

31 March 2011

Dr Jane Lomax-Smith  
Chair, Review of Higher Education Base Funding

Dear Dr Lomax-Smith

Thank you for the opportunity to have input to this important review. It is a personal submission based on my extensive involvement in policy and the mathematical sciences that dates from the late 1980s.

My comments and the data I provide are specific to the disciplines of mathematics and statistics. They should be viewed as a case study of unanticipated consequences of previous funding models, and a failure to act, before those consequences became a serious issue.

The submission exceeds 10 pages as I have appended two sources of data not readily available.

The panel has an enormous task, not just to suggest base funding for the future, but also to ensure that the funding addresses the 'unanticipated consequences' of the past. There are many other discipline areas vital to Australia that have been in decline in Australia for some time including entomology, geophysics and languages. I do not have an evidence base for these but I'm sure others do.

I wish you and your panel success in your task. I would be happy to assist with clarification or additional material in support of my comments.



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## INTRODUCTION

In 2006 the international reviewers for an ARC funded review of mathematics and statistics in Australia wrote:

*Australia's distinguished tradition and capability in mathematics and statistics is on a truly perilous path. The decline has already taken its toll: the university presence has been decimated, in part by unanticipated consequences of funding formulas and by neglect of the basic principle that mathematics be taught by mathematicians, and the supply of students and graduates is falling short of national needs.*<sup>1</sup>

As the evidence provided here will show, little has changed since the Review and it is worse in many of the smaller and rural universities.

My expertise and knowledge of mathematics and statistics includes:

- As a member of the Australian Academy of Sciences National Committee for Mathematical Sciences, involvement in the 1996 ARC funded Strategic Review of advanced mathematical sciences<sup>2</sup>
- As a member of the Federation of Australian Scientific and Technological Societies (FASTS) Executive, author of an Occasional Paper on the state of mathematical sciences<sup>3</sup> and a subsequent update<sup>4</sup>
- Member of 2005 working party that reviewed statistics education in the universities<sup>5</sup>
- Member of the Working party for the 2006 ARC funded Review of Mathematical Sciences<sup>6</sup>
- Various projects involving teaching supply, especially mathematics teachers for secondary schools, dating from 1987.

Further, as Executive Officer for the Australian Mathematical Society for a number years, and Executive Officer for the Australian Mathematical Sciences Institute (AMSI) from its inception until 31 March 2011, I have been consistently involved in data collection from the Heads of Mathematics Departments in universities across Australia.

### **I believe:**

The present Review has the potential to redress some of the problems in the mathematical sciences<sup>7</sup> and Australia needs more graduates in these disciplines. For example, this is supported by a recent DIISR report<sup>8</sup>. It also needs more graduates with degrees that include a solid mathematical skills base in other areas including education, social sciences, economics and computing. There are few discipline areas that are not dependent on some understanding of mathematical ideas and applications. In a modern economy, students need access to these skills.

Getting the funding for mathematics and statistics right is an equity and social inclusion issue. This Review must produce an outcome that ensures that graduates have the mathematical and statistical tools to fully engage in society whatever their discipline. A funding model is needed that provides adequate funding for the teaching of multiple

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<sup>1</sup> <http://www.review.ms.unimelb.edu.au/FullReport2006.pdf>

<sup>2</sup> <http://www.review.ms.unimelb.edu.au/95Review.pdf>

<sup>3</sup> [http://www.fast.org/images/occasional-papers/Lookingfor\\_future.pdf](http://www.fast.org/images/occasional-papers/Lookingfor_future.pdf)

<sup>4</sup> [http://www.austms.org.au/AustMath/braindrain\\_2002.pdf](http://www.austms.org.au/AustMath/braindrain_2002.pdf)

<sup>5</sup> <http://www.statsoc.org.au/objectlibrary/533?filename=ReviewofStatsFinalReport.pdf>

<sup>6</sup> <http://www.review.ms.unimelb.edu.au/FullReport2006.pdf>

<sup>7</sup> Mathematical sciences will be used to be inclusive of the various sub-disciplines. Where there are specific issues in regard to a sub-discipline, such as statistics, the sub-discipline will be used.

<sup>8</sup> <http://www.innovation.gov.au/Research/ResearchWorkforceIssues/Documents/DisciplineSpecificCaseStudies.pdf>

courses for diverse needs and interests. Students who graduate without mathematical and statistical skills equivalent to what is expected from similar degrees internationally, and excellent communication skills, are disadvantaged in the workplace both nationally and internationally.

