Discipline Profile of the Mathematical Sciences 2013

AMSI
AUSTRALIAN MATHEMATICAL SCIENCES INSTITUTE

DISCIPLINE PROFILE OF THE MATHEMATICAL SCIENCES 2013
1. Introduction

The Australian Mathematical Sciences Institute published its first Discipline Profile of the Mathematical Sciences in 2012

as part of the national forum “Maths for the future: Keep Australia competitive”. The intention of the profile is to provide evidence and inspiration for policy development for AMSI itself and for various levels of government and governance.

We paint a picture of the discipline in Australia, highlighting trends as they apply to school education, higher education, research and research training and career prospects for graduates. Broadly, the data shows that the demand for mathematical and statistical skills at all these levels far outstrips supply, with statistics in particular continuing to experience large unmet demand. Declining interest in advanced mathematics courses at Year 12 remains an immense challenge to securing Australia’s future skills base. Qualified mathematics teachers continue to be in short supply in Australia’s schools, particularly those in regional and low SES areas.

Domestic enrolments in higher degrees, so necessary for innovation in our economy, are languishing while demand for graduates continues to be very strong.

This year’s profile contains some results from the AMSI university member survey showing broadly that the number of combined research and teaching positions continues to be at a low ebb while research-only positions have grown strongly.

And while domestic PhD enrolments have dropped international student enrolments in higher degrees are robust.

You can find a deeper repository of information about the discipline on the AMSI web site at:
www.amsi.org.au/publications/amsi-publications/discipline-profile

Professor Geoff Prince
AMSI DIRECTOR

Note: this document does not currently cover the research enterprise of Australia’s government agencies such as ABS, BoM, CSIRO and DSTO, or the private sector in areas such as finance and mining. Research training is predominantly the domain of universities with some co-supervision and postdoctoral training taking place at the agencies.

2. School education

2.1. Student performance in numeracy and mathematics

According to the annual NAPLAN surveys, student performance in mathematics in Australia has remained largely static over the last 5 years, with student performance not going backwards or forwards:

Figure 2.1.1.

NAPLAN Numeracy

Figure TS.N1: Achievement of Students in Numeracy, Australia, 2008–2012.

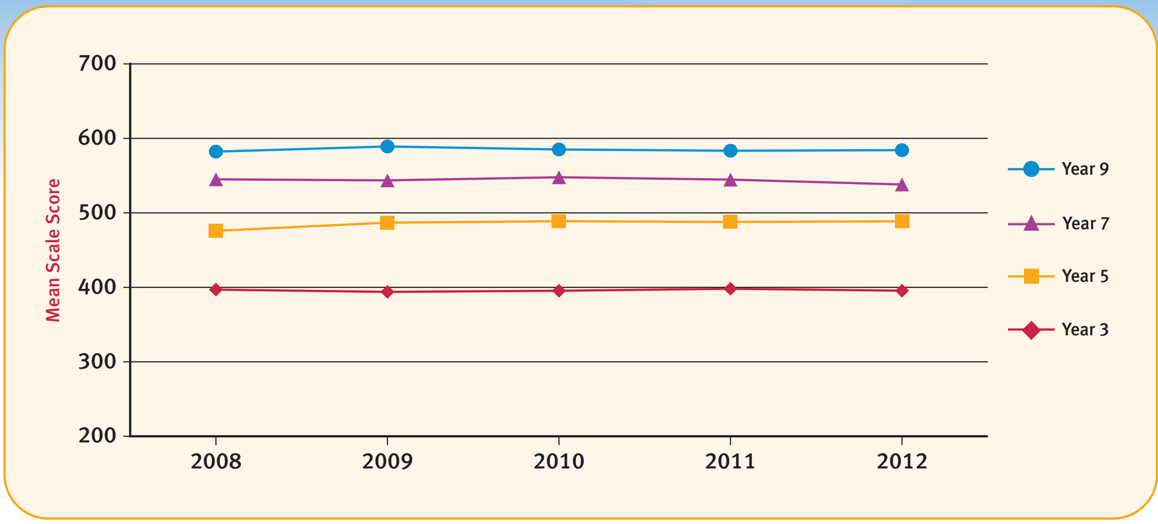


Table TS.N1: Achievement of Students in Numeracy, Australia, 2008–2012.

Students		2008	2009	2010	2011	2012	Significance of difference in means: 2008 and 2012	Significance of difference in means: 2011 and 2012
Year 9	Mean / (S.D.)	582.2 (70.2)	589.1 (67.0)	585.1 (70.4)	583.4 (72.1)	584.2 (72.4)	■	■
	% at or above NMS	93.6	95.0	93.1	93.0	93.7		
Year 7	Mean / (S.D.)	545.0 (73.2)	543.6 (71.0)	547.8 (72.4)	544.6 (73.7)	538.1 (73.9)	▼	▼
	% at or above NMS	95.4	94.8	95.1	94.5	93.8		
Year 5	Mean / (S.D.)	475.9 (68.8)	486.8 (67.8)	488.8 (69.9)	487.8 (68.2)	488.7 (70.9)	▲	■
	% at or above NMS	92.7	94.2	93.7	94.4	93.3		
Year 3	Mean / (S.D.)	396.9 (70.4)	393.9 (72.9)	395.4 (71.8)	398.1 (70.6)	395.5 (72.6)	■	■
	% at or above NMS	95.0	94.0	94.3	95.6	93.9		

Refer to the introduction for explanatory notes and how to read the graph.

Source: NAPLAN, 2012 National Report, Table TS.N1

The two most important international comparisons of student performance in the mathematical sciences, the PISA and TIMSS reports, show a slow but gradual decline of Australia's international ranking. Even though Australian students generally still perform above the international average, the distance between that average and Australian performance is falling, and a number of countries have overtaken Australia by significantly increasing their mathematics performance.

Table 2.1.1. International Student Achievement in Mathematics: selection of data from TIMSS 1995 to 2011									
	4th grade								
	Australia overall	Girls	Boys	Highest country score	Lowest country score	Int. (scaling) Average	Comparison to Intern. Average	Number of countries outperforming Australia	Countries outperforming Australia
1995	495								
2003	499	497	500	594	339	495	Above average	13	Singapore, Hong Kong SAR, Japan, Chinese Taipei, Belgium (Fl), Netherlands, Latvia, Lithuania, Russian Federation, England, Hungary, United States, Cyprus
2007	516	513	519	607	224	500	Above scaling average	12	Hong Kong SAR, Singapore, Chinese Taipei, Japan, Kazakhstan, Russian Federation, England, Latvia, Netherlands, Lithuania, United States, Germany
2011	516	513	519	606	248	500	Above scaling average	17	Singapore, Republic of Korea, Hong Kong SAR, Chinese Taipei, Japan, Northern Ireland, Belgium (Fl), Finland, England, Russian Federation, United States, Netherlands, Denmark, Lithuania, Portugal, Germany, Ireland
	8th grade								
	Australia overall	Girls	Boys	Highest country score	Lowest country score	Int. (scaling) Average	Comparison to Intern. Average	Number of countries outperforming Australia	Countries outperforming Australia
1995	509								
2003	505	499	511	605	264	467	Above average	9	Singapore, Republic of Korea, Hong Kong SAR, Chinese Taipei, Japan, Belgium (Fl), Netherlands, Estonia, Hungary
2007	496	488	504	598	307	500	Below scaling average	10	Chinese Taipei, Republic of Korea, Singapore, Hong Kong SAR, Japan, Hungary, England, Russian Federation, United States, Lithuania
2011	505	500	509	613	331	500	Not significantly higher than scaling average	6	Republic of Korea, Singapore, Chinese Taipei, Hong Kong SAR, Japan, Russian Federation

