Maths for the Future: Keep Australia Competitive

Canberra 7-8 February 2012

Policy measures

Context

Cutting-edge developments in science, technology, medicine, commerce and management rely increasingly on sophisticated inputs from mathematical scientists. Examples are abundant. In biotechnology, mathematics is said to be the microscope of the future, airlines make extensive use of advanced optimisation techniques to gain a competitive edge in a fierce market, stochastic modeling predicts behaviour in the stock market, while increasingly complex algorithms are required to ensure digital security. The means to stabilise the earth's climate over long periods will require self-consistent forward mathematical modeling. The diversity of the speakers at *Maths for the Future* highlights the critical importance of the mathematical sciences across a wide range of strategic areas.

The Problem

Currently, demand for mathematical and statistical skills far outstrips falling supply, and maintaining Australia's international competitiveness, security, population health and climate stability requires a mathematically literate population.

The greatest single challenge to the health of the mathematical sciences is the long term decline in enrolments in calculus-based mathematics subjects, often referred to as *intermediate* or *advanced*, at year 12 (see the chart in the accompanying Profile document). This decline has resulted in

- a significant reduction of the number of tertiary institutions offering mathematics and statistics majors with a consequent reduction in staffing,
- widespread university course realignments to cope with increasing numbers of less mathematically literate students,
- reduced graduation rates in the mathematical sciences,
- stagnating interest in engineering and sciences courses,
- a concentration of university based research to a small number of institutions which cannot meet the large and growing demand for PhD graduates,
- reduced intake into teacher training programs of mathematically qualified graduates,
- reduced numbers of qualified secondary school teachers, especially in regional and low SES areas, leading to fewer students in calculus-based mathematics subjects at Year 12.
- the unavailability of these subjects in many regional and low SES areas.

Postal Address: Building 161
c/- The University of Melbourne
Victoria 3010 Australia

Email: enquiries@amsi.org.au
Phone: +61 3 8344 1777
Fax: +61 3 8344 6324
Web: www.amsi.org.au

This creates a structural impediment to meeting Australia's galloping demand for mathematics and statistics graduates (see the Profile document) and it puts a brake on the national productivity growth enjoyed by other OECD countries where mathematics and statistics graduate levels are, on average, two and a half times higher than those in Australia.

The policy and action measures outlined here need to be undertaken in concert by the various stakeholders: it is our strong view that isolated measures will not be successful.

Overall measures

1. Appoint a mathematician or statistician as national mathematics adviser to advise, coordinate, promote and report on all the policy measures in this brief and more (Action: DEEWR)

2. A five-year national awareness campaign for mathematics and statistics targeted at both the school and higher education sectors. This campaign will highlight the importance of school mathematics studies for a wide variety of careers and trades and encourage the provision of effective advice on subject choice at secondary and post-secondary levels. Include professional development for both mathematics and careers teachers. It will also highlight government incentives to study mathematics and statistics (Action: DEEWR, ESA, teacher associations)

Undergraduate measures

3. Reinstate universal Year 12 mathematics prerequisites for science degrees commencing 5 years after the introduction of the senior Australian mathematics curriculum. DEEWR incentives to do so. (Action: Deans of Science, Universities Australia, DEEWR)

4. Reinstate Year 12 advanced mathematics prerequisites for engineering degrees where appropriate commencing 5 years after the introduction of the senior Australian mathematics curriculum. DEEWR incentives to do so. (Action: Deans of Engineering, Engineers Australia, Universities Australia, DEEWR)

5. Measures to increase the number of suitably prepared undergraduates who could proceed to teach school mathematics, including the effective advice on subject choice. For example, students undertaking a biology/biological sciences degree and intending to become secondary teachers could be encouraged through concrete Commonwealth incentives to complete sufficient tertiary mathematics and statistics subjects enabling them to teach secondary school mathematics as well as biology. Include incentives for early commitment by undergraduates to pre-placement training. HECS-free honours year for those subsequently completing teacher training. (Action: DEEWR, Deans of Science, Deans of Education, Universities Australia) **NOTE: Year 11 and 12 mathematics subjects should in general be taught by those with a major in mathematics and/or statistics.**

Postal Address: Building 161
c/- The University of Melbourne
Victoria 3010 Australia

Email: enquiries@amsi.org.au
Phone: +61 3 8344 1777
Fax: +61 3 8344 6324
Web: www.amsi.org.au