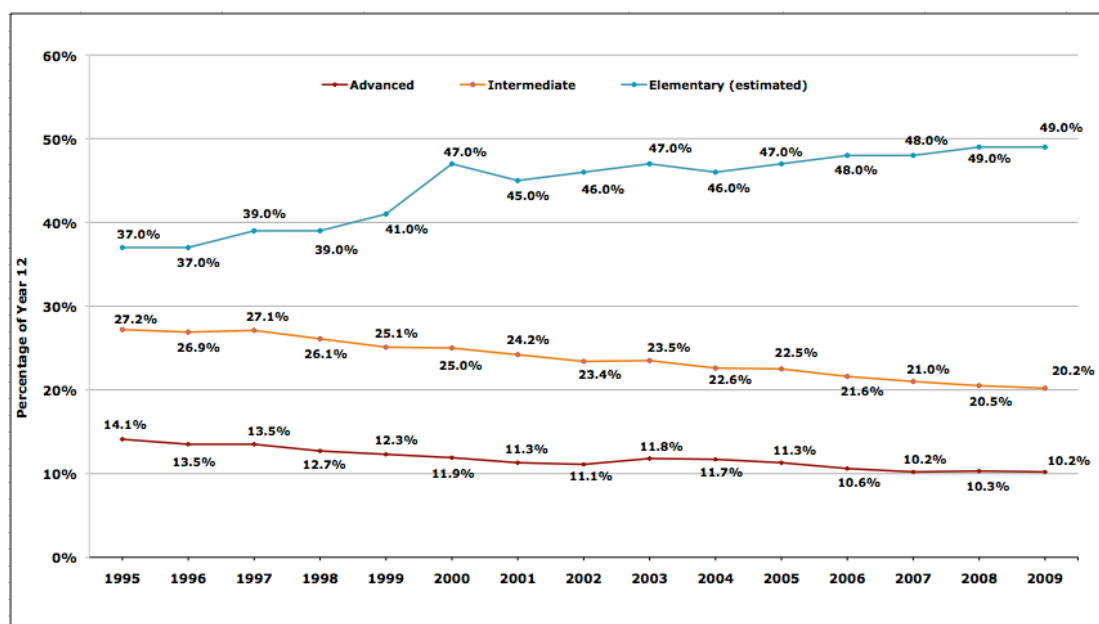
### FUNDING MODELS AND THE MATHEMATICS SCIENCES

In the 1996 strategic review the RFM was not considered a major issue. There was considerable concern about positions for early career researchers, especially those who had gone overseas for post-graduate studies. However, it was also apparent that there was about to be many retirements and this was expected to improve the situation.

Shortly after the 1996 Review was launched the Howard government was elected. The effect of the resulting higher education policy<sup>9</sup> on the mathematical sciences was that the new positions never eventuated. Mathematical sciences departments started to contract and many of Australia's most experienced researchers left for overseas. This was documented in 2000 and 2002<sup>10</sup>.

When the proposed Commonwealth Course Contribution Schedule became public in 2003 there was considerable concern within the mathematical community. There were now many compounding issues:

1. The need for computer laboratories was part of the problem. A perception remained in the minds of many university administrators was that mathematics and statistics were subjects that could be taught in large classes with a chalkboard or overhead projector.
2. More importantly, the mathematical background of many of the cohort entering universities had changed dramatically. This is shown in the following diagram:



Thus as the percentage of students gaining university places grew, the percentage with intermediate or advanced level mathematics fell. Increasingly the students entering

9 Prof. Frank Larkins recent book, Australian Higher Education Research Policies and Performance 1987 – 2010, examines this in depth.

10 Footnotes 3 and 4

university have needed specific mathematics and statistics courses that ensure that they have the mathematical knowledge to understand their subjects. It is not just about 'passing' – this is concerned with becoming a competent professional be it in engineering, primary teaching, sociology or agriculture. But the needs of these groups of students are vastly different. At the same time the mathematically talented need stimulating and challenging courses. Providing for these students in years 2 and 3 of their studies can be particularly challenging for small departments.

3. As faculties sought to maintain income, service teaching of mathematics and statistics was affected in several ways especially by being taught within the faculty concerned. This has several effects. One is that, overtime, the courses often become fossilised and no longer reflect modern mathematical techniques within the discipline. There is also a temptation to 'just in time teaching' where the mathematics or statistics needed to pass the exam on a section of the course is taught. This does not lead to robust, transferable skills. And a further temptation to reduce the amount of mathematical content required either by reducing hours and/or the level of knowledge required. Given the graph above this is very attractive. The drift of service teaching from mathematics and statistics departments has a profound effect on those departments. And it is not supported in other nations.

4. Mathematical sciences departments' income from full-fee paying students was insignificant.

The 2006 Review described the history of the RFM:

*In 1989 the institutionalised distinctions between colleges of advanced education and the 19 pre-existing universities were removed by the then Minister of Education, John Dawkins. One of their biggest distinctions was their funding levels.*

*Historical expenditure patterns were analysed and adjusted to give a relative teaching cost matrix that became known as the Relative Funding Model (RFM). The RFM had two main factors in its calculations: discipline groups and program levels. There were five groups and mathematics and statistics were in the second lowest level for undergraduate teaching and on the lowest for research degrees and other postgraduate courses.*

*Thus mathematics and statistics were funded on a historical model that took no account of the increased costs of a more diverse student population and a new development of needing to equip computer laboratories. The AVCC was apparently asked to report on the RFM in 1999 and still hasn't.*

*The problems inherent in the original model remain. In 2005 the Commonwealth Course Contribution Schedule replaced the RFM, which DEST confirmed was basically the old RFM.<sup>11</sup>*

I have a copy of an October 1999 Proposed Specifications for the Review of the Relative Costs of Teaching that suggests DETYA had commenced the Review and was in close consultation with the AVCC. I don't have information about the outcome or if the Review went ahead.