Source: Selected data from TIMSS 1995, 2003, 2007 and 2011

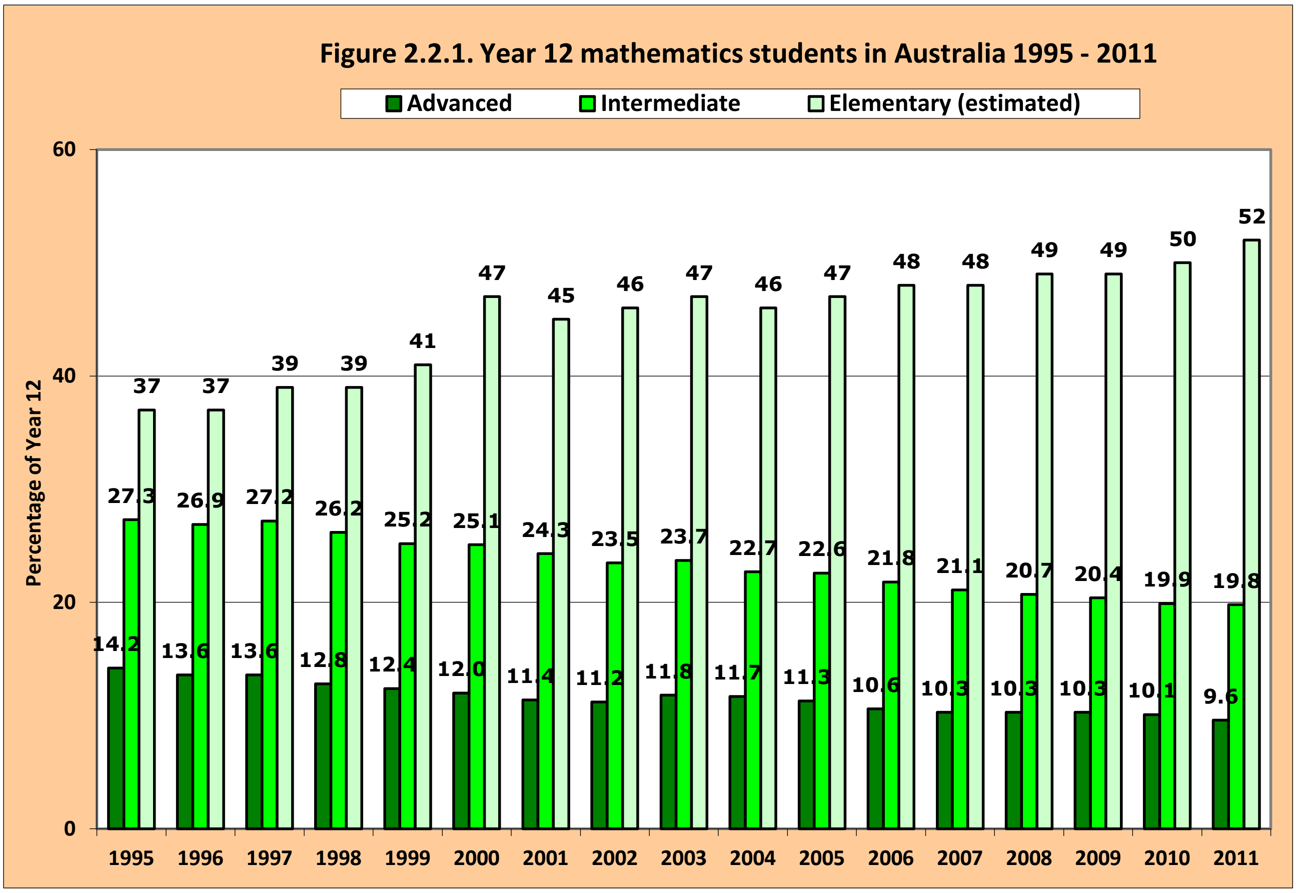
Table 2.1.2. Student performance in the mathematical sciences among 15-year olds: selection of data from OECD PISA reports over the period 2000-2009

	Australia score	Highest country score	Lowest country score	Comparison to intern. average	No of countries significantly outperforming Australia	Countries significantly outperforming Australia
2000	533	557	334	Above average	1	Japan
2003	524	550	356	Above average	4	Hong Kong-China, Finland, Korea, Netherlands
2006	520	549	311	Above average	8	Chinese Taipei, Finland, Hong Kong-China, Korea, Netherlands, Switzerland, Canada, Macao-China
2009	514	600	331	Above average	12	Shanghai-China, Singapore, Hong Kong-China, Korea, Chinese Taipei, Finland, Leichtenstein, Switzerland, Japan, Canada, Netherlands, Macao-China

Source: Selected data from PISA 2000, 2003, 2006 and 2009.

2.2. Student numbers and participation rates

Looking at Year 12 mathematics participation rates, it becomes clear that most Year 12 students study at least some mathematics, but that the proportion of students choosing the 'harder' intermediate and advanced mathematics subjects has been declining for quite some time.



Source: Frank Barrington, Year 12 Mathematics Participation Rates in Australia, AMSI data collection

This summary of participation rates includes all Year 12 mathematics students enrolled through the secondary boards of studies in the six states and in the two territories together with Australian IB (International Baccalaureate) students, for the years 1995 to 2011. In 2011, the proportion of Australian Year 12 students studying Advanced mathematics dropped below 10% for the first time since the Australian Mathematical Sciences Institute began monitoring student numbers. Last year, there were 20,608 Advanced mathematics students compared with 21,496 in 2010. The number of Intermediate students (those enrolled in an Intermediate mathematics subject but NOT enrolled in an Advanced mathematics subject) actually rose slightly, from 42,270 in 2010 to 42,548 in 2011. However, this amounted to a very small decline in the Intermediate mathematics proportion, down from 19.9% in 2010 to 19.8% in 2011. The proportion of Elementary mathematics students (those enrolled in an Elementary mathematics subject but NOT enrolled in an Intermediate mathematics subject NOR enrolled in an Advanced mathematics subject) increased again. The proportion of Australian Year 12 students studying SOME mathematics in Year 12 has remained at about 80% for some decades.

According to the results of a study in Victoria among Year 6 and Year 9 students, it seems that although the vast majority of students acknowledge that mathematics is important to their future, they do not regard the subject as fun and interesting.

Figure 2.2.2.

Figure 2D
Student attitudes to science and mathematics

Percentage of students who felt that:	Science		Mathematics	
	Year 6	Year 9	Year 6	Year 9
• the subject was important to their future	72.0	48.5	94.4	82.8
• the subject is fun and interesting	93.3	62.9	74.8	41.9
• learning the subject is easy	71.6	56.4	66.2	62.0
• they use lots of equipment in the subject	79.9	75.4	73.6	32.3
• they work in pairs or small groups in the subject	81.8	77.6	75.3	40.7
• their teacher gives them lots of work to do from a textbook	15.4	45.9	35.8	74.9

Source: Victorian Auditor-General's Office survey of Year 6 and Year 9 students, February 2012.

