



## Where can a Degree in Mathematical Science take you?

Associate Professor Jim Denier

Head

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## Do more Mathematics!

*“Do as much mathematics and statistics as you can in your degrees – these skills will empower your professional life.”*

**Sir Gustav Nossal**  
*Australian of the Year, 2000*  
*Distinguished Scientist*  
*past Director of the Walter and Eliza Hall Institute.*



## Do more Mathematics!

*“when we entered the era of high technology, we entered the era of mathematical technology”*

**Edward E. David Jr.**

past President

Exxon Research and Engineering



## What will Mathematics and Statistics do for me?

By studying Mathematics and Statistics you will develop skills in

- **Creativity** – how to **think** about problems in new and creative ways
- **Modelling** – learn how to **design** mathematical models and how to solve them, using the results to make predictions or to analyse complex situations
- **Learning** – Mathematics and Statistics gives you the ability to **confront challenging new concepts** and process information
- **Research** – the process of **posing new questions**, understanding real world processes and **make new discoveries**
- **Problem Solving** – the ability to **break problems down** to their simplest form and solve them using the methods and techniques you will learn during your university degree.



## But where can I work?

Mathematics graduates can be found working everywhere. Some of the many career paths available are:

- *Meteorologist, stockbroker, economist, geophysicist, actuary, biological scientist, naval architect, computer programmer, systems analyst, mathematics teacher, investment analyst, statistician, health administrator, accountant, patent examiner, engineer.*
- Our recent graduates have been employed by
- *CSIRO, DSTO, consulting engineering firms, United Water, Santos, the pharmaceutical industry, the telecommunications industry, biomedical research industries and institutes, banks and insurance companies, the Bureau of Meteorology, the Australian Bureau of Statistics, State and Federal Government agencies, and Universities and other research institutes all over the world*

## And how much can I earn?

### How much do Mathematics graduates earn?

Median Salary : **\$42,500**

All Fields : **\$40,800**

### How does this compare to other workers?

Median Salary as % Average Weekly Earnings: **83.0%**

All Fields : 79.7%

### *The top five starting salaries*

<i>Dentistry</i>	<i>\$60,000</i>
<i>Medicine</i>	<i>\$50,000</i>
<i>Optometry</i>	<i>\$50,000</i>
<i>Engineering</i>	<i>\$41,000</i>
<i>Education</i>	<i>\$40,000</i>
<i>Mathematics</i>	<i>\$40,000</i>

Source: [www.gradsonline.edu.au](http://www.gradsonline.edu.au)





## What career pathways are open to me?

- **Finance** is a new and important area of application of mathematics. There is a need to **model and control uncertainty in financial markets** and in financial arrangements. Employment opportunities exist in banks and corporations and in the insurance and investment industry. Study of mathematical modelling, statistics and computing provides a strong grounding for a career in finance.



## What career pathways are open to me?

- **Operations Research** is an area of significant commercial importance. It is essentially the **science of making the most out of your operation**. That might mean improving the management and operation of a production line, a telecommunications network or a fishery.





## What career pathways are open to me?

- **Statistics and Probability** studies will equip graduates for employment in all areas of business, industry, education and research that involve **the analysis and interpretation of quantitative data**. For example credit scoring, actuarial science, environmental science, quality assurance, biostatistics and medical research.



## What career pathways are open to me?

- **Mathematical Modelling in the Engineering Sciences** will equip students with the skills required to **model many important real world phenomena**, from how to make aircraft faster (and safer) to understanding how the atmosphere and oceans drive the climate. Such modelling has played an important role in all of our recent technological advances.



## What career pathways are open to me?

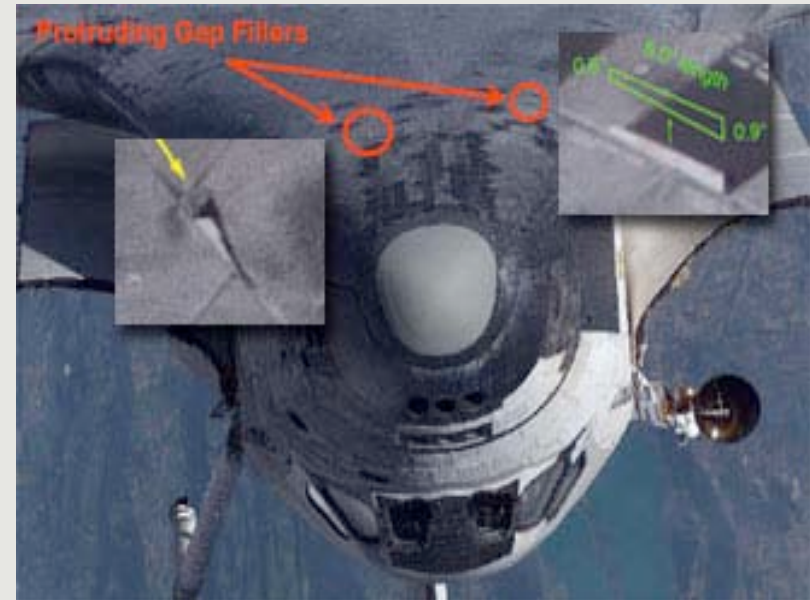
- **Bioinformatics** is a rapidly expanding **interdisciplinary field** encompassing modern biology, mathematics, statistics and computer science. It plays an important role in research on human diseases such as cancer, development of improved crops and animal breeding as well as fundamental research in biology.

