IMAges NZ

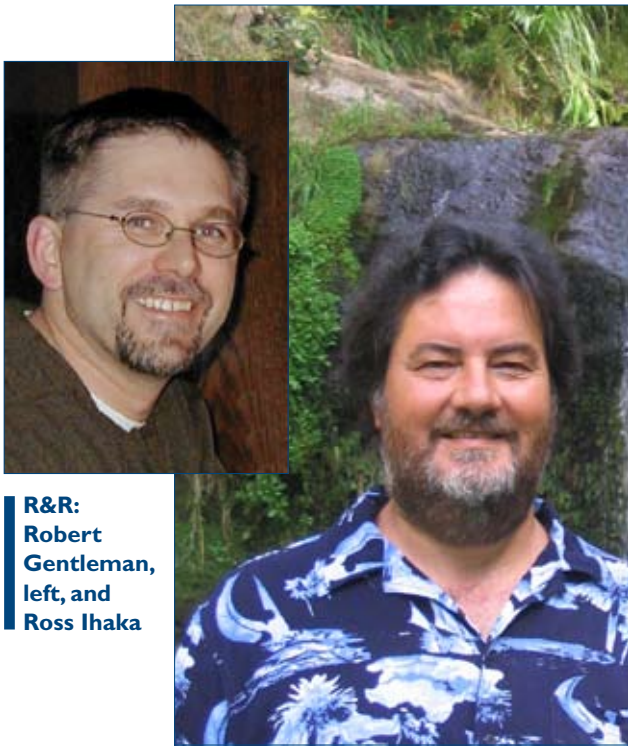
ISSUE THREE

INSIDE

New Zealand Institute of Mathematics & its Applications

The single letter that grew

When two statisticians met in a corridor at the University of Auckland back in 1990 they had no inkling that the initial of their first names would become the most commonly cited in mathematics. Jenny Rankine explains.



R&R: Robert Gentleman, left, and Ross Ihaka

The encounter between Ross Ihaka, of Ngati Kahungunu and Pakeha ancestry, and Canadian Robert Gentleman led to their collaboration on the statistical software system R. Their original goal was to create something with which they could teach their first year introductory statistics course. They based R on existing software called S, and developed programming techniques to reduce memory demands and performance difficulties when dealing with large problems. They called it R after their names and because single letters can't be trademarked.

Rather than take the commercial route that S had, they took out a GNU public licence. "By making the software free," says Ihaka," we started to pick up a lot of collaborators. People aren't keen on working on commercial software, because their work gets taken over by the companies. We have the top researchers in the world involved in R, but we couldn't afford to pay them to work on it. They made R more and more useful, and more and more people started to use it. Now it's probably the most fully-featured piece of software in the world."

R can be used for linear and generalised linear models, nonlinear regression models, time series analysis, classical parametric and nonparametric tests, classification, clustering and smoothing. It also displays data in a range of well-designed charts, graphs and other diagrams.

R gets a life of its own

Ihaka and Gentleman's original paper about R has accumulated "a couple of thousand citations", as did another paper with the core collaborators, according to Ihaka. The software took on a life of its own; the R Foundation formed by the R Development Core Team in 2002, with Ihaka and Gentleman as presidents, is based at the Vienna University of Technology in Austria. Mathematical publisher Springer told Ihaka it is preparing about 30 books for its series on applications of R.

Gentleman now heads the Program in Computational Biology at the Fred Hutchinson Cancer Research Center in Seattle, USA. Ihaka still "dabbles" on uses for R, but this self-taught programmer is now consumed by writing another programme. "The working name is L; I hope it will be better, a thousand times faster and able to handle much bigger problems than R."

His impetus is that "our ability to process and even store data is far exceeded by the rate at which we can collect it. Twenty years ago, we used to work with 50 to 100 numbers - now we work with billions. We might be comparing fertilisers using 50 plots of wheat in a field, or analysing high-resolution images from electronic telescopes, or analysing people's purchasing habits from their supermarket transactions. We need better tools."

Ihaka is using Lisp, "which dates back to the 1950s and is used in artificial intelligence and large-scale ▶2

Welcome

We've had some great feedback on the first two issues of IMAges. We hope you enjoy this one just as much. It features our new MathsReach initiative, with a range of items about the work and interests of New Zealand mathematicians and statisticians and one of the high-profile visitors brought to New Zealand by the NZIMA.

Find out more from www.nzima.org.

Marston Conder and Vaughan Jones
Co-Directors

programming. R was an implementation of Lisp, but we didn't know much about it so there are fundamental limits on in speed and problem size in R as a result. The machines you needed back then to run Lisp were bigger than we could afford, but now it's available on the smallest PC."

At the moment, the project occupies Ihaka and a Masters student. "People think you should get commercial sponsors, but we can't do it like that. We need hundreds of people working on it, and you can't get the investment to pay that many people."

Ihaka describes his work on R as "enormous fun. I get the occasional bottle of Scotch or free meal - a woman who teaches in a poor Black university in South Africa sent me a book they'd produced. A man researching tropical diseases in South America told me R was the only software they could afford. In a lot of developing countries it's the only one they use. Because it's so widely used, R has provided us with all sorts of contacts."

Ihaka is writing a book on R programming and one on statistical graphics and visualisation. He wanted to recommend a book to students about using colour and drawing graphs, but found few that were accurate about colour wavelengths and how our eyes perceive colour.

See also

www.r-project.org/foundation/main.html
www.gnu.org/

Remote but live

In March, audience members around the country were able to participate live in Professor Marcus du Sautoy's public lecture on the Music of the Primes (see page 7).

