZIAM 2007, annual conference of the professional association for industrial and applied mathematics in Australia and New Zealand
www.anziam07.murdoch.edu.au/

29 January to 2 February, Fiji
SPM07 Second South Pacific Conference on Mathematics
www.riemann.usp.ac.fj/~spcm07/

5-9 February, Wollongong, NSW, Australia
MISG-07 Mathematics-in-Industry Study Group 2007
* Cost reduction for NZ students affiliated with the NZIMA*
www.misg.math.uow.edu.au/

16-20 April, Hanmer Springs
NZIMA Programme Workshop on Modelling Invasive Species and Weed Impact
www.math.canterbury.ac.nz/bio/NZIMA/

Quandles knots & manifolds

Topology is a pure maths discipline, but a focus of the NZIMA Summer Meeting on topology in January was the cracking of current banking and financial encryptions. Jenny Rankine investigates.

Meeting speakers Michael Freedman and Kevin Walker, of Microsoft, explored topological quantum field theory, developed originally to measure the set of all loops on a surface – what topologists call the fundamental group. They discussed the potential of these coding methods for breaking cryptographic systems based on integer factorisation, widely used in banking.

Co-director of the NZIMA programme on Geometric Methods in the Topology of 3-Dimensional Manifolds, Professor David Gauld, of the University of Auckland, said the Taipa meeting this year attracted 60 people, from Australia, Japan, North America, the UK and around New Zealand.

The meetings were initiated by programme co-director Professor Vaughan Jones in 1994, and focus on a different branch of mathematics each year. Until this year Professor Jones was the southern hemisphere's only Fields Medallist, the maths equivalent of the Nobel Prize. It was awarded to him in 1990 by the International Mathematical Union for a new polynomial knot invariant (an object that distinguishes one theoretical knot from another), which was named after him.

Topology is sometimes called rubber sheet geometry, because it concerns itself with the spatial properties that are preserved after shapes are stretched or deformed without breaking. It does not distinguish between a square and a circle (as a rubber band circle can be stretched into a square) and it ignores distances (so that two different sized circles are equivalent in a topological universe).

Professor Gauld is studying manifolds – abstract mathematical spaces – that are too big to measure; some physicists think the universe is an example. "If we're trying to apply the maths to the universe, there's a long way to go," he says. "I'm still dabbling in two dimensions and physicists want solutions for three to ten dimensions."

The programme's third co-director, Dr Roger Fenn, of the University of Sussex, is working with PhD student Stevie Budden on quandles. These algebraic objects give rise to knot invariants. BSc honours student Michael Brough is doing his dissertation on a new knot invariant. Applications of knot theory include DNA recombination.

"People say pure mathematicians are just playing games with bunches of rules," says Gauld. "The amazing thing is that so often, ten or 50 years later, these great applications arise. When I first heard about topological quantum field theory in 1994, there was no mention of their connection with banking encryptions."

$$V = -t^{-3} + 3t^{-2} - 3t^{-1} + 4 - 4t + 3t^2 - 2t^3 + t^4$$

NOTABLE MATHS PROBLEMS

POINCARÉ CONJECTURE

(1900) If M is a 3-manifold with trivial fundamental group, and Π_i(M)=0 for i=1,2 and =Z for i=0,3 (ie, M has the homotopy groups of a 3-sphere), then M is homeomorphic to the 3-sphere.

Simply: (1904) That if any loop on the surface of a three-dimensional shape can be shrunk to a point (as any loop can on a 3-D sphere) then the shape is just a 3-D sphere.

Discipline: Topology

Originator: Jules Henri Poincaré, 1854-1912.

Incentive: $US1million, one of the seven Millennium Prize Problems of the Clay Mathematics Institute.

Notable false proof: JHC Whitehead, 1934.

Has led to: Interesting new examples of 3-manifolds; several celebrated cases of Poincaritis.

Unusual aspect: Solving this problem in four and more dimensions has been much easier than solving it in three.

Likely proof: Grigori Perelman, Steklov Institute of Mathematics, St Petersberg, 2002 and 2003, although the Clay prize has yet to be awarded.

NZIMA programme connection: Geometric Methods in the Topology of 3-Dimensional Manifolds.


Meeting participants Gabriela Slezakova and Qing Zhang, students at Waikato and Massey. Right: Vaughan Jones.