## What career pathways are open to me?

- **Teaching Mathematics and Information Technology.** A career in teaching Mathematics and Information Technology is available to students who complete a Bachelor of Mathematical and Computer Sciences and a Graduate Diploma in Education (or equivalent qualification).
- A career in teaching is also available through the double degree Bachelor of Mathematical and Computer Sciences/Bachelor of Teaching.

## The value of higher Mathematics

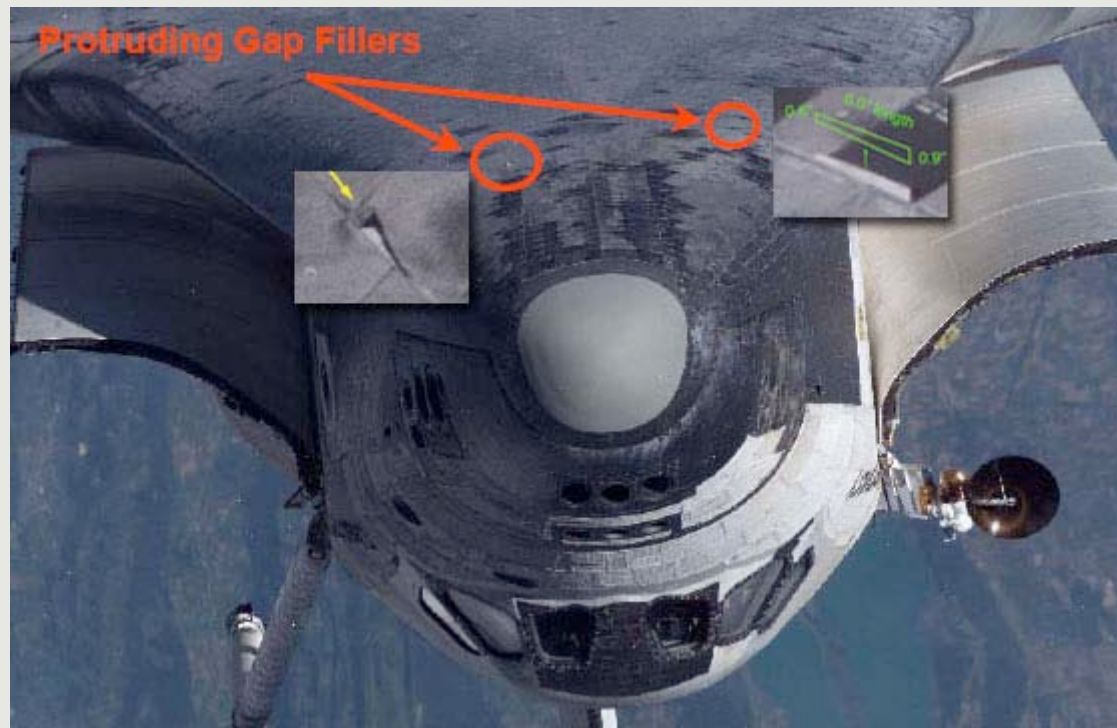
- “Engineering analysis determined neither of the gap fillers that are sticking out was needed for landing.”
- “This could potentially affect the aerodynamic flow during re-entry, causing turbulence and unwanted heating in a scenario known as *tripping the boundary layer*.”



Source: [www.nasa.gov/returntoflight/crew/EVA\\_gapfiller.html](http://www.nasa.gov/returntoflight/crew/EVA_gapfiller.html)



## The value of higher Mathematics



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## Adding Value with Mathematics

- “Deputy Shuttle Program Manager Wayne Hale said he asked the experts if they had enough data *to be 100 percent confident the vehicle could fly safely during entry.*”
- “Citing the *large uncertainty* about aerodynamics at the altitudes and speeds of a Shuttle re-entry. Hale said *in the end it came down to be a really simple decision ... the remedy is easy and we ought to go exercise that remedy.*”



**Source:** [www.nasa.gov/returntoflight/crew/EVA\\_gapfiller.html](http://www.nasa.gov/returntoflight/crew/EVA_gapfiller.html)



## So what was all the fuss about?

- To answer this question we need to talk a little about *turbulent fluid flows*.
- The picture at the right shows a computer simulation of a *turbulent fluid flow*.
  - To visualize the flow think of shaking up a bottle of salad dressing, with the oil on the bottom (blue) and the vinegar on the top (red).
  - *Turbulent* flows can best be thought of as being *chaotic*
  - Turbulent flows *transfer heat* much better than non-turbulent flows

