# Mathematics, Science, University and Beyond

**A/Prof Rob Womersley**

School of Mathematics and Statistics

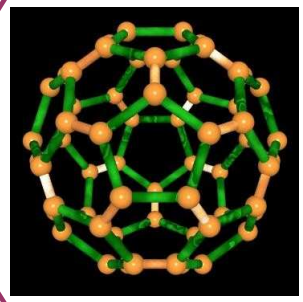
University of New South Wales

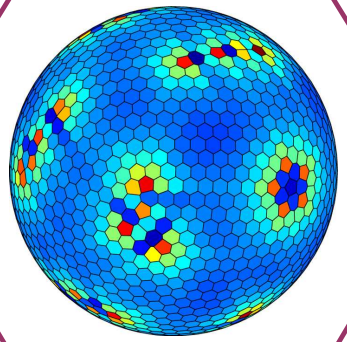
R.Womersley@unsw.edu.au, http://www.maths.unsw.edu.au/~rsw/

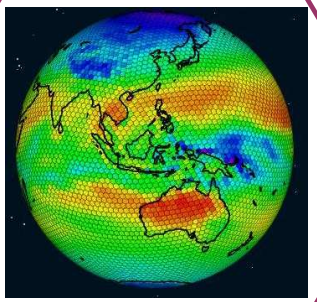
# Contents

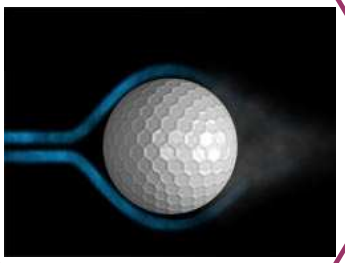

- Mathematics and Statistics
- Science
  - ▷ Biology, Chemistry, Mathematics, Physics
- University of New South Wales (UNSW)
  - ▷ Faculties
  - ▷ Schools
- Degrees/Programs
  - ▷ Advanced Mathematics
  - ▷ Talented Students
- Careers
  - ▷ What can you do with a Science degree
  - ▷ Graduate attributes
  - ▷ Where are they now?

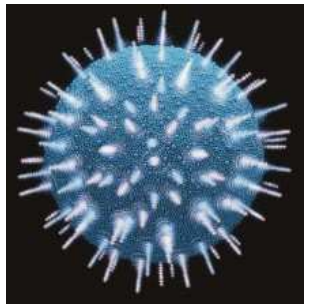
# Mathematics & Statistics in all Spheres of Life









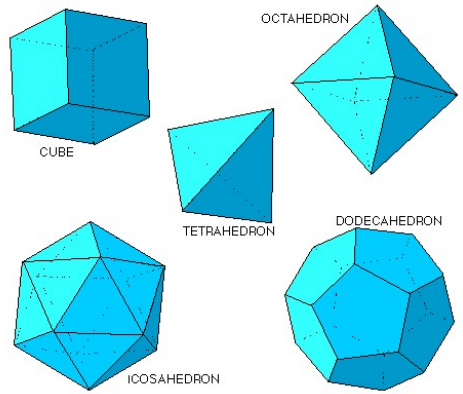


# Science

- Paradigms
  - ▷ Theory - testable, prediction
  - ▷ Experimentation - repeatable, physical
  - ▷ Computation - model, check, predict
- Aims
  - ▷ Understanding the universe
  - ▷ Determining the questions
  - ▷ Answering the questions
- Examples
  - ▷ Global climate warming?, Water/life on Mars?
  - ▷ Ethanol as an alternative fuel? Stem cell research?
  - ▷ Combing hair over a bald patch? Atomic energy?
- Research
  - ▷ Basic, fundamental vs Applied vs Economic benefit
  - ▷ Prof Ian Fraser, Australian of the Year 2006, Cancer vaccine

# Geometry to Sport

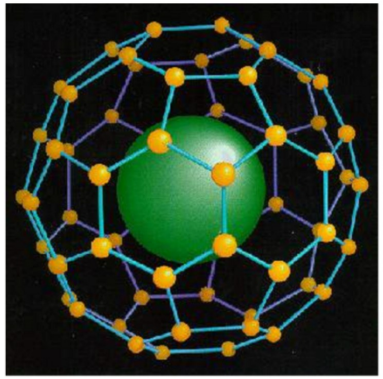
- Plato, Greek Philosopher 400 BC, and ancient temple