From: Victorian Auditor-General, Science and Mathematics Participation Rates and Initiatives, Victorian Auditor-General's Report, June 2012

2.3. Teacher profiles and qualifications

The available data on qualifications of mathematics teachers in secondary education suggest that in 2010, 64.1 % of teachers teaching Mathematics in Years 11-12 indicated that they had at least 3 years' tertiary education in the field, down from 68% in 2007. In years 7/8-10 this number declined from 53 % in 2007 to 45.8% in 2010. The proportion of teachers with one or two years tertiary education has gone up slightly, but the slowly declining number of teachers with 3 years or more tertiary education in mathematics is cause for worry.

Table 2.3.1.

Table 5.17 Teachers teaching in selected areas: qualifications, experience and professional learning activities

Area currently teaching	Years of tertiary education in the area (%)				Methodology training in the area?	>5 years teaching experience in the area?	Professional learning in past 12 months in the area?
	1	2	3+	Total with at least 1 year	Yes (%)	Yes (%)	Yes (%)
Primary							
LOTE	12.6	4.5	47.4	64.5	52.9	52.8	41.5
Special Needs	10.4	7.1	44.4	61.9	57.9	51.5	54.7
Secondary							
Chemistry 11-12	6.8	14.8	74.9	96.5	67.5	69.7	44.2
IT 7/8-10	10.5	8.5	33.8	52.8	42.5	46.1	47.3
IT 11-12	11.3	8.5	46.9	66.8	52.0	64.4	62.6
Maths 7/8-10	15.2	15.7	45.8	76.7	60.4	62.8	49.4
Maths 11-12	9.1	16.6	64.1	89.7	76.3	78.3	59.7
Physics 11-12	19.9	16.8	54.1	90.9	56.9	66.5	43.5

From: Phillip McKenzie, Glenn Rowley, Paul Weldon, Martin Murphy, *Staff in Australia's Schools 2010*, ACER, November 2011

Table 2.3.2.

Table 6.14: Teachers teaching in selected areas: qualifications, experience and professional learning activities

Area currently teaching	Years of tertiary education in the area (%)				Methodology training in the area?	>5 years teaching experience in the area?	Professional learning in past 12 months in the area?
	1	2	3+	Total with at least 1 year	Yes (%)	Yes (%)	Yes (%)
Primary							
LOTE	6	4	39	52	37	56	55
Special Needs	9	4	31	44	37	53	66
Secondary							
Chemistry 11-12	8	14	73	94	74	70	58
IT 7/8-10	12	7	24	42	26	52	56
IT 11-12	7	13	40	60	46	60	64
Maths 7/8-10	9	11	53	73	60	67	58
Maths 11-12	6	13	68	87	75	77	72
Physics 11-12	19	16	60	94	72	72	55

Note: Weighted data.

From: Phillip McKenzie, Julie Kos, Maurice Walker, Jennifer Hong, *Staff in Australia's Schools 2007*, ACER, January 2008

The data also show differences in teacher training levels between metropolitan, provincial and remote areas. The percentage of teachers with three years or more tertiary education in mathematics in Years 7 to 10 is 45% in metropolitan areas, and 37% and 40% in provincial and remote areas respectively. For Years 11 to 12, teachers in provincial and remote areas also show comparatively less tertiary education background in mathematics (57% and 43% respectively) than their counterparts in metropolitan areas at 64%.

Table 2.3.3.

APPENDIX F

HIGHEST YEAR LEVEL OF TERTIARY EDUCATION IN FIELD BY GEOLOCATION: 2010

	Highest Year Level of Tertiary Education in Field														
	None			Year 1			Year 2			Year 3 and higher			**Total**		
	Metro	Prov.	Remote	Metro	Prov.	Remote	Metro	Prov.	Remote	Metro	Prov.	Remote	Metro	Prov.	Remote
Year 7-10 Maths	359 24%	223 31%	31 26%	242 16%	119 6%	20 17%	214 14%	116 16%	20 17%	669 45%	266 37%	48 40%	1484	724	119
Year 11-12 Maths	112 12%	62 16%	7 14%	92 10%	47 12%	9 18%	139 15%	62 16%	13 25%	600 64%	226 57%	22 43%	943	397	51
Year 11-12 Physics	21 8%	11 9%	2 18%	38 15%	24 20%	4 36%	50 20%	19 16%	1 9%	139 56%	66 55%	4 36%	248	120	11
Year 11-12 Chemistry	12 4%	7 5%	0	27 9%	13 9%	2 33%	40 13%	22 15%	3 50%	220 74%	103 71%	1 17%	299	145	6
Year 11-12 Biology	18 5%	17 9%	2 11%	11 3%	9 5%	0	18 5%	7 4%	2 11%	342 88%	147 82%	14 78%	389	180	18

From: Office of the Chief Scientist, Mathematics, Engineering and Science in the National Interest, May 2012, Appendix F

Available teaching positions in mathematics are more likely to remain unfilled than any other teaching positions: even though the situation in 2010 was slightly better than 2007, mathematics teaching positions remain the most difficult to fill. The same conclusion can be drawn from a recent Victorian study, which shows that 14.8% of vacancies for mathematics teachers in Victoria remain without appointment (outside metropolitan areas this figure rises to a staggering 24.5%).

Table 2.3.4.

Table 12.8: Unfilled teaching positions in 2007 and 2010

	Day 1 of the school year				Time of the survey[1]			
	% of schools[2]		*Total positions*[3]		% of schools[2]		Total positions[3]	
	2007	*2010*	*2007 (%)*[4]	*2010*	2007	2010	2007 (%)[4]	2010
Primary								
General	*10*	*7.6*	*1500 (2%)*	*1 080*	9	2.3	1300 (2%)	610
LOTE	*4*	*2.9*	*500 (13%)*	*240*	5	2.9	400 (11%)	250
Special needs	*5*	*0.8*	*500 (4%)*	*70*	6	0.6	600 (4%)	40
Library	*4*	*3.6*	*300 (4%)*	*280*	5	2.5	400 (6%)	190
Secondary								
English	*8*	*7.5*	*300 (1%)*	*350*	6	5.1	200 (1%)	340
LOTE	*5*	*5.4*	*150 (2%)*	*150*	5	6.3	150 (2%)	190
Mathematics	*10*	*8.3*	*300 (1%)*	*400*	13	7.6	400 (2%)	390
Science	*8*	*7.2*	*200 (1%)*	*190*	11	5.0	300 (1%)	190
SOSE	*5*	*3.2*	*150 (1%)*	*190*	5	4.7	150 (1%)	250

Notes

1 Any teaching position that, at the time of the survey, had been vacant for 10 consecutive weeks or more which was not filled by a permanent teacher or long-term reliever.

2 The estimated % of schools reporting at least one unfilled position in the area concerned (rounded to the nearest whole number in 2007).

