Why the mathematical sciences matter: An industry perspective

Ian Marschner
Director of Biometrics
Pfizer Australia

Mathematical input to the lifecycle of a medicine

What should a new medicine target?

Understanding disease causes
Bioinformatics
Epidemiology

What effect do we predict a new medicine will have?

Modelling the impact of a medicine
Mathematical models of pharmacological processes, disease transmission etc.

Is the medicine safe and beneficial?

Controlled studies
Biostatistical design & analysis of clinical trials

Is the medicine's cost worth its benefit?

Health economics
Data synthesis
Meta-analysis
Cost-effectiveness analysis

How do we manufacture the medicine for ongoing quality?

Manufacturing
Quantitative quality control processes

How do we optimise the long term benefit & safety?

Post-marketing surveillance
Design and analysis of treatment strategy studies and safety surveillance data

Mathematical thinking is indispensable

- Consider virtually any industry research & development (R&D) process and mathematical thinking in some form will be a key component of most steps in the process
- In many cases such mathematical and statistical rigour is mandated by governments and regulatory authorities
- This mathematical activity is not “nice-to-have”. It is a core industry activity and will be done somewhere.
- The challenge is to ensure it is done in Australia

Factors impacting R&D investment

- Availability of talent
  - Quality of talent
  - Size of talent pool

- Attractiveness of investment environment
  - Costs
  - Tax laws
  - Investment incentives

- Under current conditions investment is occurring. Investment will increase as the attractiveness of investing and the availability of talent increases (and vice versa…)

Recent trends in pharmaceutical industry

- Some major companies have made significant "knowledge-based" investments in Australia in the area of mathematical sciences

- Some recent examples over last 5 years
  - Pfizer: Asia Biometrics Centre
  - Eli Lilly: Clinical Outcomes Research Institute
  - Roche: Biometrics Department

- Regional investments driven by perception of high quality talent in Australia relative to Asia-Pacific region and aided by local investment incentives (PIIP, P3 etc.)

Challenges to maintaining and expanding investment

- Shortages of high quality talent in mathematical sciences

- e.g. The majority of statisticians working in the pharmaceutical industry trained outside of Australia

- Global trend towards off-shoring activities to lower cost countries, particularly India and China
  - Currently focusing on off-shoring of "non-strategic" activities but this could change in the face of under-supply

We are at a critical point

- Given current international investment trends we are at a critical point in relation to industry investment in mathematical science jobs in Australia:

  - Pro: Australia's quality and reputation in the region represent an attractive investment proposition

  - Con: Australia's current mathematical sciences skills shortage and the global trend towards investment in lower cost countries represent a significant challenge

What is needed

- Educational models and funding mechanisms that facilitate the supply of a large pool of talented graduates

- Continued improvements in the attractiveness of the investment environment to drive further increases in foreign and local investment

Case Study: Biostatistics

- Increasing difficulty experienced by many institutions and employers in appointing biostatisticians with suitable training and experience
- Government review (PHERP) recommendation:

  "A working party be established to examine ways by which Australia's supply of biostatisticians can be enhanced. This working party should include representatives from both within and outside the public health workforce. Depending on the outcome of this process, special PHERP innovation funds should be considered as a means to support increasing the pool of biostatisticians in Australia"

Background

- Task force formed around group of senior academics and industry representatives in biostatistics, to develop a strategic plan for biostatistical training oriented to both government and industry needs
- Awarded a grant from DHA of $1.2m over 5 years to establish a high-quality biostatistical training program
- **Biostatistics Collaboration of Australia** consortium formalised via an MoU between universities, and contract with DHA
- 2001: courses available at UQ, Newcastle, Sydney. 2002: enrolments at UMelb, Monash, Macquarie

Biostatistics Collaboration of Australia

Partner Universities

THE AUSTRALIAN NATIONAL UNIVERSITY

POSTERA CRESCAM LAUDE
THE UNIVERSITY OF MELBOURNE

The University of Sydney

The UNIVERSITY of NEWCASTLE AUSTRALIA
I LOOK AHEAD

MACQUARIE UNIVERSITY ~ SYDNEY

MONASH UNIVERSITY

SCIENTIA AC LABORE
THE UNIVERSITY OF QUEENSLAND

THE UNIVERSITY OF ADELAIDE AUSTRALIA
SUB CRUCE LUMEN

Core Funding

Australian Government
Department of Health and Ageing

Scholarship Funding & Strategic Support

Pfizer

Roche

Program Aims

General objective

- **To meet the need for highly qualified and skilled biostatisticians in government, academia and industry**