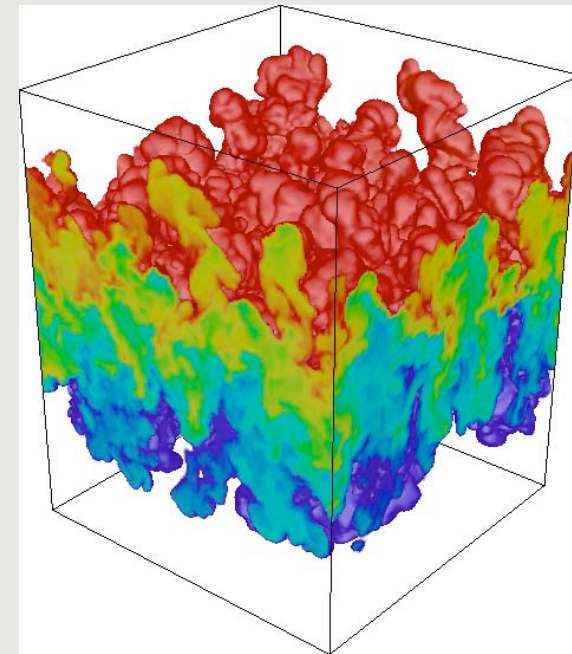


Image: courtesy of Dr Trent Mattner

## So what was all the fuss about?

- If the flow over the surface of the Space Shuttle became turbulent prematurely due to the *gap filler sticking out* at or near the **speed at which the peak heating** of the shuttle surface is known to occur then the “**increased heat load due to the turbulence would exceed the allowed margins for safety**”
- Predictions available to NASA on what speed the flow would become turbulent ranged from Mach 21 to Mach 24.
- The speed for “peak heating” is **Mach 23!**



Source: [www.nasa.gov/returntoflight/crew/EVA\\_gapfiller.html](http://www.nasa.gov/returntoflight/crew/EVA_gapfiller.html)

## And the result of all this was ...

- Suit up Steve, you're going for a walk!
- But seriously ...
  - Because we don't understand what is happening at these high speeds any predictions we make are prone to errors
  - In this case a **very large** error  
 $100 \times [(24-21)/21]=14\%$
- There is much more work to be done before we are able to predict, with any certainty, what happens in problems like these.



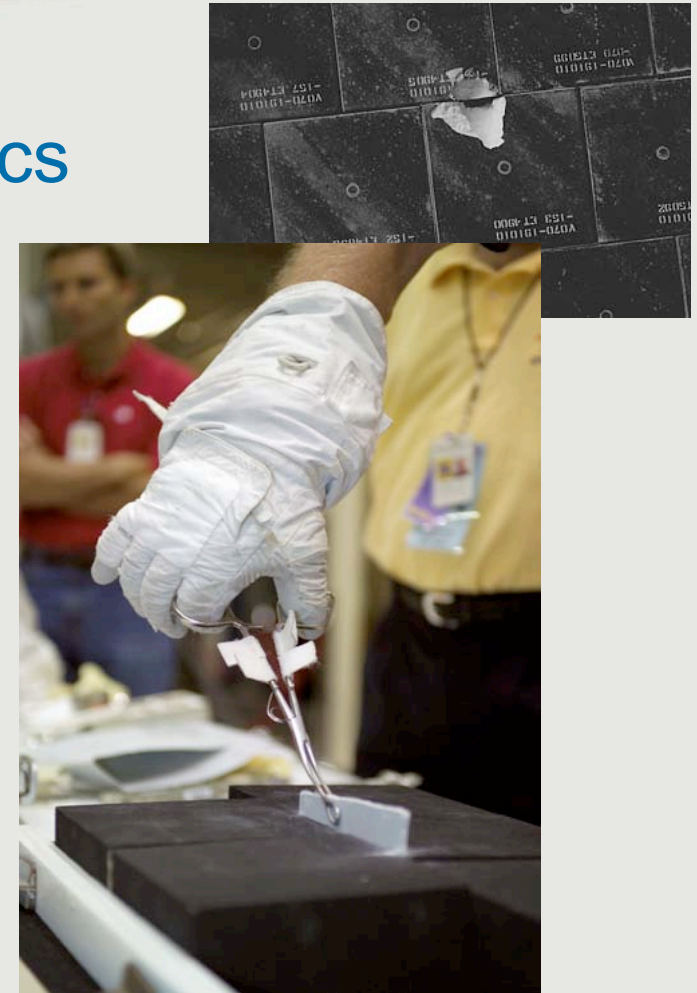
Source: <http://www.jsc.nasa.gov/Bios/htmlbios/robinson.html>



## Adding Value with Mathematics

- To remove the “the large uncertainty about aerodynamics at the altitudes and speeds of a Shuttle re-entry” requires a level of mathematical modelling (and mathematical complexity) that can only be undertaken by a person trained to the highest mathematical level.

Source: [www.nasa.gov/returntoflight/crew/EVA\\_gapfiller.html](http://www.nasa.gov/returntoflight/crew/EVA_gapfiller.html)





So why do more Mathematics and Statistics?

*Mathematical and Statistical skills give you a competitive edge in the workplace.*