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New Zealand Institute of Mathematics & its Applications

The maths/art nexus

Until the end of 2010, expatriate New Zealander Peter James Smith was Professor of Mathematics and Art at RMIT in Victoria, Australia.



Smith has straddled two very different fields for three decades. He has written an influential statistics textbook, and exhibited his landscape oils covered with handwritten maths notation, as well as work in other media in regular solo exhibitions since the 1970s.

He first mixed mathematics and art in an exhibition of paintings using the Fibonacci numbers in Auckland in 1977. "People encourage trans-disciplinary work," he says, "but it's very difficult to assess. It's important to do because the education system separates people from age 12 into one stream or the other. It's a very destructive split. Often teams of people collaborate across art and science disciplines, but they don't understand what the other side has done - it's not seamless."

He concentrates on the language of maths in his paintings. "I don't like beautiful symmetric diagrams; the formulae that produce symmetry are interesting but not the picture of symmetry. It's wonderful to bring to non-mathematicians some of the simple delights of how group theory works - the $1+1=0$ argument - they're so used to the language that they don't know what a gift it is."

The mathematical language in his paintings has included data sets, such as 1880s experiments on speed of light, and the orbital elements (position, location and appearance) of Halley's Comet. "It illustrates how statistics is such a powerful thing - by

gathering that data you get to know about the world. I used a lot of theorems and simple proofs, often from number theory, and my own research; I produced a new result on a painting before it was published in a journal. That's when the nexus is working really well, having that moment of insight when you're working on a canvas that mathematicians have at the blackboard."

He was in New Zealand to give a lecture on Truth + Beauty, the title of his recent solo exhibitions and of a book he is writing. "It contextualises the mark making on my paintings over the last 30 years. It will have a lot of maths - understanding the nature of proof, deductive reasoning; all those things art people don't know. The process of proofs and the failed alleyways that mathematicians go down to discover things are very precious."

"Starting with axioms and definitions and constructing and proving theorems - just like Euclid built all geometry from five axioms - that's the wonder and the magic."

Smith was one of two Antarctic New Zealand Artist Fellows in early 2010. Their most mathematically interesting find was NASA's website tracking of icebergs between 2000 and 2005, when they drifted north of Christchurch. "The traces they left bordered on chaos theory; it's an interesting relationship between something mathematically chaotic and some scribbled mark."

In 2010, Smith was applying linear regression to art and real estate markets. "It's ironic that when you retire, your research suddenly starts looking hopeful! I was working with a database of realised secondary market (auction) prices for art, which is an example of left censoring. The information you have is not the actual realised price, but you know the price is less than the reserve because it was passed in at auction. The reserve therefore becomes a left censored data point. Real estate people would pay millions to type ▶ 2

Welcome

In this, our 11th issue, you'll find articles about people working on matroids, symmetry and C^* -algebras. We also take a closer look at the CensusAtSchool project, interview a researcher who is examining what respect means in the mathematics classroom, and a professor of mathematics and art.

Marston Conder and Vaughan Jones
Co-Directors

Top: Ice Station, 2011, oil on linen, with a diagram of Antarctica's annual mean sea ice extent that shows it is increasing.



Homage to Descartes, 2006; Bowen Falls, Milford with overlays of the mathematics of rainbows.

passed in at auction.”
 Like all teachers, Smith aimed to ‘future-proof’ his statistics teaching. “You teach students what boxplots look like, so they can recognise the analytical thinking that goes into that object when it changes to a new generation, and they can question it and invent a better one.” However, he thinks there is a danger with “pressing a button on statistics software that works dynamically”, because at the end they still may not know what the animation represents.

◀ in an address and get a value for a property based on sales and properties

“Variability is very difficult for students to understand. I think it takes more than slick software.”

Panel from Fading Light series, 2003, oil on linen, with research created on canvas before publication in the scientific literature.



Asking unpopular questions

Megan Clark is asking what respect means in the mathematics classroom, how senior secondary and undergraduate university teachers can collaborate, and other subversive questions.

Clark, who is head of the School of Mathematics, Statistics and Operations Research at Victoria University of Wellington, and her former PhD student Robin Averill are talking with secondary mathematics teachers and students from a range of schools and neighbourhoods about respectful behaviour in the classroom, and observing their interactions.

“There is clearly some miscommunication about it,” says Clark. “Some behaviours that teachers might think as respectful, students may see as patronising, for example. Some discussion of a student’s family life will be seen as intrusive and disrespectful by some students, who believe the teacher’s role is only within their subject, but by other students as an indication that the teacher has bothered to find out about the whole person.”