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<sup>11</sup> Peta Lane, Minister's adviser, gave me a contact in the then DEST who confirmed this.

In December 2006 DEST released a discussion paper concerning a Review of the Impact of the Higher Education Support Act 2003 that was to report on the then existing Funding Cluster Mechanism.

This proposed Review came after the 2005 Review of Statistics at Australian Universities and coincided with the release of the 2006 Review of Mathematical Sciences. Both these reviews expressed serious concerns about the effect of the funding model on mathematical sciences in the universities. I don't believe the DEST review was ever public or even if it was completed. However the 2007 budget saw a very substantial increase for mathematics and statistics.

However, as the history of funding for the teaching of mathematics and statistics reveals, it is not sufficient to provide universities with the funding for specific disciplines unless there is a mechanism to ensure that is where the money is spent.

### **THE EFFECT ON UNIVERSITY MATHEMATICS DEPARTMENTS**

To summarise and reiterate what I have said above: At the time of the 1996 Review there was considerable concern about the lack of new academic positions being advertised. A particular aspect of this was that mathematics had traditionally encouraged its best students to complete their PhDs overseas and now it was becoming very difficult for them to come back. However, contraction of departments was not expected and many retirements were in the pipeline.

However, the funding to the universities that followed the 1996 election meant that what actually happened was that as positions became vacant they were not filled and mathematical sciences departments did contract. Not only were the best young people not coming back but now many of the best researchers were also leaving. The brain drain is documented in the FASTS Occasional paper and update<sup>12</sup>.

Compounded by a decline in the number of mathematically well-qualified students from Year 12 with the background for courses requiring considerable mathematics and a funding model that was inadequate, university mathematical sciences departments continued to contract.

In 2007 funding for the teaching of mathematics and statistics was considerably increased, but there was no requirement for universities to use it to improve the provision of mathematics and statistics courses. Only a few did and mathematics and statistics departments, with one or two exceptions, continued to decline.

Data collected in 2008 and 2010 is provided in Appendices 1 and 2. Both documents include personal comments from Heads that give a deeper picture than raw numbers. The 2006 Review showed that the Go8 lost over 30% of their teaching and research staff in the period 1995-2005. While these universities have maintained viable departments the same cannot be said for the smaller, and especially the regional, universities. The result is seen the number of universities no longer offering majors in mathematics and the larger group that cannot offer a major in statistics.

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<sup>12</sup> See footnotes 3 and 4. Some authors have referred to 'brain churn' using data collected by immigration as people enter and exit Australia to suggest that as many mathematical scientists came in as left. As far as the mathematical sciences are concerned this is nonsense—top researchers left and were not replaced.

The parlous state of mathematics in many of Australia's universities is further demonstrated by the recent ERA exercise. To quote Professor Nalini Joshi, Chair of the Academy's National Committee for the Mathematical Sciences:

*Forty-one tertiary institutions submitted research outputs to be evaluated. Out of these, 17 did not receive an assessment in the mathematical sciences. This means that these 17 institutions did not have enough research publications in mathematical sciences in the six-year reference period to meet the ERA minimum threshold. What is this threshold? It is a minimum of 50 research outputs (or 30 outputs in the case of pure mathematics) in the reference period: 01 January 2003 – 31 December 2008.*

*To understand this a little more, consider a fictional mathematics department with ten research active staff members publishing one paper each per year in a mathematical journal. This department would have 60 research outputs over the reference period and so would receive an ERA assessment. The reality in Australia is that many tertiary institutions do not have such numbers of mathematically active staff.*

*Only 12 institutions received an assessment for statistics.*

### **TEACHER SUPPLY**

The number of universities no longer offering majors in mathematics, statistics or a combination of mathematics and statistics has impact on the potential number of new mathematics teachers. In secondary schools mathematics is the most widely reported area of shortfall quoted by principals.

The percentage of graduating secondary teachers qualified to teach mathematics is around 7%. The time in the school curriculum for mathematics is around 14%. This supply and demand mismatch has existed for over ten years. It is not surprising that the performance of Australia's Year 8 students in TIMSS has gone from statistically above both the UK and USA in the mid-90s to statistically below both these countries.

While physical sciences are also an area of shortfall, there is a good supply of teachers qualified to teach junior science. The shortages appear at the Years 10-12 when specific classes in Chemistry and Physics are needed and majors in these areas are required. However, these subjects have a smaller enrolment in the senior years and there exists a pool of general science teachers who could be upgraded. It is also likely that more students would major in physics and chemistry if mathematics education provision was improved.

The mathematics teacher problem is massive. The new Year 7 mathematics teachers is likely to be a young female biology graduate who gave up mathematics well before university. With no mathematics in their degrees they have not completed any courses in teaching mathematics.

The downward spiral emerges of too few mathematical sciences graduates leading to an inadequate supply of teachers, to school students not having a mathematics education that leads to participation in the more advanced Year 12 subjects etc

Currently thousands of young Australians are deprived of an adequate education in the mathematical sciences by virtue of an inadequate supply of properly qualified mathematics teachers in schools that is compounded by woefully under-resourced mathematics and statistics teaching in the universities.

