New Zealand Institute of Mathematics & its Applications

Breaking our Olympiad records

New Zealand's International Mathematics Olympiad (IMO) team this year in Kazakhstan broke three New Zealand records.

This was the first IMO in which all team members won medals, and the first with two silvers.

Silver medallists were Malcolm Granville and Tom Yan (Auckland Grammar School), with bronze medallists Stephen Mackereth, (King's College), Yuan Wang (Hillcrest High School), Robert Zhang (Auckland Grammar) and Sicong Zhang (Auckland International College). New Zealand also achieved its highest ever international ranking, 29th out of 97 countries.

Granville says it was a combination of an unusually strong team, well-suited questions, and studying together. Team leader Dr Chris Tuffley, from Massey University in Palmerston North, thought members' own study and fortnightly Auckland training sessions helped, as did as did the extra experience from competitions during team selection.

Professor Ivan Reilly, chair of the NZ Mathematical Olympiad Committee (MOC) since 1986, credits the Auckland sessions by Arkadii Slinko and PhD students and the gradual improvement among the top five percent of maths students.

While there were no girls in this year's team, Reilly says New Zealand has sent more girls to the IMO than any other country.

"We've had some outstanding girls in the team. In 1991, when I was leader, Diane Maclagan was the third highest-achieving girl at the Olympiad." She is now an Associate Professor at the Mathematics Institute at the University of Warwick.

"Medallists often get offered scholarships by New Zealand universities, but those who do very well get offers from overseas, where they know that these kids don't have the support available in other countries."

The competition is not a level playing field, says Reilly. "In China they are trained for six months ahead of the Olympiad, and it's unthinkable that they don't win a medal! My friends who lead other teams ask 'How come you do so well, when you have only four million people?'"

He has just marked 200 papers submitted by candidates for the MOC's annual January maths camp.

The best 24 get a week of maths in Christchurch, and compete for a squad of 12 who do more training. From them, next year's IMO team will be chosen.

Contestants must be under 20 and not be registered in any tertiary institution. They sit two exams, each with three questions and each lasting over four hours, with no calculators allowed. Each problem is worth seven points, so a perfect score is 42. Problems are chosen from secondary school level geometry, number theory, algebra and combinatorics.

Granville says he likes the way that IMO problems "can be incredibly difficult but only involve elementary maths. I learned a lot of new maths that I wouldn't have been exposed to at school, made a lot of connections from other countries, and met lots of New Zealanders who are really interested in mathematics." He hopes to study maths at ▶**2**
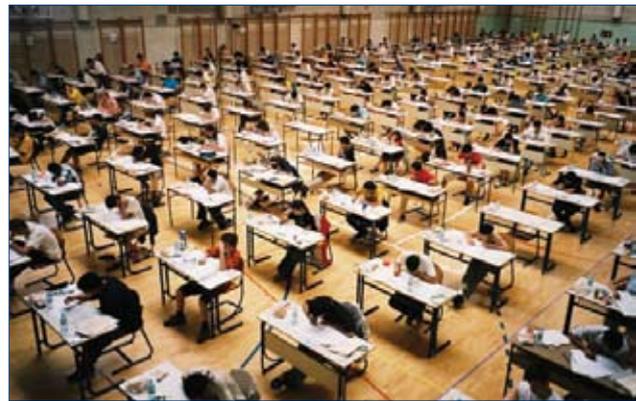
Welcome

October 20 is the first World Statistics Day - inside we have a three-page spread on what some of New Zealand's statisticians are working on today. We celebrate the outstanding result of this year's International Mathematics Olympiad team and interview the 2010 Forder lecturer, Ben Green, as well as one of the NZIMA's most recent PhD students. We hope you enjoy reading it.

**Marston Conder and Vaughan Jones
Co-Directors**

MATHEMATICAL EVENTS

22-25 November, Hanmer Springs
2010 NZ Postgraduate Mathematics & Statistics Conference
Shannon Ezzat, University of Canterbury, contact sez10@uclive.ac.nz

29-30 November, University of Auckland
Annual Conference of the Operations Research Society of NZ
www.orsnz.org.nz/#conference

7-9 December, University of Otago, Dunedin
Annual NZ Mathematical Society Colloquium
http://nzmathsoc.org.nz/colloquium/home.php

9-14 January 2011, Raglan
Annual NZMRI/NZIMA Summer Meeting, theme: Dynamical systems
www.math.canterbury.ac.nz/NZMRI2011/

6-11 February, Leigh
Annual NZ Phylogenetics Meeting
www.math.canterbury.ac.nz/bio/events/leigh2011/

6-11 February, RMIT, Melbourne, Australia
2011 MISG Workshop
www.rmit.edu.au/maths/misg

◀ l university in 2011.

Tuffley competed in 1990 in China, where he won a bronze medal, and in 1991 in Sweden. "There were 56 countries when I first went, now there are close to 100. We tried to meet a lot of the different teams after the competition and stayed up far too late."

"Going to the IMO made a big difference to me; it made me see mathematics as a really fun and exciting thing to do. Four of us went those two years in a row and got close; all four went into maths at university."