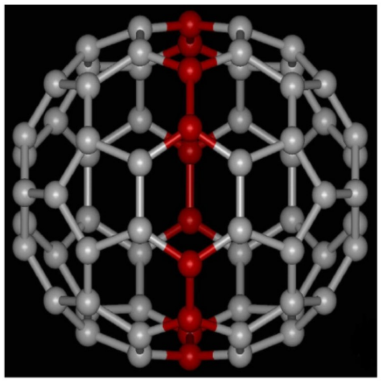


- Modern sport

# Chemistry, Nanotechnology

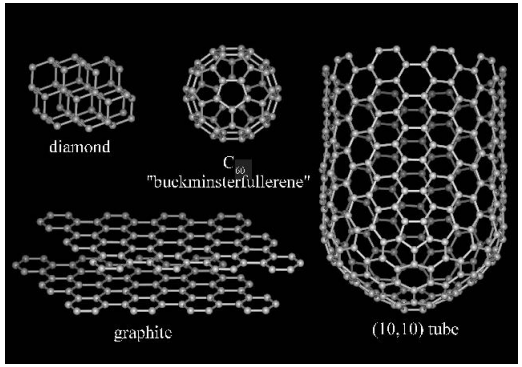
- Fullerenes (Buckyballs) $C_{60}$
- Large carbon molecules $C_{70}$, $C_{100}$

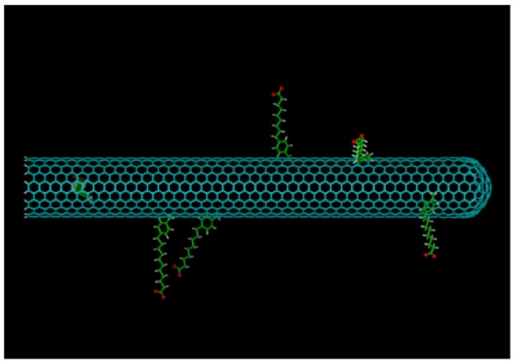




(Richard Smalley, 1985, Noble Prize Chemistry, 1996)

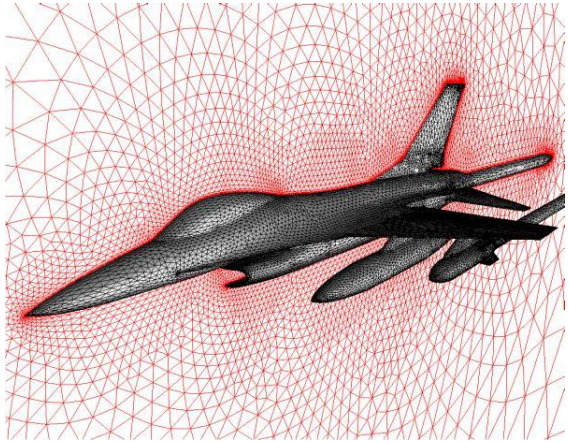
- Nanowire – nanometres in diameter, much longer