## IMPLICATIONS FOR THE CURRENT REVIEW

I am not going to attempt to spell out what the funding should be as others with a better knowledge of the costs are in a better position to do that. And while adequate funding for the teaching and learning of mathematics in the universities is a very important part of improving the mathematical skills base of Australia but it is only part of the solution. The UK is the only English-speaking nation in recent times to make significant gains in students' appreciation and participation in the mathematical sciences<sup>13</sup>.

The UK experience was outlined for the Australian Council of Heads of Mathematical Sciences meeting by Prof. Celia Hoyles in February 2010<sup>14</sup>. The UK initiatives featured a raft of integrated actions that included promotion of careers in mathematics and statistics, improving the discipline and pedagogical knowledge of existing teachers and financial incentives for mathematics graduates to enter teaching.

For the UK experience to be duplicated in Australia there would need to be very much greater presence of mathematical sciences in universities across Australia. This is because university mathematical sciences are already stretched to the limit with an increasingly use of casual staff and difficulties in finding appropriate part-time and casual staff (Appendix 2). Majors need to be re-established or established in all universities to provide the opportunity for more students to consider this option. And improved staffing would enable more universities to be involved in providing appropriate courses for improving teachers' discipline knowledge.

The most important lessons learnt from the experience of the mathematical sciences is that:

- It is not enough for governments to fund teaching at a level seen as desirable for good teaching and learning outcomes in a discipline, if the money can then be diverted to other areas, and
- That the shift of service teaching out of discipline departments weakens the discipline department and results in poor delivery of courses, if not initially, then over time.

This raises questions about the autonomy of tertiary institutions. But this is tax payers money and there seems to have arisen a situation where some quite small projects within higher education are audited to the last cent while large grants for teaching and learning are not audited at all. Such reporting need not be a rigorous process but a simple reporting of cost of teaching staff, computing, space costs etc that could be backed by an occasional audit of some institutions to ensure compliance. It could be incorporated into the work of the Tertiary Education Quality and Standards Agency. Students and their parents now face considerable costs in obtaining a university education. That education should not be compromised by funds for teaching and learning being used for anything other than the purpose for which they were allocated.

Finally, there is the issue of re-invigorating teaching and learning in disciplines of strategic national importance that have contracted (mathematical sciences) or almost disappeared (geophysics, entomology, some languages etc). The failure of government funding for teaching and learning in Australia to keep pace with other nations means there is now a gap that is unlikely to be able to be met completely for some years.

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13 The London Mathematical Society (2010), UK Mathematical Sciences – Research and Teaching in Symbiosis

14 <http://www.amsi.org.au/index.php/publications/external-publications/382-prof-celia-hoyles-on-successful-strategies-in-the-uk>

In the short term it would be sensible to look at something like the UK model of identifying strategically important and vulnerable subjects<sup>15</sup> for special attention.

I recognise that some of my comments here fall outside of the remit of the panel. But Australian higher education desperately needs some thinking 'outside of the square' and an aggressive response to some of the problems now inherent in the system that have the potential to have a serious long-term effect of innovation, national and personal wealth, and particularly social equity.

Jan Thomas  
31 March 2011

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15 <http://www.hefce.ac.uk/aboutus/sis/>



## MATHEMATICAL SCIENCES QUESTIONNAIRE REPORT

### Background

The National Strategic Review of Mathematical Sciences Research in Australia titled “Mathematics and Statistics: Critical Skills for Australia’s Future” covered the spectrum of mathematical activity from school mathematics to advanced level postgraduate courses and research. It had two priorities:

1. An improved funding model for mathematics and statistics, and
2. Funding for national infrastructure, initially specifically through improved funding for the Australian Mathematical Sciences Institute (AMSI).

The Review’s five key recommendations were linked to actions and key performance indicators (KPIs).

The 2007 May budgeted provided new funding for mathematics and statistics. Prior to this, AMSI was invited to apply for an out-of-round Collaboration and Structural Reform (CASR) grant. The CASR grant fell well short of the funding recommended in the Review. Further, it became apparent that very little of the new money for mathematics and statistics was being used to support and strengthen mathematical sciences departments in the universities.

At the beginning of 2008 a questionnaire was sent Heads of Mathematical Sciences in the universities. The questionnaire sought to identify the extent of the flow of new money to mathematics and statistics and responses to the KPIs that were linked to this funding.

### Responses

The questionnaire was sent to 40 Heads of Mathematical Sciences ‘units’. In two universities statistics is taught in a different faculty. Responses were received from 34 Heads. Of the remaining six institutions, it is likely that only one presently offers a 3-year sequence in mathematics and/or statistics and this one is unlikely to continue to do so. This will affect a 3-year statistics course being offered by another university that did respond. The viability of their 3-year sequence depends on course-sharing with the non-responding institution currently offering a 3-year sequence.

Some general observations:

- There seems to have been a general assumption that in excess of 50% of the new money would go to ‘administration’
- Many departments are trying to do more with fewer resources. One, with less than ten staff, is teaching up to and including honours with no collaborative teaching through AMSI or the Access Grid network
- At least two smaller units/groups seem to be in real danger with a 9 to 3 and 6 to 4 drop in permanent staff
- Few seem to expect their university managers to care about mathematics or statistics
- There were several comments about the difficulty of getting statisticians and maintaining courses in statistics
- A number reported likely ‘restructures’. A lack of transparency and information about current and future budgets was also apparent in a surprising number of responses.
- Several noted the difficulty of attracting students to mathematics and statistics.
- Universities not offering a 3-year sequence in mathematic and/or statistics tend to have large enrolments in teacher education.