3 The estimated number of total unfilled positions in the area concerned (rounded to the nearest 50 in 2007 and to the nearest 10 in 2010).

4 The estimated number of unfilled positions is expressed as a percentage of the number actually teaching that subject (rounded to the nearest whole number).

The figures reported in this table are estimates of population values obtained from the SiAS sample. Each should be seen as an estimate, not as an exact measure of the population that it represents. See Section 2.6 and Table 2.10 for a guide to the likely precision of the estimates in the table.

Source: Phillip McKenzie, Glenn Rowley, Paul Weldon, Martin Murphy, *Staff in Australia's Schools 2010*, ACER, November 2011

Table 2.3.5.

Figure 3A
Average number of applications for science and mathematics teacher vacancies and percentage of vacancies with no appointment, 2011

	Average applications per vacancy (number)			Vacancies with no appointment made (per cent)		
Vacancy type	Metro	Non-metro	State	Metro	Non-metro	State
Science teacher	18.4	8.1	**14.9**	8.5	11.8	**9.6**
Mathematics teacher	21.9	10.8	**17.2**	7.9	24.5	**14.8**
Dual science and mathematics teacher	29.3	12.2	**22.4**	8.1	15.1	**10.9**
Other disciplines	28.2	12.7	**23.4**	5.2	7.5	**5.9**

Source: Victorian Auditor-General's Office analysis of Department of Education and Early Childhood Development data.

Source: Victorian Auditor-General, Science and Mathematics Participation Rates and Initiatives, June 2012

The difficulty in filling these vacancies is very likely to translate in principals requiring teachers to teach outside their field of expertise, recruiting retired teachers on short-term contracts, or recruiting teachers not fully qualified in subject areas with acute shortages.

Table 2.3.6.

Table 12.12: Secondary Principals' strategies to deal with staffing shortages

Which of the following strategies do you use to deal with teacher shortages at your school?	Secondary Govt %	Secondary Cath %	Secondary Ind %	All %
Reduce the curriculum offered	25.3	9.0	9.3	18.4
Reduce the length of classroom time for a subject	3.7	1.8	14.6	5.6
Combine classes within subject areas	21.3	24.6	22.5	22.3
Combine classes across subject areas	1.8	4.6	0.0	2.0
Combine classes across year levels	18.5	10.7	12.5	15.5
Require teachers to teach outside their field of expertise	46.7	57.3	14.3	42.2
Recruit teachers not fully qualified in subject areas with acute shortages	26.3	28.6	6.2	23.0
Recruit retired teachers on short-term contracts	28.4	20.5	21.2	25.1
Share programs with other schools	12.7	8.4	7.4	10.7
Other	4.4	1.3	0.8	3.0
Not relevant – no recent teacher shortages	27.1	33.0	50.7	33.4

Note: Principals could indicate >1 strategy. The figures reported in this table are estimates of population values obtained from the SiAS sample. Each should be seen as an estimate, not as an exact measure of the population that it represents. See Section 2.6 and Table 2.10 for a guide to the likely precision of the estimates in the table.

Source: Phillip McKenzie, Glenn Rowley, Paul Weldon, Martin Murphy, *Staff in Australia's Schools 2010*, ACER, November 2011

3. Higher education

3.1. Staffing at mathematics departments

Table 3.1.1. AMSI Member Survey 2012: number of staff employed in mathematical sciences departments in FTE (excluding casuals)

	2011 Teaching only	2011 Research only	2011 Teaching & Research	2011 All Staff	2012 Teaching only	2012 Research only	2012 Teaching & Research	2012 All staff	Change Teaching & research	Change All staff
Go8 universities	9.00	120.59	278.36	407.95	15.00	134.20	267.67	416.87	-3.84%	2.19%
Non-G08 universities	12.00	42.65	254.45	309.10	10.00	61.15	254.15	325.30	-0.12%	5.24%
Total all universities	21.00	163.24	532.81	717.05	25.00	195.35	521.82	742.17	-2.06%	3.50%

Source: AMSI Member Survey 2012, preliminary results

According to the AMSI Member Survey conducted in 2012, the participating mathematics departments in Australia employed slightly over 742 staff (in FTE). Between 2011 and 2012, a minor decline in Teaching and Research staff has been offset by a slight rise in the number of total staff, mostly due to a rise in Research only staff. Earlier figures from the National Strategic Review for the Mathematical Sciences conducted in 2006 indicated that between 1995 and 2005 a dramatic decline had taken place in Teaching and Research staff at mathematics departments among the Group of Eight universities. New figures from 2011 and 2012 show that this stark decline has been halted when looking at the Go8 universities overall, even though the situation differs per university. However, 'Teaching and Research' staffing figures are still a long way down from 1995 levels.

Table 3.1.2.

Table 2: 'Teaching and research' staff (normal academic staff) in mathematical sciences departments in the Group of Eight universities 1995–2005: statistics gathered from questionnaires returned by the departments.* Staff whose positions are classified as 'teaching only' or 'research only' are not listed here.

	1995			2005			change 1995 to 2005	
Teaching & Research	male	female	total	male	female	total	number	percent
Adelaide	33	9	42	18	6	24	–18	–42.9%
Melbourne	34	3	37	29.5	5	34.5	–2.5	–6.8%
Monash	46	5	51	21.6	4.5	26.1	–24.9	–48.8%
NSW	61	6	67	40.23	9.1	49.33	–17.67	–26.4%
Sydney	60	4.5	64.5	33.08	5.33	38.41	–26.09	–40.4%
WA	33.1	2	35.1	22.5	2	24.5	–10.6	–30.2%
Queensland	26.83	1.6	28.43	22.8	5.05	27.85	–0.58	–2.0%
ANU Mathematics	12.5	0.5	13	8	3	11	–2	–15.4%
ANU FAS	19	1	20	12	1	13	–7	–35.0%
Total Go8	325.43	32.6	358.03	207.71	40.98	248.69	–109.34	–30.5%

* *Except for two Monash university staff transferred to other departments and several econometricians from ANU transferred to other departments, all losses represent genuine loss of employees from the university. Staff from the ANU Department of Finance and Applied Statistics whose expertise is in finance rather than statistics are excluded to avoid misleading data arising from department restructuring.*