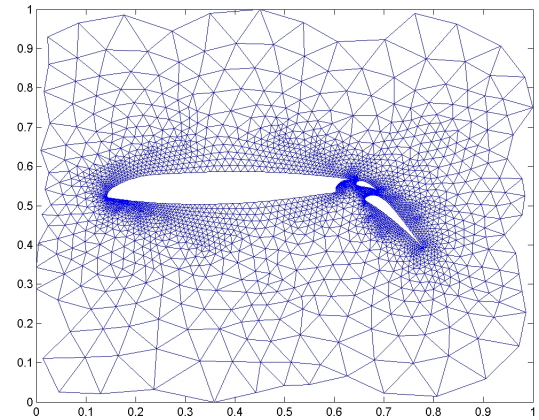


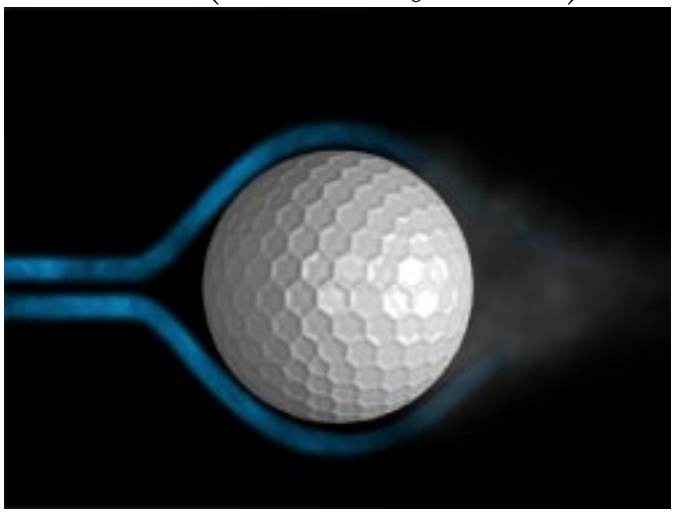
# Engineering, Industrial design

- Airplane, car design: grids, flows



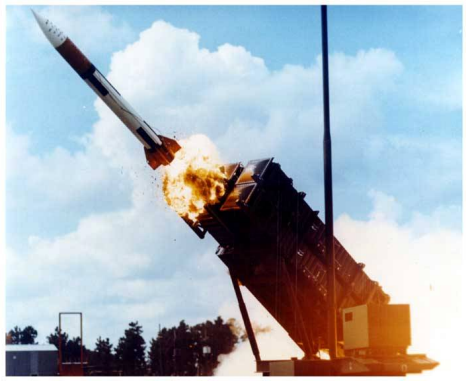



- From planes to golf balls (Calloway Golf)



# Computing

- Computer Science vs Computational Science
- Disasters

▷ Patriot missile disaster: 

$$\frac{1}{10} = \frac{1}{2^4} + \frac{1}{2^5} + \frac{1}{2^8} + \frac{1}{2^9} + \frac{1}{2^{12}} + \frac{1}{2^{13}} + \cdots = 0.0001100110011001100110011001100\ldots.$$

24 bit timer stored 0.00011001100110011001100

error $= 0.0000000000000000000000011001100\ldots$ binary, $\approx 0.000000095$

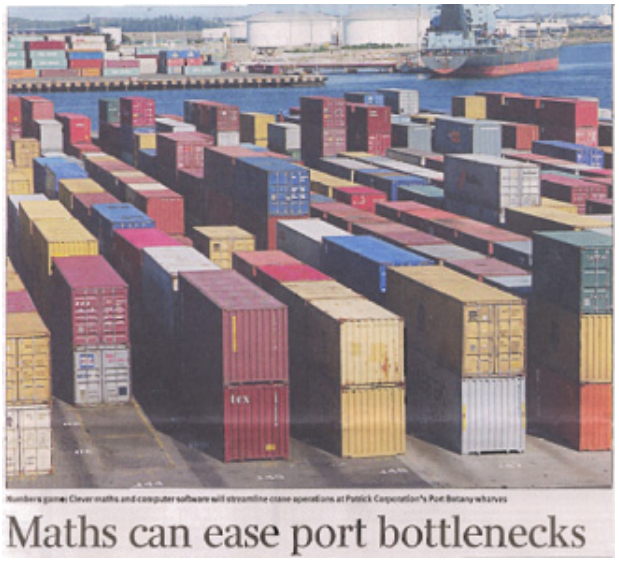
Timer running 100 hours $\Longrightarrow$ error $= 0.000000095 \times 100 \times 60 \times 60 \times 10 = 0.34$