Summary responses to the specific questions are below. Insufficient information was provided for quantitative measures other than for staff numbers. However the lack of progress in implementing the Review recommendations is clear.

### **Question 1**

*Please indicate whether you expect some of the additional funding to be passed on during 2008.*

8 indicated yes, for some it was unclear.

*If yes, please indicate the percentage of new funding you are likely to receive.*

Only 3-4 indicated significant increases and they all seemed to accept that it was a percentage after the 'administration' deduction.

*If no, are there any indications of increased funding after 2008?*

There was no optimism that if they had not already got an increase that this situation would change after 2008.

*Any further comments?*

Several about changing funding allocations and a general sense from these that budgets filtered down eventually but the model could always change and then?

### **Question 2**

*Number of permanent academic staff – 'normal' teaching and research only – not full-time research*

On 1 January 2007 there were 596.45 staff. Twelve months later it was 552.95

This has not been broken down into levels but quite a number of the new appointments that were made were at the top end. It is suspected that this was in response to a possible RQF. Thus this decline in staff may reflect an even bigger drop in staff who are prepared to work at the coal face of, for example, service teaching to engineers. A number seemed to be anticipating further appointments during the year but also further retirements. Some of the non-continuing appointments appeared to be stop-gap measures to cover teaching commitments.

### **Question 3**

*In 2008 are you offering more or fewer courses in mathematics and statistics? Please quantify.*

Given Q2, it is remarkable that many said the same. About 11 said less and about 6 said more. In general it was a one or two course change. One 'more' response was from a department that had about 8 less staff at the beginning of the year.

### **Question 4**

*In 2007 could you offer a 3-year sequence leading to a major in mathematics?  
In 2008?*

Two responses were from statistics groups so the sample was 32. Of these 6 could not offer a 3-year sequence in 2007, one of these could in 2008. One responded 'just' to both years and another 'only just' for 2008. Non-respondents would add to these figures.

### **Question 5**

*In 2007 could you offer a 3-year sequence leading to a major in statistics?  
In 2008?*

Two responses were from mathematics only teaching departments so the sample was 32.

10 could not offer a 3-year sequence in 2007, two said 'with great difficulty' and a couple only if supplemented with mathematics courses. One 'yes' was a 'hope so' for 2008. The difficulty in finding staff was noted by several. Two universities may be affected by the possible break-down of shared course arrangements caused by potential staff losses at both of them. Added to the non-respondents, the situation is approaching where only about half the universities can offer a 3-year sequence in statistics.

*Any further comments concerning course offerings?*

A couple mentioned help from collaborative arrangements such as the AMSI Summer School and the Access Grid network—initiated through AMSI and its International Centre of Excellence for Education in Mathematics (ICE-EM)—and strengthened by a University of Sydney CASR grant.

**Question 6**

*Some other key performance indicators from the Review are listed below. Please comment, where relevant, in regard to your institution, especially in the period 2007-2008*

- (a) *Staff-student ratios improved: Same, worse or slight improvement*
- (b) *More tutorials and computer laboratory use: 5 said 'yes', 1 said 'worse' and the rest were the same.*
- (c) *Number of new continuing appointments: New appointments seemed to be either necessary replacements to maintain programs or at level E. See reference to possible RQF above.*
- (d) *Number of new non-continuing appointments: Generally seemed to be stop-gap to keep courses running.*
- (e) *More applications from talented mathematicians and statisticians abroad: If they had advertised, generally 'yes', especially for 'pure', but not for statistics.*
- (f) *Student load in mathematics and statistics (quantify if possible): Small increases or decreases but nothing noteworthy.*
- (g) *Increased number of service courses taught in mathematical sciences departments (quantify if possible): A few small increases, most the same. One had biology decrease by 30%*

**Question 7**

*Please attempt to forecast the funding environment for mathematical sciences at your institution in 2009 relative to that for 2008. Will it likely be better, or will it be worse? Only one or two expected improvement, many were quite pessimistic. 'Same' was common comment.*

**Anything you would like to add?**

(included here are a number of comments that were scattered throughout or in covering notes)