The NZIMA and University of Auckland/BeSTGRID presented the lecture to participants at the Universities of Auckland, Canterbury and Massey - Palmerston North and Albany campuses - and the Auckland University of Technology using portable AccessGRID nodes on the Kiwi Advanced Research and Education Network (KAREN) courtesy of BeSTGRID.

Two-way video and audio meant that another 100 people watching remotely were able to ask questions and participate in the discussion after the lecture with the 250 in one of the two University of Auckland lecture theatres needed for this event. In fact, the audience in other centres asked more questions than the one in Auckland.

Marston Conder, a NZIMA co-director, described the broadcast as a landmark event in New Zealand mathematics. Many remote participants had never been part of a lecture like this before, and many wanted to do similar broadcasts themselves.

Presenters can write their usual whiteboard notes on a tablet laptop, which is then projected up onto a wall for the audience.

See also

www.math.auckland.ac.nz/~bonning/video/marcus-du-sautoy.wmv for a sample video of the lecture on AccessGRID

www.bestgrid.org/index.php/Main_Page for information about the BeSTGRID and AccessGRID technologies

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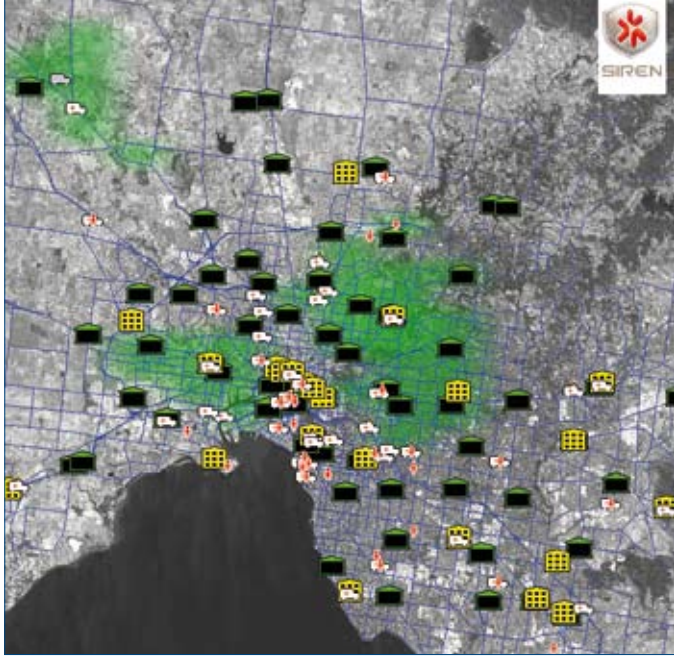
It is easier to square a circle than to get round a mathematician.
Augustus de Morgan

Southern Fields

The only two Fields Medallists from the southern hemisphere, Terry Tao (2006) and Vaughan Jones (1990) now work in the same part of the world. Professor Tao was brought up in Adelaide and is based at the University of California in Los Angeles. Professor Jones, born in Gisborne and a co-director of the NZIMA, is based at UC in Berkeley.



Emergency siren racing

Jenny Rankine talks with an Auckland researcher who helped export New Zealand mathematics solutions around the world.

When an ambulance passes, siren blaring, most people think of those for whom it races through suddenly still streets.

Dr Andrew Mason, in the Department of Engineering Science at the University of Auckland, also thinks of how he can improve the optimisation mathematics behind ambulance scheduling so that it gets to its destination in time to save lives. For the last five years, most of his research has been dedicated to this task.

It all started with a chance meeting at a rostering conference in 1998. "St John wanted help with their rostering problems. Once I started, it became clear that we needed mathematical tools to work out how many staff were needed. With Shane Henderson I coded a simulation in C++ that we called BARTSim - Better Ambulance Rostering Technology Simulation - a pun on Bart Simpson."

"It used Geographic Information Systems-style visualisations to provide managers with a view of their problem they'd never seen before," he says. Loaded on a PC, it showed tiny flashing ambulances travelling through city streets, picking up and dropping off patients before returning to base.

"It was a real breakthrough. When we first showed St John they were impressed - they had GIS systems for dispatch but not for data analysis. Today GIS tools are commonplace." The simulation never actually answered the rostering question, but it did help St John with decisions about where to locate and how to run their bases.

In the same year Mason co-founded Optimal Decision Technologies, now called the Optima Corporation, which initially concentrated on rostering optimisations for Air New Zealand. The ambulance simulation sat on Mason's shelf until he was invited to tender for a similar project for the Melbourne Metropolitan Ambulance Service (MAS) in 2001. The University of Auckland licensed the simulation to Optima and they won the tender.

"Once we got into the guts of the Melbourne system we realised it was far more complicated than Auckland," he says. "They would often send two, three or even four vehicles to an accident; there were around five times as many calls, vehicles and roads. We made big changes to BARTSim, and it was renamed SIREN - Simulation for Improving Response-times of Emergency Networks." Mason and Optima had found a niche for optimisation research products that no one else supplied.

Optima developed the simulation into SIREN Predict, and sold it to emergency services in Australia, Denmark, Canada and the UK. It also developed another product, SIREN Live, which solves optimisation problems interactively in real time for dispatchers, taking into account vehicle locations, types and status, base and standby locations, staff shifts and call information.

"The beauty with tackling Melbourne's complex system first is that any other city has been relatively straightforward," says Mason. As Optima's Research Director, his goal is to reduce the time taken to implement Siren for a new city, including the effort it takes to build and calibrate the road network.

"Twenty years ago, finding how long it took to travel from A to B was virtually impossible. Now, fully- ▶4

Users can watch ambulances travelling between callouts, bases and hospitals in Siren's virtual city. Below: Andrew Mason.
Photo by Geoff Dale, courtesy of the University of Auckland.