Scud $1,676$ metres/sec $\Longrightarrow$ error $> 0.5$ km

Outside range gate of patriot tracking $\Longrightarrow$ 28 dead

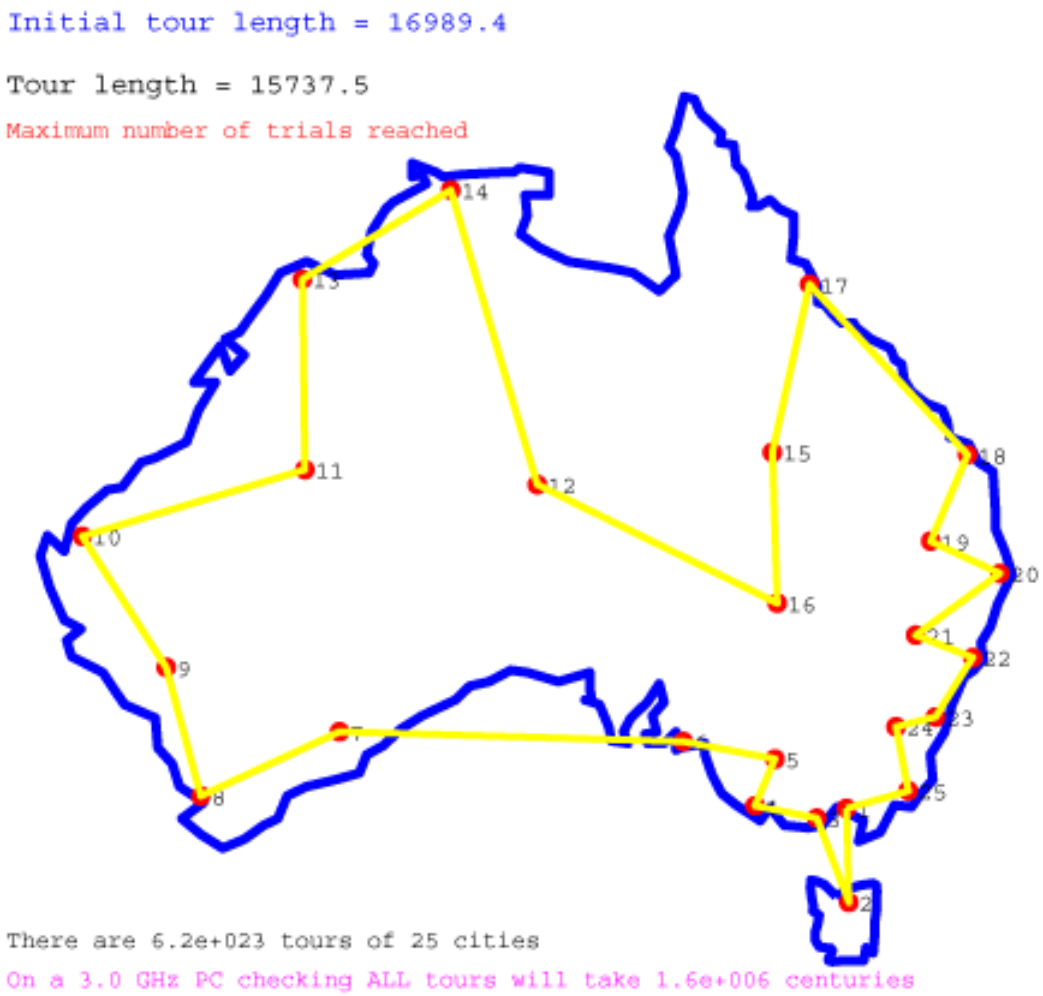
# Management, Operations Research

- BHP-Billiton - planning of open cut mines
- Patricks, Port Botany - Container movement