- Our institution has made it clear that none of the money is to be used for mathematics.
- At faculty level our full income is reflected. Schools within our faculty are then allocated faculty funds in proportion to their income. The problem lies in our faculty not being allocated a proportionate share of the full university's income in a similar manner. Our faculty is thus indirectly subsidising other faculties.
- We offer a major in mathematics, with a proper honours programme, but only by having staff over-teaching. This has seriously impacted on research output in mathematics, and collaborative research efforts have not been able to be realized.
- Almost no students want to do ma/stats and load only exists in a few compulsory subjects
- We are extremely concerned about this year's enrolment and the trend.
- Most education-science students do one introductory course in mathematics and one introductory course in statistics. Mathematics is not emphasised as being important for a science degree.
- Attracting talented staff in statistics particularly difficult
- Situation better than it has been for years. Have strategic funds to support research, staffing budget up, student numbers up and about to get new building. Supportive new dean arrived 3 years ago.
- I have given up fighting bureaucracy here. I shall lay down and die or go elsewhere. Perhaps I shall just die. However, given an ounce of encouragement (I do not have even that here), I have been known to bounce back very quickly. When I joined XXX in 1988, as a senior teaching fellow and PhD candidate, the last thing on my mind was that mathematics would not even exist here in 2008! Despite its intrinsic value, with excellent supervisor and highly-credible referees, I am now ashamed to even claim my PhD from here.
- XX is struggling the way many regional universities are struggling – what once was quite a broad offering across disciplines which met the needs of the local region is transforming into a market-driven offering optimised around student demand. There is no mechanism in university policy to prevent the decommissioning of low-enrolment areas of academic endeavour like mathematics. Unless the policy settings at a local and national level are changed, the presence of mathematics in universities at places like XX will continue to decline. The support of AMSI in this difficult context is much appreciated – that we add something to the AMSI footprint does, I hope, show that we can work to our mutual benefit.
- In July 2008, we shall be down to 2 statisticians. It is not hyperbole to suggest that the intention is to remove stats from (a regional university) and have amateurs teach low level service units.
- We have not increased the service teaching we do, but we have strengthened the quality of what we do, and so the threats to remove it from us have disappeared. In this sense, we have improved our service teaching relevance and quality and secured a stronger future for ourselves.

Pre-election part of an email from one Head read:

*I am writing in the harsh light of local university budgeting following the initial euphoria over the change at the Federal level to the funding of the mathematical sciences. At A University we are nearing the end of the 2008 budget round, and during the last two or three weeks it was becoming apparent that the expected increased weighting for mathematics and statistics had not been incorporated. I went to see B the A University Director of Policy and Planning, taking my Head of School with me.*

*B made it quite clear to us that the change at the Federal level was an ill-thought out policy, done for political reasons, and that there was no obligation on the university to follow suit. (He also related his 'incredible' expertise in this area, as a former employee of DEST responsible for the original Relative Funding Model, and his on-going association with that section.) We asked how the Federal Government would view this non-implementation of its policy, and in particular the view of Julie Bishop. B's answer to this was that DEST wouldn't be concerned, and that Julie Bishop wouldn't get involved in such fine detail. I also suggested that this could be raised with the Vice-Chancellor but we were told that our VC was getting similar submissions from all over the university and would not be at all sympathetic... We left not surprised but nevertheless rather depressed.*

### **Final comments**

The results of this questionnaire are extremely disappointing. We believe that there is bipartisan support for improving the mathematical sciences in Australia. The previous government improved core funding. It also provided some funding for AMSI which continues to support collaboration across the mathematical sciences. The current government gives every indication that it is aware of the problems that it has inherited. However urgent action is needed to ensure that government funding for the mathematical sciences is used for what it was intended. And better funding is needed for AMSI to support the collaborative approaches that have sustained so much during this difficult period for mathematics and statistics in Australia.

Prof. Hyam Rubinstein (Chair) Prof. Peter Hall, Ms Jan Thomas (Members)  
Review Working Party  
March 2008

## Summary Results — ACHMS Meeting February 2010 Survey

### Background

The questionnaire attached (Appendix 1) was circulated to the Head of Mathematical Sciences at all Australian Universities. It sought to provide a snapshot of how the mathematical sciences were faring in the university sector. Concerns had also been raised on the apparent increase in the use of casual staff and so this was also explored.

Completed questionnaires were received from 32 separate departments. Questionnaires were not returned from Victoria University, University of Southern Queensland, University of Tasmania, Australian Catholic University, Curtin University, University of Canberra, University of Ballarat and ANU Statistics.

### Responses

Over the last 3 years (2007—2009) in your department/school:

1. **Undergraduate M&S subject enrolments\* have**  
16 reported an increase, only one reported a decrease
2. **M&S majors have**  
Of those offering a major 4 reported an increase, 3 a decrease
3. **Honours (or equivalent) student numbers have**  
5 reported an increase, 5 a decrease
4. **Domestic research students numbers have**  
6 reported an increase, 7 a decrease
5. **International research students numbers have**  
11 reported an increase, 2 a decrease
6. **Total research students numbers have**  
10 reported an increase, 4 a decrease
7. **Use of casuals as tutors/demonstrators/markers has**  
20 reported an increase, 2 a decrease
8. **Use of casuals as lecturers has**  
17 reported an increase, 4 a decrease (in 3 of these, continuing staff had increased)
9. **Continuing staff numbers have**  
9 reported an increase, 15 a decrease
10. **Fixed term, research only, staff numbers have**  
8 reported an increase, 2 a decrease
11. **Fixed term teaching staff numbers have**  
4 reported an increase, 1 a decrease
12. **Overall research income from all sources has**  
12 reported an increase, 7 a decrease
13. **I am concerned about the increasing number of casual tutors:** 8 Yes / 21 No / 3 NA
14. **I am concerned about the increasing numbers of casual lecturers:** 15 Yes / 11 No / 6 NA
15. **I have had difficulties finding appropriately qualified casual staff:** 20 Yes / 10 No / 2 NA
16. **Compared to 2009 our 2010 discretionary budget is**  
5 reported an increase, 2 a decrease, 17 about the same,
17. **In 2010 are you offering:**
  - (i) A major in mathematics: Yes 25, No 7