6. Introduce an undergraduate scholarship scheme for students studying mathematics or statistics. This scheme should contain a component intended for students who wish to study the discipline but have been unable to access advanced mathematics subjects at year 12. The scholarships should be extendable into a postgraduate teaching qualification. (Action: DEEWR, States)

7. HECS-free places in those first year university subjects designed to bridge mathematically under-prepared students into programs requiring mathematics and statistics. (Action: DEEWR)

8. HECS-free places for Honours and two-year Masters (e.g., at the University of Melbourne) in mathematics and statistics to improve retention into PhD programs. (Action: DEEWR)

Postgraduate measures

9. Provide a dedicated allocation of Australian Postgraduate Awards (APAs) in mathematics and statistics to the universities to improve retention from honours and masters programs. Incentives for universities which provide such a dedicated allocation from their own award program. Especially important in smaller and regional universities.(Action: DIISR, Universities Australia)

10. Provide a stipend top-up on APAs to improve retention from honours and masters programs. This is particularly important in statistics where employment demand is severely reducing retention. (Action: DIISR, Universities Australia)

11. Re-weight the funding of PhDs in mathematics and statistics to match those in the physical sciences. (Action: DIISR)

School education and teacher training measures

12. Set national 3, 5 and 10-year targets for increased enrolments in Year 12 advanced mathematics subjects. (Action: MCEECDYA, DEEWR, States)

13. Identify regions with low or no enrolments in advanced mathematics subjects in Year 12 and coordinate and fund shared provision of these subjects. Use NBN. (Action: MCEECDYA, DEEWR, States, DBCDE)

14. Upgrade out-of-field teachers starting in low SES and regional areas and with those teachers needing least discipline content (e.g., biology graduates with some maths/stats). Identify qualification/content providers from amongst the universities. Utilise the National Partnerships. Make the subjects HECS free. Utilise NBN for online provision. Involve ESA. Set 5-year targets. Provide a "Golden Welcome" for teachers completing their upgrade qualification. (Action: MCEECDYA, DEEWR, States, DBCDE)

15. Every secondary school to have a maths/stats graduate as discipline leader within 5 years. Start with schools most in need and offer incentives to teachers (e.g., the UK's "Golden Welcome") and schools. (Action: MCEECDYA, DEEWR, States)

16. Every primary school to have a mathematics specialist (an individual with appropriate tertiary content qualifications) within 5 years by appointment or

Postal Address: Building 161
c/- The University of Melbourne
Victoria 3010 Australia

Email: enquiries@amsi.org.au
Phone: +61 3 8344 1777
Fax: +61 3 8344 6324
Web: www.amsi.org.au

training with “Golden Welcome” or incentives upon completion of training. Incentives to schools. (Action: MCEECDYA, DEEWR, States)

17. Golden welcomes for new, qualified mathematics teachers working in “difficult to fill” positions. (Action: DEEWR, States.)

18. Jurisdictions to return to offering salary increments/incentives for honours graduates and postgraduates to enter the teaching profession in the public school systems. (Action: States.)

19. Identify undergraduate degrees with mathematical sciences content and weight these studies in the calculation of GPAs for entry into postgraduate Diplomas of Primary Education. (Action: Deans of Education, AITSL, Universities Australia)

20. Improve and standardise relevant mathematics content in pre-placement training for primary teachers over the next 5 years. (Action: Deans of Education, AITSL, Universities Australia)

    (a) Primary Bachelor of Education programs. Conventional entry from year 12 must require a 70% percentile score in any year 12 mathematics subject in the *Australian Curriculum: Mathematics* except *Essential Mathematics* or current equivalent. (Action: AITSL, DEEWR, Deans of Education, Universities Australia)

    (b) The program itself must contain 2 subjects of mathematics content, identifiably tailored to the knowledge requirements of primary teachers, at least one of which must be taught in the first year. These subjects should be delivered in conjunction with the provider’s mathematics and statistics discipline centre and are the subjects referred to in the paragraph above. In addition, the program should contain 3 subjects of mathematics pedagogical content knowledge. (Action: AITSL, MCEECDYA, DEEWR, States, Deans of Education)

Professor Geoff Prince
AMSI Director
January 2012

Postal Address: Building 161
c/- The University of Melbourne
Victoria 3010 Australia

Email: enquiries@amsi.org.au
Phone: +61 3 8344 1777
Fax: +61 3 8344 6324
Web: www.amsi.org.au