Tuffley enjoyed seeing the other side of the IMO as a leader. Country leaders make up the IMO Jury, which is separated from the students and forbidden to communicate with them until after the competition. The Jury decides on the final questions, translations and marking schedules before competition starts. Team leaders then meet the host country's six co-ordinating (marking) committees, one for each question, to agree on their team's marks. The Jury then decides the cut-off points for medals.

Tuffley hopes to lead New Zealand's 2011 team to the Netherlands and 2012 team to Argentina. *Jenny Rankine*

The team enjoys some outdoor combinatorics by the Otan Korgaushylar monument before the competition. Photo: Chris Tuffley.

See also
www.nzamt.org.nz/nzimo/
www.imo-official.org/
http://hardproblemsmovie.com/

Crochet the hyperbolic plane

An exhibition of crochet in the hyperbolic shapes of various corals, called Seagardens Aotearoa, will open at the Estuary Arts gallery in Orewa from the end of November until the end of January. The shapes are based on the first easily usable physical models of hyperbolic space, developed by mathematician Daina Taimina in 1997, using ideas from William Thurston (see *IMAges* 8).

Crocheting these shapes is very simple; Seagardens Aotearoa co-ordinator Glenys Stace is working with local fibre arts groups to add to the display.

See also
www.seagardens.wordpress.com (the password for the museum page is museum)
www.math.cornell.edu/~dtaimina/

From IMO to PhD

New Zealand's only IMO gold medalist (in 2002), Simon Marshall, centre, defended his PhD thesis at Princeton University earlier this year. He is pictured afterwards with NZIMA Co-Director Professor Vaughan Jones, left, and Professor Andrew Wiles of Princeton. Marshall's PhD was titled 'On the cohomology and quantum chaos of the general linear group in two variables'.

World-leading
statistics education

The invitation to speak recognises the innovative and very visual ways they have developed for students to think about their data, and the underpinning research supporting developments in the New Zealand school statistics curriculum.

The New Zealanders will also feature strongly at the society's fourth International CensusAtSchool Workshop in Plymouth the week after, launching the RSS' ten-year statistical literacy campaign in the UK.

The recognition also reflects international excitement about the new curriculum. "The involvement of professional statisticians, researchers, teacher developers and lead teachers in developing the secondary school statistics curriculum is unique in New Zealand," says Wild.

"New Zealand is leading in curriculum scope, meeting students' future practical needs in work and life, and in how it represents data. International software developers want to work with our Ministry of Education, because they anticipate other countries drawing from the country's statistics curriculum and want their software to be part of it."

Says Pfannkuch: "Statistics in the curriculum is fairly new in many countries, and usually a lot less developed than in New Zealand. The majority of people trying to deal with statistics run into mathematical roadblocks; we can use visual methods to avoid them.

"Data imaging software can help teenagers to understand patterns in data, and allows teachers to introduce statistics concepts to younger students. We are aiming for students to make inferences about the world without taking their eyes off their data animations, so the connections between question, data and answers are immediate and obvious.

"Looking at the world using data", says Wild, "is like looking through a rippled glass window. What we see is not quite the way it really is. Statistical inference is about how to take that into account."

Pfannkuch, with Pip Arnold, leads a project called Building Students' Inferential Reasoning, developing classroom implementations of new statistics learning in Years 10 and 11 with a team of eight teachers.

Students use new hands-on activities and data animations, reinforced by physical gestures, to learn how to take sample size and variability into account when making inferences.

"Statistics was largely taught descriptively; now we're putting in the conceptual underpinnings," she says. The new curriculum focuses on fundamental thinking about questions and interpretation of the data, rather than the mechanical aspects that computers can do.

"Some of these data visualisations allow students to compare samples of 10, 100 and 1,000 to see the effect of sample size on the stability of estimates."

The Census At School New Zealand project, run by the University of Auckland Statistics Department, and supported by Statistics New Zealand and the Ministry of Education, enables students to collect data about themselves every two years.

"Because the data is about them they are interested and engaged," says Pfannkuch. "They understand the background, and can hypothesize about why things turn out the way they do. Also, because they contribute their own data, they know what can go wrong and they can pick up dirty data. Learning data cleaning is also new at the school level."

In a world where every sports game presents statistics, and every health article mentions health risks, where Google and other web applications are massive users of statistics, and surveys and polls monitor all kinds of activity, the New Zealand curriculum should improve young people's ability to participate in decisions and social debates about evidence. The RSS shares this goal – hence its 10-year statistics literacy campaign, getstats.

See also
www.rss.org.uk/pdf/Wild_Oct._2010.pdf (RSS talk)
www.censusatschool.org.nz/2009/informal-inference/WPRH/ (talk animations)
www.rsscse.org.uk/news/rsscse-news/315-getstats
www.getstats.org.uk/
www.gapminder.org/ (data animations illustrating the UN Millennium Development Goals)

The only talk at the Royal Statistical Society's (RSS) World Statistics Day event in London on October 20 will be given by Professor Chris Wild, below (top), Dr Maxine Pfannkuch and Matt Regan, all from the University of Auckland. The RSS says the paper "is set to transform the international landscape of statistical education". Jenny Rankine spoke with them.

"Whenever I see ..."

"I remember ..."