Clark is also working on better integration of senior secondary and early university maths education, with Professor Bill Barton at the University of Auckland, Professor Glenda Anthony from Massey University and Dr Alex James from Canterbury University. “Teams in Christchurch, Auckland, Palmerston North and Wellington will trial a programme designed by secondary and tertiary teachers in secondary schools that take part.”

Clark says senior secondary mathematics and tertiary teachers have been more collaborative than in some other subjects; “University staff have been members of the NZ Association of Mathematics Teachers for years and regularly speak at conferences. Putting their perspectives together should make a richer experience for students.”

In their exploration of the transition from high school to university mathematics courses as a rite of passage, she and Canadian colleague Miroslav Lovric have cast strong doubt on the worth of transition or bridging courses. “Students doing these courses do no better than students of the same background who didn’t do them, which questions the prevailing assumptions. People assume because it’s a nice thing to do, it’s a good thing to do. At some stage students have to become independent learners, and I think we prop them up for far too long.” This is unpopular talk, but not unusual from someone who likes to examine assumptions “that are never questioned, yet are the basis of practice”.

Megan with her son Max in Hanoi.



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Census@school

by and for students

Rachel Cunliffe, kneeling on left, with participating students from St Mary's School in Northcote; CensusAtSchool supporter Shane Cortese is at the back. Photo: Godfrey Boehnke, University of Auckland.

More Canterbury students took part in the biennial 2011 CensusAtSchool than in 2009, despite the earthquakes that led to the cancellation of the Government Census.

Teachers and students in years 5 to 13 at New Zealand schools still have until the end of the year to participate in the fifth of these national school surveys. Around 25,000 primary, intermediate and secondary students had completed it at the time of writing, answering a range of questions about themselves, which include body measurements, transport, school subjects, technology, favourite TV show, global issues and the Rugby World Cup.

Preliminary results show a slight increase in respondents whose favourite learning area is mathematics and statistics: from 7.76 percent in 2009 to 8.4 this year. The proportion of boys to girls whose favourite subject is maths has slightly increased since 2003 to almost double - 11.6 percent of boys compared to 6.1 percent of girls.

However, this difference is largely at primary school level. The parabolic curve in maths interest, with peaks at primary school and among 17-year-olds, has persisted in the 2011 respondents so far: Maths was a favourite of 19 percent of 8-year-olds, dropping to five percent of 14 and 15-year-olds, and rising to 10 percent of 17-year-olds.

CensusAtSchool fits into the statistics curriculum and teaches the value of statistics in everyday life through information, by and for the students. With some surveys, students vote on which questions they've suggested should be included, says Co-Director Rachel Cunliffe.

There are many constraints on questions; the demographic data is the same as the official Census; some questions need to be common across most years, and a small number must be asked so CensusAtSchool data can be compared internationally. "We also want timely questions," she says. "We try to have lots of different types of variables that are interesting to kids as well as being useful data, with nice relationships they can investigate." "They love it because it's a different activity, and it's interactive. They're not just sitting at a computer - they're measuring each other, asking each other's opinions. They're really interested in the answers to the questions, and how they compare with other students in their class and overseas."

The measuring and collection of information for the survey can be done in a single lesson, and online responses can be in English and Maori. "Teachers get their class data back immediately, so they can start using it the next day if they want to." The survey is accompanied by 42 class activities.

"We provide the tools so that teachers and students can build their own tables and analyse data themselves," says Cunliffe. The online random sampler enables data to be viewed as animated graphs, while the data viewer page enables students to explore data relationships and comparisons.

"We do some data cleaning, but we're not rigorous," she says. "For example, in finger lengths there's a separate bell curve of students who entered their data in centimetres rather than millimetres, with tiny finger lengths, and the main bell curve, which has major spikes every five millimetres. Students were probably rounding it up to the

nearest half centimetre, or they measured in centimetres, realised their mistake and just multiplied it up. That gives teachers a really good opportunity to discuss measurement problems and data cleaning."

CensusAtSchool is funded jointly by the Ministry of Education, Statistics NZ and the University of Auckland, which provides staff time for technical support by Department of Statistics Multimedia Manager Stephen Cope, for data cleaning and analysis. Data from 2011 will be released next term, and new data added until the end of this year.

See also

www.censusatschool.org.nz/

www.censusatschool.com/

www.stats.govt.nz/tools_and_services/services/schools_corner.aspx

The mathematician's best work is art, a high perfect art, as daring as the most secret dreams of imagination, clear and limpid. Mathematical genius and artistic genius touch one another.

Gosta Mittag-Leffler