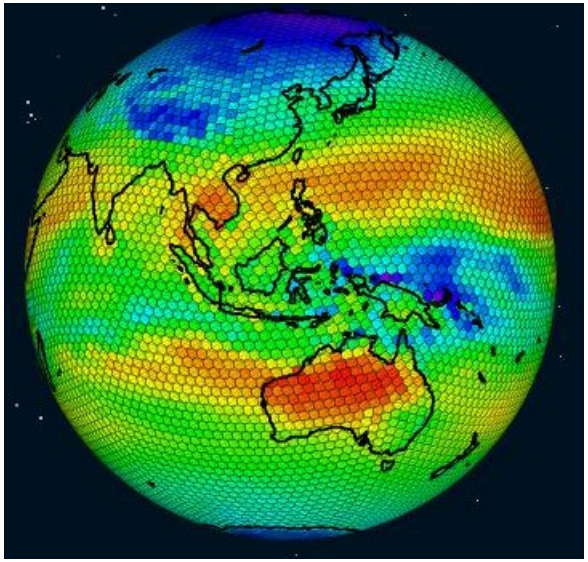
# Travelling Salesman Problem - TSP

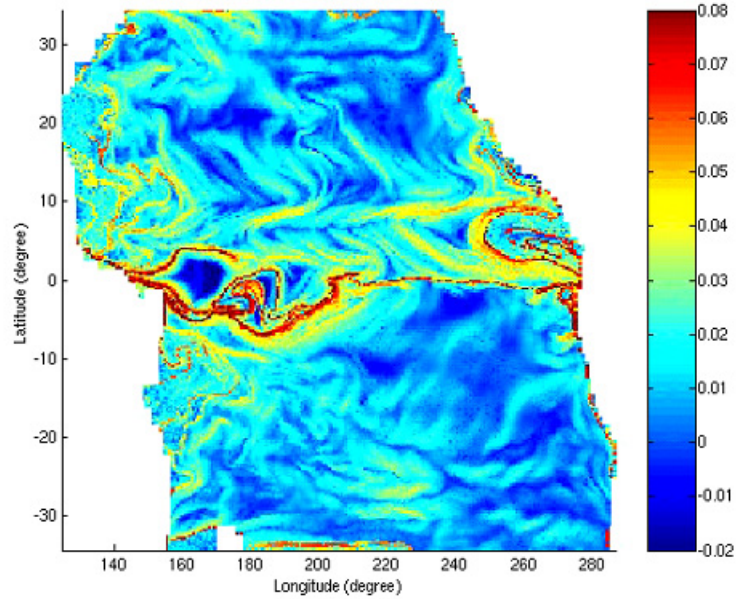
- Visit each city exactly once and return to start