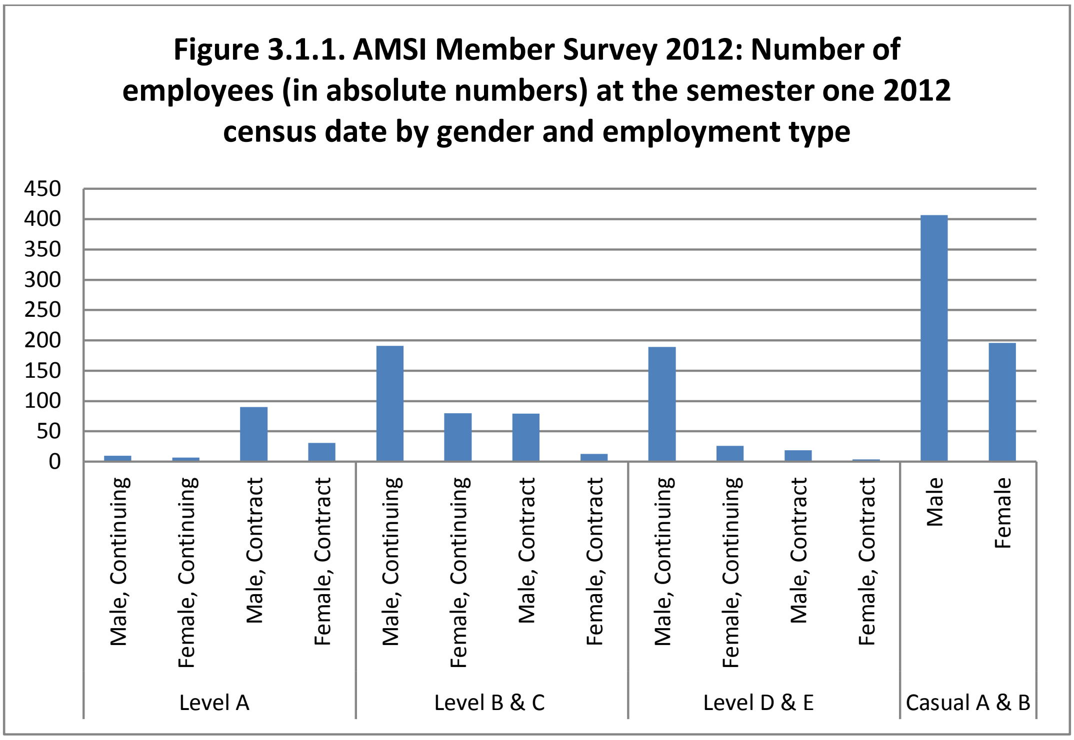
Source: National Strategic review for Mathematical Sciences Research in Australia (2006), *Mathematics and Statistics: critical skills for Australia's future*, table 2

Table 3.1.3. AMSI Member Survey 2012: 'Teaching and Research' staff employed in mathematical sciences departments in Group of Eight universities in 2011 and 2012, compared to 2005*

Teaching and Research	2005	2011	2012	comparison 2005-2012	
				number	%
University of Western Australia	24.5	21.50	19.50	-5.00	-20.41
ANU	24	50.16	56.17	32.17	134.04
The University of Adelaide	24	30.50	28.00	4.00	16.67
University of Sydney	38.41	34.80	34.30	-4.11	-10.70
The University of Melbourne	34.5	38.60	26.10	-8.40	-24.35
The University of Queensland	27.85	31	32	4.15	14.90
University of New South Wales	49.33	44	42	-7.33	-14.86
Monash University	26.1	27.8	29.6	3.50	13.41
Total Go8	248.69	278.36	267.67	18.98	7.63

*Staff classified by the participating universities as 'Teaching only' or 'Research only' are not listed in this table.

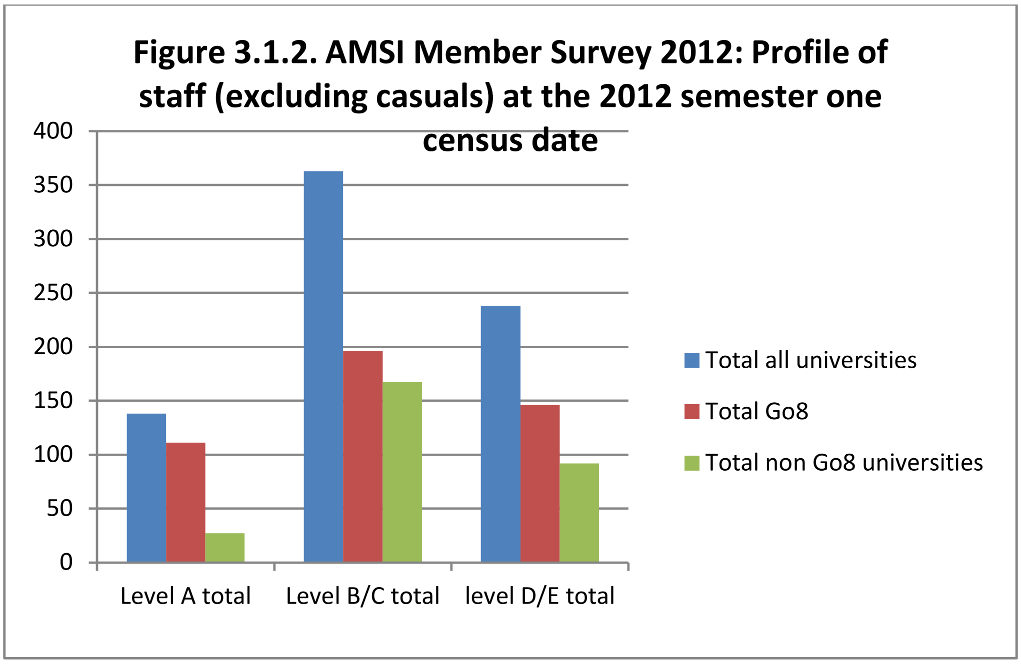
Source: AMSI Member Survey 2012, preliminary results



Source: AMSI Member Survey 2012, preliminary results

It is clear that in the mathematical sciences the academic workforce is predominantly male, the proportion of females reducing with each level of seniority. About 48% of casuals are female, decreasing to 38% at level A, 34% at level B/C and 14% at level D/E. The proportion of staff on fixed-term contracts as opposed to continuing positions also decreases among more senior levels of employment.

The staffing profile is slightly "top-heavy" with a relatively large number of staff employed at the senior levels D and E, and a low level of employment at the entry level A (most visible at the non Go8 universities), which suggests that there might be an issue with rejuvenation of the academic workforce.



Source: AMSI Member Survey 2012, preliminary results

Table 3.1.4. AMSI Member Survey 2012: Tutorial teaching by academic and casual staff in 2012

	tutorial hours all staff	tutorial hours casual staff	% of total taught by casuals
Average Go8 Universities	223.16	169.16	78.27%
Average non-G08 Universities	99.99	68.69	56.31%
Average all universities	139.40	100.84	63.34%