(ii) A major in statistics: Yes 15, No 16, ? 1

(iii) A major with a mix of mathematics and statistics Yes 20, No 10, ? 2

### Comments added by Heads

**Q1** *Our system makes it difficult to track whether a student actually obtains a mathematics major.*

**Q13** *No. This helps support our honours and PhD students  
No, we need to train students to teach as well*

**Q14** *Yes. But on the positive side, we have been using post docs and have been able to extend their contracts as  
they teach. Also helps their CVs  
No, post docs need lecturing experience*

### Other Comments

*'...we have gone from a full-three year mathematics and statistics degree program plus service teaching at the turn of the century to offering only those mathematics courses that core to any non-mathematics university program (this is effectively a small number of service courses...but perhaps it is time to begin again – a new VC has injected a much needed boost to morale...'*

*'We have vacant positions, but were unable to fill some in 2009 due to low quality of applicants'*

*'...we are only allowed to spend our agreed Expenditure, which is \$1.3m less than our income...Maths, Stats and...are now bankrolling the Science Faculty. I have managed for the first time to have 100% continuing lecturing staff'*

*'We have more service teaching in first year due to increases in engineering and aviation enrolments. No new staff...I just keep being told the sessional budget needs to be cut. There seems to be no relationship between student numbers, sessional budget and staff numbers. Last year we taught 160EFTSU with 4 full-time staff.'*

*'Staffing numbers continue to decline, as other disciplines use their non-specialist staff to do their 'maths'. Maths education is terrible in our Ed degree, and all discipline specific staff tend to be excluded... Applied science degree has reintroduced a compulsory maths subject, but it's only high school level. The specific needs of dominant disciplines like engineering help to support the maths standard, but also deny the opportunity to do maths with broader reach than the narrow engineering focus.'*

*'Difficult to find/attract staff to full-time, on-going appointments and statistics remains a major problem...moves to reduce the number of combined/double degrees on offer is adversely impacting on maths majors and hence potentially staffing. Admission of a greater number of inadequately prepared (in maths) students to B.Eng and other degrees has led to a demand (and need) for enhanced tutorial programs in first and higher years but we lack resources (financial and qualified people) to effectively offer this.'*

*'The current and recent situation has been dire...A mathematics regeneration is planned...The new appointments, even if funded, may prove difficult to fill!'*

*'Our School has suffered by a reduction in statistics lecturers (one resignation and one long-term sick leave). It has therefore been challenging to find suitable replacements (both for tutoring duties as well as lecturing).'*

*'In 2009, we had a 45% increase (over 2008 figures) of enrolments, entirely due to service teaching requirements...These numbers produced an increased funding allocation to the Faculty of Science for 2010, none of which was passed to the Department and so we have not been able to make any extra appointments to improve the staffing situation.'*

*'Currently the University has a recruitment pause. Aim o advertise further continuing positions later in 2010.'*

*'The slight increase in budget has not been sufficient to cover the reasonably large increase in enrolments.'*

One Head noted that domestic research student numbers have been stable *'due to lack of scholarship funding'*.

*'We are still experiencing some growth in staffing numbers.'*

*'Research activity in Applied Mathematics continues grow at...and our staff have recently secured significant funding from the government, CSIRO and industry. On the education front, ... is planning to run an Applied Mathematics co-major in its science degree next year and we have also expanded our advanced mathematics offerings to Engineering students (offered as electives).'*

*'We have no maths...'*

*' Mathematics Discipline underwent change management in 2006 reducing the number of FTE staff from 4.5 on-going plus one contract staff to 1.5 on-going and 1 contract staff... now we have 2 ongoing staff and 1 contract staff. At the same time our student numbers started to grow from 78 EFTSUs in 2006 to 142 EFTSUs in 2009...Because of the staffing situation, 3 of the first year classes were taught by casuals, increasing the coordination load on the few full time mathematicians. Tutors were recruited from postgraduate students, but as we do not have very many of them, this puts also pressure on things...In 2010, our Head of School has decided to change the way units are taught to effectively abolish tutorials in first year classes in favour of larger workshop-type classes... In addition there has been a decree to reduce the number of lecture hours in the subjects from 3 to 2. There is no money for marking in this model, leading to the lecturers having to do all the marking themselves ... The effect is a severe intensification of work with student staff ratios of well over 100. I have two young colleagues who are hardest hit in that they have only been in their jobs for less than 2 years, so not only have they got to cope with high teaching loads, but also with unit development and the need to establish a research niche. All in all, a very bad position to be in.'*

*'I am the sole remaining statistician and am over 60. I am expected to teach 10 units/year to encompass STAT100 (a glorified high school unit) and MSc... (A regional University) has accepted OS students and now finds that these students want to study maths. This does not translate to new appointments. There is no lessening in the demand for statistics at all levels.'*