Specific aim

- **To achieve in graduates a level of statistical competence that is:**
  - technically higher than that of existing degrees in public health and epidemiology
  - attuned to real-world applications in health and medical sciences

Program Structure

Three-tier award structure

Postgraduate Certificate

Postgraduate Diploma

Master of Biostatistics

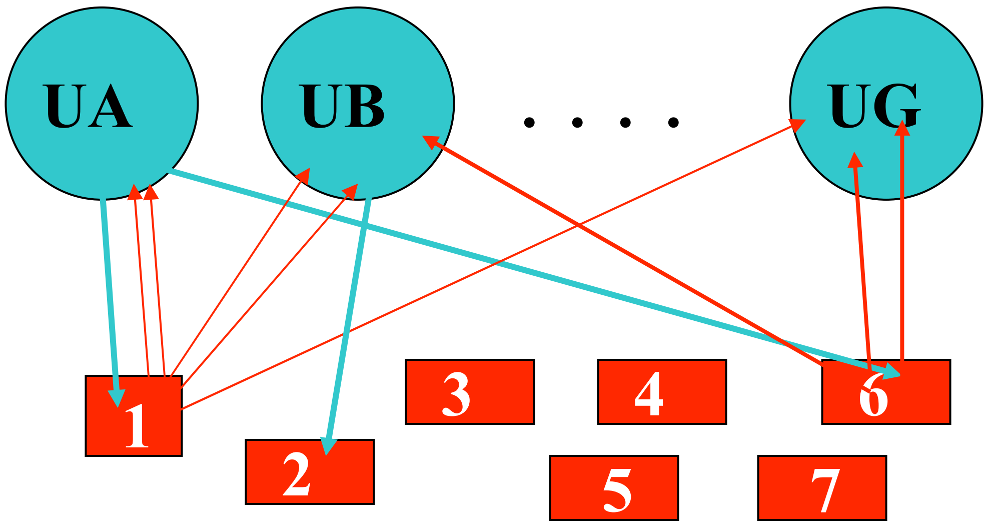
- qualifications are subsets of each other with an increasing degree of maturity/rigour required as the level of qualification increases

Enrolment & Delivery

Students enrol in Program at one consortium university

Units of study delivered by other consortium universities

All units in Program accredited by all consortium universities



Units of study:

Delivering university

Students

Delivery of Units

- All subjects taught in distance mode (except project)
- Materials sent in paper form (± CD-ROM)
- Online delivery (using WebCT)
  - online discussions between students and teachers

Student Numbers

Number of students (actively) enrolled in units of study within the BCA program						
	At end of 2001	At end of 2002	At end of 2003	At end of 2004	At end of 2005	At Oct 2006
Melbourne	0	15	23	45	42	46
Monash	0	4	7	11	18	12
Newcastle	10	19	13	11	5	3
Queensland	0	3	11	17	21	20
Sydney	5	14	21	37	40	67
Macquarie	-	-	-	7	12	14
Total	16	55	75	128	138	162
No of unit places	28	131	234	329	394	703

External Reviews

- Independent external review committee (chair Professor Louise Ryan, Harvard):
  - "The BCA has been successfully established as an outstanding multi-institutional system for developing, strengthening and sustaining Australia's workforce of career biostatisticians." (2004)
- National review of PHERP:
  - "The BCA is the best example of PHERP Phase III strengthening the basis for high-level and consistent quality education programs." (2005)

BCA Multi-institution model

- <u>Efficiency</u>: avoids duplication through collaboration and economies of scale
- <u>Quality</u>: gives students access to experts across a consortium of universities
- <u>Collaborative</u>: Academia, government and industry co-operating to target a national shortage in mathematical sciences
- Potential prototype for other areas of the mathematical sciences

Mathematical Sciences Foster Investment

- The availability and attractiveness of employing mathematical talent in Australia is a key component to:
  - Attracting foreign investment from multi-national companies
  - Attracting local companies to develop research discoveries in Australia rather than going off-shore

- We have the opportunity to capitalise on past successes to create a critical mass of investment in mathematical sciences in Australia

What Australia needs

- Education models and funding mechanisms that facilitate the supply of a large pool of talented mathematical science graduates
  - <u>Quality</u>: maintain a point of distinction between Australia and lower cost countries
  - <u>Size</u>: produce sufficient numbers to avoid under-supply

- Continued improvements in attractiveness of investment environment to drive continued increases in foreign and local investment