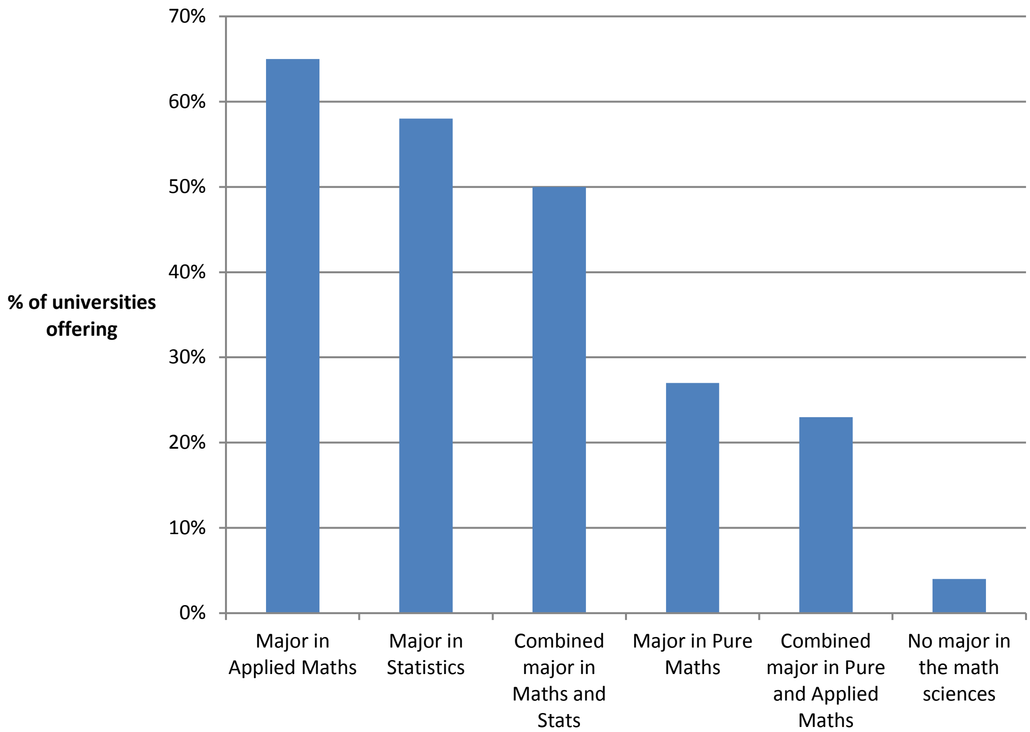
Source: AMSI Member Survey 2012, preliminary results

Due to ambiguities in the survey questions as well as local differences in interpretation of what constitutes "tutorial" teaching the figures in table 3.1.4. have to be read with extreme caution. However, it is clear from these figures that a very significant proportion of tutorial teaching is performed by casual staff. As can be seen from Figure 3.1.1., departments often employ a significant number of casual staff on a part time basis to cover tutorials, therefore in absolute numbers casual employees often vastly outnumber other staff.

3.2. Mathematics teaching at universities

3.2.1. Majors offered

Figure 3.2.1.1. AMSI Member Survey 2012: Majors offered in the mathematical and statistical sciences



Source: AMSI Member Survey 2012, preliminary results

The most prevalent major in mathematical and statistical sciences is in Applied Mathematics, which is offered by 65% of all universities surveyed. Second most popular is a major in Statistics at 58% followed by a combined major in Mathematics and Statistics. Only one of the universities surveyed reported not offering a major in the mathematical and statistical sciences at all, however among smaller universities that are not AMSI members the proportion of departments not offering a major is likely to be higher. These figures cannot be compared easily with earlier figures from 2010 as the breakdown is not the same, however it is interesting to note that in 2012 more departments appear to be offering a major in Statistics, and fewer departments a combined major in Mathematics and Statistics.

Table 3.2.1.1. Major Degrees offered in 2010

Degree	Major in Mathematics	Major in Statistics	Major in Mathematics/Statistics
% of departments offering	78%	47%	63%
% of departments not offering	22%	50%	31%
Other		3%	6%

Source: ACHMS/AMSI Data collection, 2010

3.2.2. Service teaching to other disciplines

Mathematics is an essential element of many disciplines and service teaching to other departments is an important part of teaching in mathematical and statistical sciences at universities. According to the table below, mathematical sciences (including statistics) are the second most important service discipline after biological sciences to disciplines such as IT, Engineering, Agriculture and Environment, Health, Society and Culture and Management.

Figure 3.2.2.1.

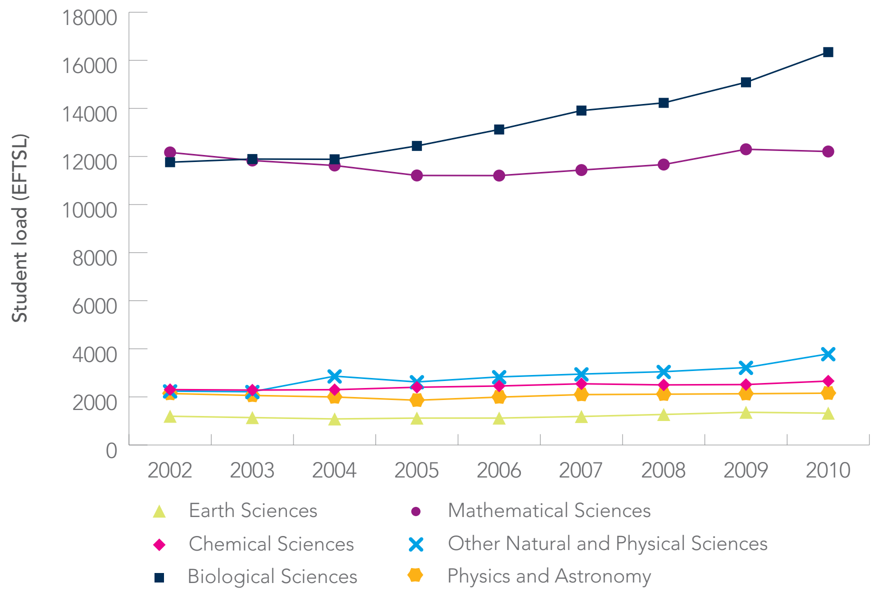
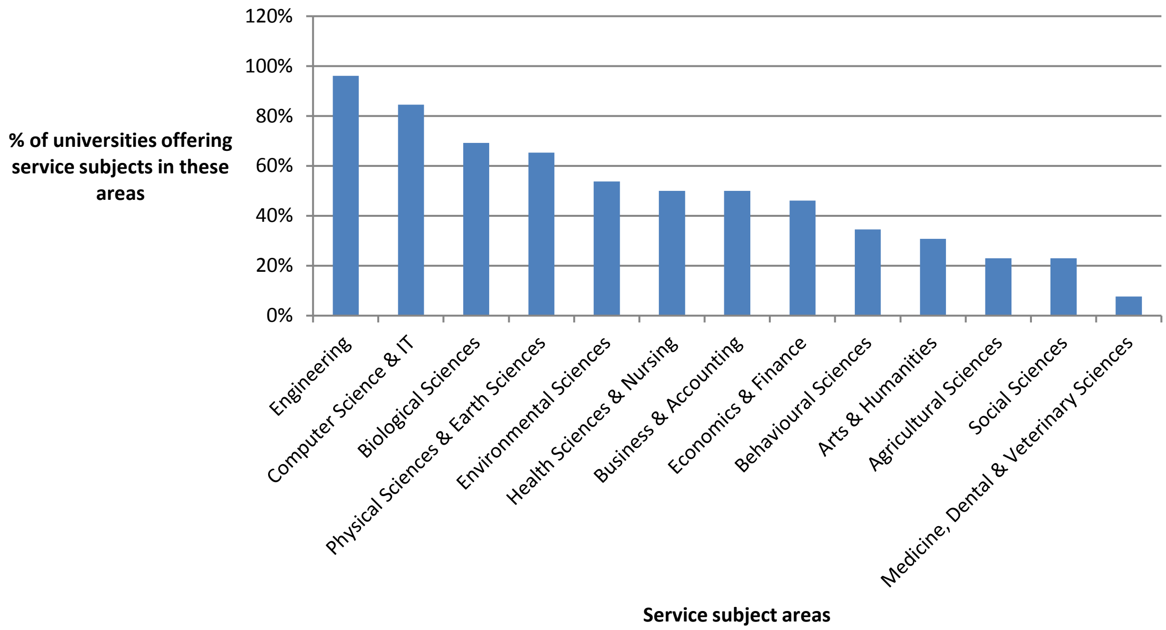


Figure 4.4.16 Undergraduate science service teaching: narrow disciplines

Source: Office of the Chief Scientist, *Health of Australian Science*, May 2012, page 84.

