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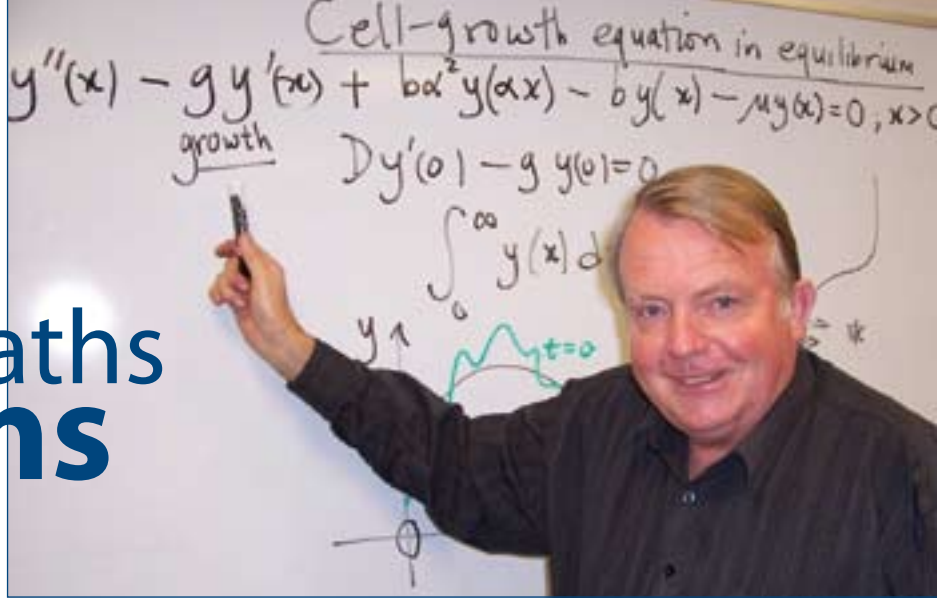

Finding maths solutions

Professor Graeme Wake is surrounded by a ferment of mathematical problem-solving. Jenny Rankine explains.

He is Director of the Centre for Mathematics in Industry at Massey University in Albany. Every summer for the last four years, organisations have brought their maths-related problems to the Mathematics-in-Industry Study Groups of the Australian and New Zealand Industrial and Applied Mathematics (ANZIAM), the first time they had been held in New Zealand.

Some of the best applied maths minds in the country concentrated on solutions for TransPower, Fisher and Paykel, New Zealand Steel and other organisations in power supply, manufacturing, soil erosion, aeronautics, horticulture, tree growth, mining and financial markets. "Over three years we made substantial progress on 19 out of 20 problems," says Wake. "Many were completely solved in a week and some led to ongoing contracts."

"Financial maths is one of the fastest growing areas of applied maths - the futures and foreign exchange markets are heavily mathematical. Good maths models are crucial for survival in big markets. The New Zealand stock market is just starting to get involved, but the finance industry can't get the right graduates - we're not producing enough of them here."

Maths consultancy

Professor Wake also relishes the problems he works on as a private maths consultant. They range from large projects about controlling agricultural spray drift to smaller contracts. "The unique mix of academic and consulting mathematics is very enriching."

"I finished a problem this morning for a company producing materials to clean air conditioning systems in large buildings, to stop Legionnaires Disease and other bugs. They wanted an optimisation routine to reduce waste. The engineers knew what they needed but couldn't work out the relationship between the processes and the constraints. I managed to do the algorithm for Excel and the engineers wrote up the programme."

An even more local problem came from a family friend who manages a carpet warehouse. "She asked me about carpet offcuts; she didn't know how much was left in off-cut rolls and didn't want to waste staff time unrolling them. She knows how wide they are, so I gave her a solution and told her how to use it. All she had to input was the number of rings in the roll, the thickness of the carpet, the diameter of the hole in the middle and the outside of the roll, and that gave her the length. Industrial mathematicians need to be able to take problems that are not stated in mathematical terms, solve them and provide a user-friendly output."

"There is a lot of consulting work out there, although it's a challenge. There wouldn't be more than a couple of dozen people in the country earning their living by maths consultancy, although a lot of people do it on the side. Some of the most successful have interdisciplinary backgrounds in medical, agricultural or engineering fields and are able to talk the client's language. You learn it by doing; it's not so easy to train students in it - it's not like textbook maths."

Wake is Professor of Industrial Mathematics at Massey and the NZIMA's full-time Maclaurin Fellow for 2007/08. The fellowship is named after Richard Maclaurin, the foundation Professor of Mathematics at Victoria University of Wellington more than 100 years ago, who later became a noted President of the Massachusetts Institute of Technology (MIT) in Boston.

During Wake's research year he is mounting a "full attack on non-local calculus", which is used in mathematical models of situations where cause and effect are separated by time, space or age. This interest grew from his earlier work on modelling cell growth, which is now used to quantify the growth of tumour cells and the effects of chemotherapy treatment.

"Calculus at year 13 is about rates of growth proportional to size now, but the rate of growth in cells is related to the size of the organism one division before. It's non-standard calculus - in fact, it's not in the text books. There are few procedures for the generic analysis of these types of problems."

Wake is investigating properties such as wavelengths and frequencies, and developing solution techniques for the functional differential equations involved. If he is successful, his work will relate to a wide range of applications.

Top: Graeme Wake. Below: A model of the effectiveness of shelter belts in stopping insecticide spray drift has resulted from a Maths-In-Industry Study Group, bottom.