*'I coordinate and teach six courses a year. For three years I have pushed for another maths lecturer as my workload is too high...I am continually told that we do not have the resources to appoint another lecturer, but I seriously doubt this, considering that enrolment numbers are very high. There is absolutely no move to appoint another lecturer. The main statistics lecturer left last year...we train maths-teachers, engineers and scientists!'*

*'While it is somewhat positive that we have not lost further ground locally during the survey period, this is coming off a preceding period in which there had been substantial attrition in staffing and funding.'*

### **Comments – Jan Thomas**

Two years ago a questionnaire was sent Heads of Mathematical Sciences in the universities. The questionnaire sought to identify the extent of the flow of new money to mathematics and statistics and responses to the KPIs in the Strategic Review (2006) that were linked to this funding. I noted at the time that *'the lack of progress in implementing the Review recommendations is clear.'*

In 2008 there were 34 responses and this year it was 32. It is clear that in 2010 the majority of Departments have a greater student load with the same or less on-going staff. The on-going lack of progress in implementing the Review continues.

This is possibly one reason why the issue of casual staff was raised during 2009 and addressed in the 2010 survey. It would be wonderful if it was possible to extract concrete data on student numbers, staffing etc and some of us have tried. I believe what we do have from both 2008 and 2010 is evidence of continued decline with the exception of a handful of departments.

In regard to the use of casuals, the current issue of Australian Universities Review has a useful article on



casual employment in higher education (see <http://www.aur.org.au/>). The authors conclude:  
*The realities of the labour market where employers use casual employment as a cost-saving measure undermine the argument that casual employees gain flexibility and work/life balance and suggest that they are jobs rather than careers. A major outcome for people in long term casual employment is frustrated careers.*

Relating this to the survey, few Heads were concerned about the use of casuals for tutoring as it provides income and experience for their post-graduate students. However once these students want careers, their on-going appointment as casuals probably does become a matter for concern. And if they are in high-demand areas they will not stay in casual employment in the universities if they can get career positions elsewhere. Hence the concern about finding appropriately qualified casual staff. Most mathematical sciences graduates with higher degrees have other options. They will go to other employment or overseas if on-going positions are not available in Australian universities. At the same time it is clear the mathematical sciences departments are under-staffed and many more positions should be available.

Nowhere is this more apparent than in the number of universities that cannot offer majors. The 2008 and 2010 figures cannot be compared directly as in 2008 a question regarding a major that was a mix of mathematics and statistics was not asked. However, it would appear that there has been small decrease in the number of universities offering a major in mathematics and a larger drop in those offering a major in statistics.

Given the importance of statistics and many areas of mathematics to the research capability of any university, it must be concluded that their capability is less than optimal and declining. As is the readiness for research degrees of many graduates who are getting less than optimal mathematical and statistical preparation from understaffed and poorly supported mathematical sciences departments.

One final comment, the opportunity to complete a PhD in a strong department has become concentrated in a few institutions. To quote Barlow from his review of research in Australian universities (2009)<sup>1</sup>:

*Investment in mathematical sciences R&D appears to have tracked with growth in the university sector as a whole over the past decade. But investment growth has also become increasingly concentrated, with a diminishing number of institutions active in the field. Four institutions now account over half of all Australian university R&D expenditures in mathematics and statistics and for nearly two thirds of national competitive grant income in the field. At the same time, research in mathematics and statistics is essentially non-existent in around half of all Australian universities.*

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<sup>1</sup> Personal communication

## ACHMS Meeting February 2010 – Survey (Appendix 1)

Name:

Department/School:

Institution:

Please circle your response.

Over the last 3 years (2007—2009) in your department/school:

18. Undergraduate M&S subject enrolments\* have  
Increased / decreased / been stable / don't know
19. M&S majors have  
Increased / decreased / been stable / don't know / NA
20. Honours (or equivalent) student numbers have  
Increased / decreased / been stable / don't know / NA
21. Domestic research students numbers have  
Increased / decreased / been stable / don't know / NA
22. International research students numbers have  
Increased / decreased / been stable / don't know / NA
23. Total research students numbers have  
Increased / decreased / been stable / don't know / NA
24. Use of casuals as tutors/demonstrators/markers has  
Increased / decreased / been stable / don't know / NA
25. Use of casuals as lecturers has  
Increased / decreased / been stable / don't know / NA
26. Continuing staff numbers have  
Increased / decreased / been stable / don't know
27. Fixed term, research only, staff numbers have  
Increased / decreased / been stable / don't know / NA
28. Fixed term teaching staff numbers have  
Increased / decreased / been stable / don't know / NA
29. Overall research income from all sources has  
Increased / decreased / been stable / don't know / NA
30. I am concerned about the increasing number of casual tutors: Yes / No / NA
31. I am concerned about the increasing numbers of casual lecturers: Yes / No / NA
32. I have had difficulties finding appropriately qualified casual staff: Yes / No / NA
33. Compared to 2009 our 2010 discretionary budget is bigger / smaller / about the same / NA
34. In 2010 are you offering:
  - (iv) A major in mathematics: Yes / No
  - (v) A major in statistics: Yes / No
  - (vi) A major with a mix of mathematics and statistics Yes / No

Other comments about the staffing situation in your department/school? Use the reverse side.

\* across all degree enrolments and including service subjects