Figure 3.2.2.2. AMSI Member Survey 2012: Areas of service subjects offered in 2012



Source: AMSI Member Survey 2012, preliminary results

All mathematics departments who responded to this question in the survey supply service teaching to other disciplines. Most departments supplied teaching to at least 2 or 3 other areas; some even offer teaching in up to 12 subject areas. The average number of subject areas serviced by participating mathematics departments is 6.4. Engineering, Computer Science and IT, Biological Sciences and Physical and Earth Sciences are the most important subject areas.

3.3. Student numbers

3.3.1. Undergraduate enrolments and completions

Table 3.3.1.1. AMSI Member Survey 2012: Undergraduate enrolments in 2011 and 2012 (in EFTSL)

	2011			2012			Change		
	3rd year	2nd year	1st year	3rd year	2nd year	1st year	3rd year	2nd year	1st year
Total Go8 universities	634.83	1834.88	4409.80	686.63	1976.15	4316.30	8.16%	7.70%	-2.12%
Total non Go8 universities	464.26	1057.43	2667.11	479.98	1399.05	2650.85	3.39%	32.31%	-0.61%
Total all universities	1099.08	2892.31	7076.91	1166.61	3375.20	6967.15	6.14%	16.70%	-1.55%

Source: AMSI Member Survey 2012, preliminary results

In 2011 and 2012, first year mathematics subjects accounted for about 7,000 EFTSL, around 3,000 EFTSL in second year subjects and around 1,100 in third year subjects according to the figures provided by the universities participating in the AMSI Member Survey. Overall enrolment figures increased from 2011 to 2012. The spike in second year EFTSL in the non Go8 universities is in large part due to one university picking up very substantial new service teaching. The total undergraduate load remained stable overall despite a slight increase in the Go8 universities and a slight decrease in the non Go8 universities.

Table 3.3.1.2. AMSI Member Survey 2012: Total undergraduate load in EFTSL per FTE teaching staff (excluding casuals) in 2011 and 2012

	2011	2012	Comparison
Average G08	24.14	25.10	3.98%
Average non Go8 universities	28.97	28.40	-1.98%
Average all universities	27.29	27.30	0.03%

Source: AMSI Member Survey 2012, preliminary results

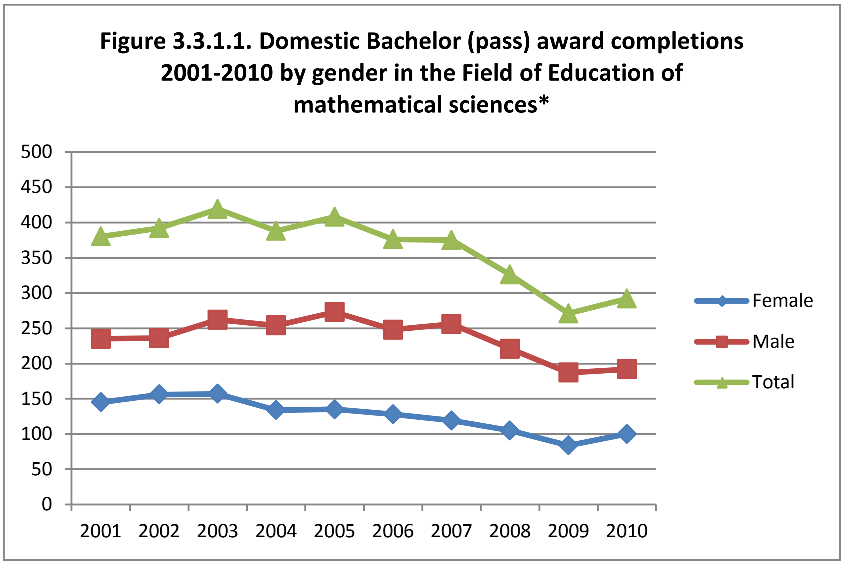
In absolute numbers, in 2012 around 38,000 students enrolled in one or more undergraduate mathematics subjects. Over 55% of undergraduate enrolments consisted of male domestic students. International students accounted for about 17.5% of enrolments. The male-female division was slightly more even at the non G08 universities, with 37.5% of all domestic and international students at non Go8 universities female, against 32.64% at Go8 universities.

Table 3.3.1.3. AMSI Member Survey 2012: Undergraduate student profile (in absolute numbers) at the semester one 2012 census date by gender and domestic/international status

	Domestic numbers		International numbers		Domestic %		International %	
	Male	Female	Male	Female	Male	Female	Male	Female
Total Go8	16195	7588	3277	1848	56.02%	26.25%	11.34%	6.39%
Total non Go8	4883	2777	857	664	53.19%	30.25%	9.33%	7.23%
Total all universities	21078	10365	4134	2512	55.34%	27.21%	10.85%	6.60%

Source: AMSI Member Survey 2012, preliminary results

Due to the large part played by service teaching in mathematical sciences, many Australian students complete at least some mathematics and statistics subjects during their studies. However, the number of students who go on to complete a Bachelor degree in mathematical sciences is substantially lower. According to DEEWR data, the number of domestic graduates seems to have declined in 2009 and 2010 as per the table below. Please note that the bachelor graduate figures in the table below are too low, as some of the universities with the largest number of bachelor graduates are not represented. However, if the decline in the number of bachelor graduates is accurate and the start of a continuing trend there would be cause for worry.



*Data from 29 universities, no data from University of Melbourne and University of Queensland included.
Source: DEEWR Higher Education Data

3.3.2. Employment of mathematics bachelor graduates

Table 3.3.2.1. Bachelor graduates in mathematics four months after completion of their degree (2010)

What are the characteristics of bachelor graduates in mathematics?			
	Males	**Females**	**Total**
Survey responses: mathematics	299	159	**459**
Sex: mathematics (%)*	65.1	34.6	**100**
Sex: all fields of education (%)*	37.6	62.3	**100**
Median age: mathematics (years)	22	23	**23**

What are bachelor graduates in mathematics doing after graduation?			
	Males	**Females**	**Total**
Available for full-time employment (%)	42.8	50.3	**45.3**
Available for full-time employment: all fields of education (%)			**64.7**
In further full-time study (%)	44.8	32.7	**40.7**
In further full-time study: all fields of education (%)			**19.0**
Of those available for full-time employment:			
In full-time employment: mathematics (%)	66.4	67.5	**66.8**
In full-time employment: all fields of education (%)	75.4	76.8	**76.2**

Most frequently reported occupations:
1. Business, Human Resource and Marketing Professionals
2. Design, Engineering, Science and Transport Professionals
3. Education Professionals

What are bachelor graduates in mathematics in full-time employment earning?			
	Males	**Females**	**Total**
Median salary: mathematics	$52,000	$50,600	$51,100
Median salary: all fields of education	$50,000	$49,600	$50,000

* Percentages of males and females might not add exactly to 100.0 due to missing sex data.