# Climate, Oceanography, Weather

- Global climate models and ocean circulation





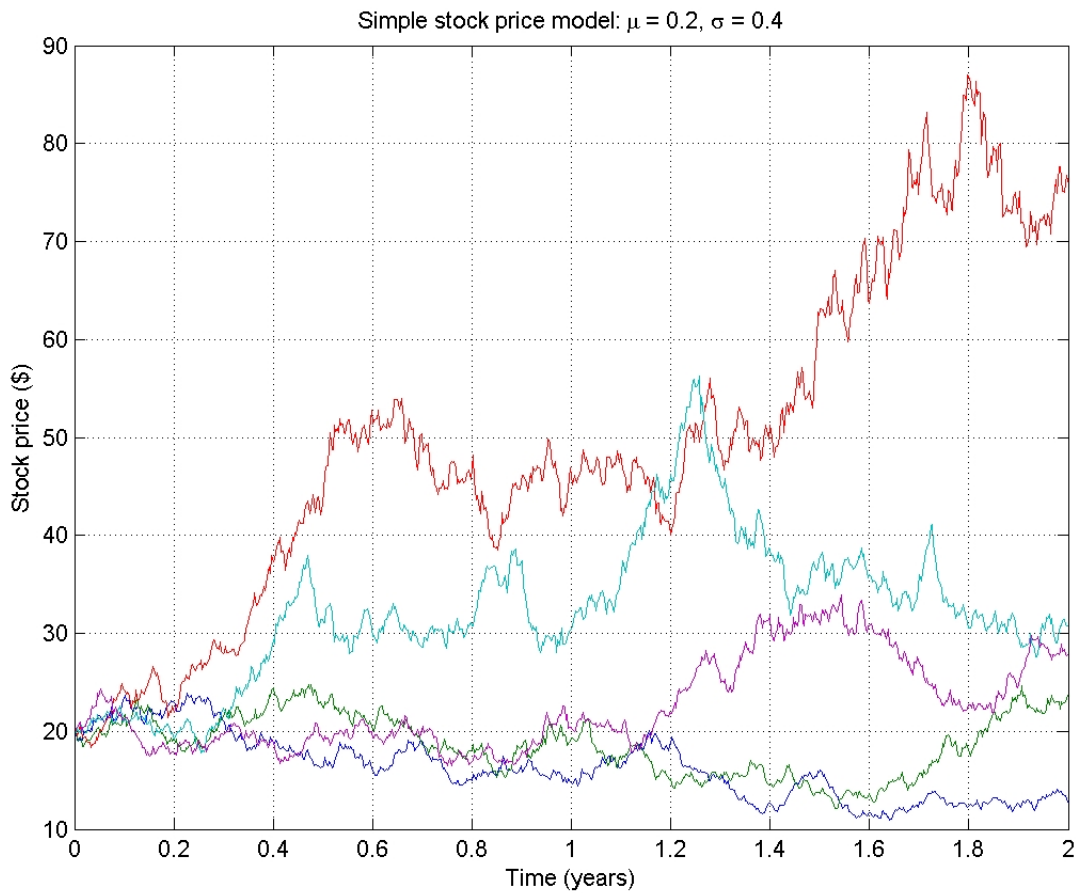

- $CO_2$ concentration

  - ▷ Prof Matthew England, Federation Fellow,
- ▷ Climate change Research Centre (CCRC)
  - ▷ `http://www.ccrc.unsw.edu.au`

Climate Change Research Centre

# Statistics - Probability, Uncertainty, Risk

- Financial modelling, risk management




- Data mining, analytics, bioinformatics

# UNSW – Faculties

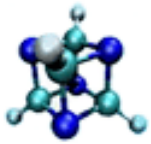
- Arts and Social Science
- Australian Defence Force Academy (ADFA)
- Built Environment
- Business (including AGSM)
- College of Fine Arts (COFA)
- Engineering
- Law
- Medicine
- Science

# scienceUNSW – Schools

Aviation

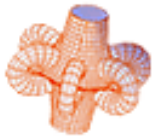
Biological, Earth & Environmental Sciences

Biotechnology & Biomolecular Sciences



Chemistry

Materials Science & Engineering



Mathematics and Statistics

Optometry and Vision Science

Physics

Psychology

Risk and Safety Science

# Courses

- **Course**
  - a unit of study, subject
  - 6 units of credit (UoC), up to 6 contact hours per week
  - eg MATH1131 Mathematics 1A + MATH1231 Mathematics 1B
  - Assumed knowledge eg HSC Extension 1 Mathematics, Chemistry

    `http://www.maths.unsw.edu.au/students/future/mathsentry.html`
  - The right first year mathematics course

    `http://www.maths.unsw.edu.au/students/future/choosingcourses.html`
- **Semester**
  - 4 courses (24 UoC)
- **Year**
  - 2 semesters, 8 courses (48 UoC)
- **Degree**
  - 3 years (144 UoC), 4 years (192 UOC), ...

# Degrees

- Science (3 years)
  - BSc - Bachelor of Science
  - Major + electives + general education (12 UoC)
  - Over 30 majors in science
- Advanced Science or Advanced Mathematics (4 years)
  - Advanced Science (UAC 42 9013)
  - Advanced Mathematics (UAC42 9014)
  - Automatically includes honours
- Combined Degrees (not exhaustive)
  - BSc/BA - Bachelor of Science, Bachelor of Arts (4 years)
  - BSc/BEd - Bachelor of Science, Bachelor of Education (4 years)
  - BEng/BSc - Bachelor of Engineering, Bachelor of Science (5 years)
  - BCom/BSc - Bachelor of Commerce, Bachelor of Science (4 years)
  - BSc/LLB - Bachelor of Science, Bachelor of Laws (5 years)

# Advanced Mathematics

- New degree BSc (Advanced Mathematics) in 2008, part of Advanced Science
- Separate UAC entry BSc (Advanced Mathematics) in 2009
- Plans in Advanced Mathematics
  - ▷ Applied Mathematics
  - ▷ Pure Mathematics
  - ▷ Statistics
  - ▷ Quantitative Risk
  - ▷ High Performance Students Plan (Invitation only)
- Plans in Advanced Science (relevant to Mathematics & Statistics)
  - ▷ Physical Oceanography
- 4 year degrees including honours, UAI $\geq$ 95, maintain high credit
- Combined degrees
  - ▷ Advanced Mathematics + Arts (5 years)
  - ▷ Commerce + Science (4 years), Engineering + Science (5 years)

# Talented students

- High Performance Students Plan in Advanced Mathematics
  - Very top Mathematics students
  - UAI $\geq 98$, HSC Maths Ext 2 $\geq 97$ or Maths Olympiad training
  - By invitation only: write to Head, School of Mathematics and Statistics
  - Design your own degree with approval of Academic Mentor
- Talented student schemes
  - Talented students tutorials
  - Higher versions of core Mathematics and Statistics courses
  - Mentors
  - Specially tailored degrees
  - Higher level subjects
  - Summer vacation scholarships
  - Science and Mathematics Olympiad

# Scholarships

- All universities offer scholarships, including specialist ones
  - ▷ UNSW AAA scholarship to top student in each school
  - ▷ Co-op scholarships
  - ▷ Teachers scholarships
  - ▷ Rural scholarships
  - ▷ For minority groups
  - ▷ `http://www.scholarships.unsw.edu.au/`
- School of Mathematics and Statistics scholarships
  - ▷ First year Scholarships
  - ▷ Rural Scholarships
  - ▷ Teachers Scholarships
  - ▷ Statistics Scholarships
  - ▷ Alma Douglas Scholarship
  - ▷ Meteorology and Oceanography Scholarships
  - ▷ See Mathematics and Statistics web site

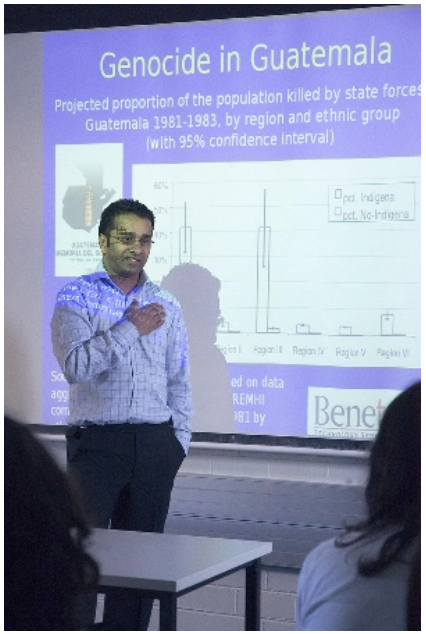
# Careers

- You will change careers several times
- The majority of future jobs are unknown today
- Logical and critical thinking
- Apply scientific approaches to practical applications
- Communication skills - written and oral
- It is a global economy
- Adaptability and ability to learn are crucial
- '... if possible do Maths... (it) is the single most useful ability to have in your kit-bag to equip you for any eventuality."

  -Ross Gittens, Economics Editor, Sydney Morning Herald

# Graduates – Maths & Stats

- Peter Cotton – Pure Mathematics Honours 1996, PhD Standford, Morgan Stanley, Wall Street
- Jaci Brown - BSc 2000, PhD 2005 Ocean modelling, Weather Girl Hobart, Research Yale (USA)
- Romesh Silva – Statistics Honours 2000, Human Rights



# Links

- General
  - ▷ http://www.myfuture.edu.au/
  - ▷ http://jobguide.dest.gov.au/
  - ▷ http://www.gradsonline.edu.au/
  - ▷ http://www.abc.net.au/acedayjobs/
- Mathematics and Statistics Careers
  - ▷ http://www.ice-em.org.au then Careers
  - ▷ http://www.austms.org.au/Jobs
  - ▷ http://www.statsci.org/jobs/
- Mathematics and Statistics
  - ▷ http://www.amsi.org.au/
  - ▷ http://www.statsoc.org.au/
  - ▷ http://mathworld.wolfram.com/
  - ▷ http://en.wikipedia.org/wiki/Mathematics
  - ▷ http://en.wikipedia.org/wiki/Statistics

- UNSW
  - http://www.science.unsw.edu.au
  - http://www.maths.unsw.edu.au
  - http://www.maths.unsw.edu.au/highschool/dothemaths/dothemaths.html
- Future students
  - http://www.unsw.edu.au/futureStudents/undergrad/ced/HSCPlus.html
  - http://www.maths.unsw.edu.au/students/future/futurehome.html

# School of Mathematics and Statistics, UNSW

SCHOOL OF
MATHEMATICS &
STATISTICS

Algebra & Discrete Mathematics
Biomathematics
Biostatistics
Computational Mathematics
Dynamical Systems
Financial Mathematics
Mathematical Modelling
Modern Analysis
Nonlinear Phenomena
Oceanography
Optimization
Quantitative Risk
Stochastic Processes

UNSW THE UNIVERSITY OF NEW SOUTH WALES | Faculty of Science

www.maths.unsw.edu.au
+61 2 9385 7111