Source: Graduate Careers Australia, extract from Grad Job and Dollars - Mathematics – Bachelor Graduates (All) and GradFiles 2010

Compared to other areas of study, a very high percentage of bachelor graduates in the mathematical sciences proceed to further full-time study. The 2010 figures above indicate that only about 45% of graduates are available for full-time employment after finishing their degree. Of those who do seek full-time employment 66.8% have found it four months after graduation.

In 2011, the median starting salary increased to $55,000, up from $51,100. Of the bachelor graduates available for full-time employment 71.9% was in full-time employment against 76.3% overall. However, again a very high number of bachelor graduates (slightly under 40%) sought further full-time study (Source: Graduate Careers Australia, GradStats 2011 and GradFiles 2011).

3.3.3. Honours and Higher Degree enrolments and completions

According to the longitudinal data assembled by Peter Johnston on behalf of the Australian Mathematical Society, Honours Degree completions in mathematics and statistics in Australia have, despite spikes upwards and downwards, have been fairly stable with perhaps a very slight increase over the long term. Honours completions were up in 2011 compared to 2010. (Please note that, for the time being, the two-year coursework Masters degrees offered at Melbourne University have been merged with the Honours data).

Figure 3.3.3.1.

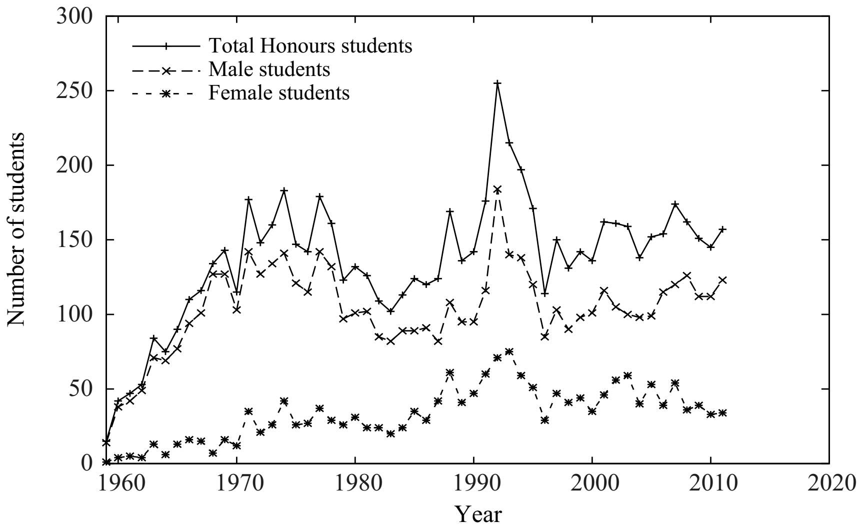


Figure 1. Number of Honours degrees completed in mathematics and statistics, 1959–2011.

Source: Peter Johnston, *Higher Degrees and Honours Bachelor Degrees in mathematics and statistics in Australia in 2011*, submitted for publication to the Gazette of the Australian Mathematical Society, issue 5 2012.

Figure 3.3.3.2.

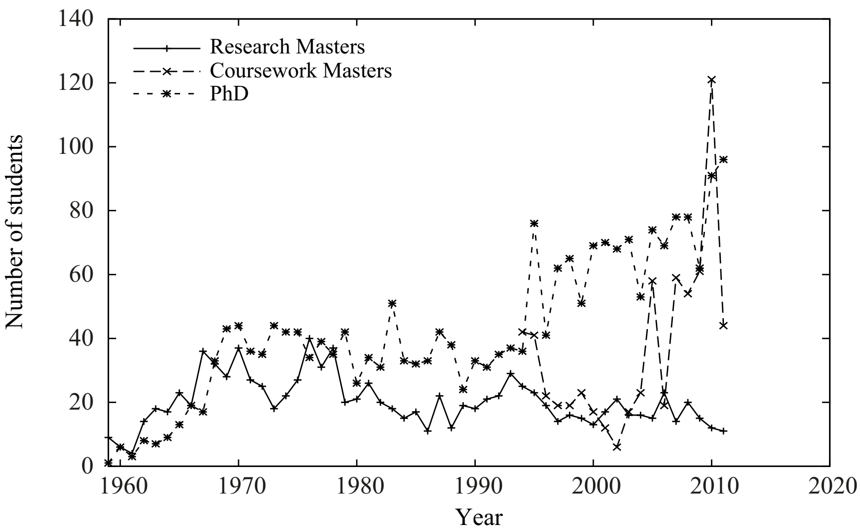


Figure 2. Number of research higher degrees completed in mathematics and statistics, 1959–2011.

Source: Peter Johnston, *Higher Degrees and Honours Bachelor Degrees in mathematics and statistics in Australia in 2011*, submitted for publication to the Gazette of the Australian Mathematical Society, issue 5 2012.

The longitudinal data also indicate that PhD completions are slowly increasing, however Research Masters completions have been very low for quite some time. The completion rate of Coursework Masters spiked considerably in 2010, only to fall again in 2011.

Table 3.3.3.1. AMSI Member Survey 2012: Honours and Higher Degree enrolments in 2011 and 2012 (in EFTSL)

	2011				2012				Change			
	PhD	Coursework Masters	Research Masters	Hons	PhD	Coursework Masters	Research Masters	Honours	PhD	Coursework Masters	Research Masters	Hons
Total Go8	281.40	137.00	35.80	119.50	299.30	135.90	28.60	113.50	6.36%	-0.80%	-20.11%	-5.02%
Total non Go8 universities	238.50	152.25	25.00	52.25	257.00	173.76	26.00	60.13	7.76%	14.12%	4.00%	15.07%
Total all universities	519.90	289.25	60.80	171.75	556.30	309.66	54.60	173.63	7.00%	7.05%	-10.20%	1.09%

Source: AMSI Member Survey 2012, preliminary results

According to the AMSI Member Survey total enrolments (in EFTSL) in Masters by Research declined between 2011 and 2012, however all other enrolments were moderately up against 2011. (Please note that in the AMSI Member Survey the two-year Masters degree at Melbourne University has been listed under Coursework Masters). Since the total number of PhD and Masters by Research enrolments represent all students doing their degree at any one time within a multi-year timespan it is also important to look at new enrolments and completions. New PhD commencements were slightly down from 2011 levels in 2012, however so were completion levels, which suggests PhD students might be taking slightly longer to complete their degree. The Masters by Research enrolments remained low in 2011 and 2012.

Table 3.3.3.2. AMSI Member Survey 2012: Commencements and completions of PhD and Masters by Research Degrees in 2011 and 2012

	PhD commencements		**PhD completions**		**Masters by research commencements**		**Masters by research completions**	
	2011	2012*	2011	2012*	2011	2012*	2011	2012*
Total Go8 universities	89	86	52	48	10	19	8	7
Total non Go8 universities	59	55	51	39	14	7	0	7
Total all universities	148	141	103	87	24	26	8	14

* respondents were asked for projected 2012 figures at the time of data collection

Source: AMSI Member Survey 2012, preliminary results

Table 3.3.3.3. AMSI Member Survey 2012: Honours and Higher Degree student profile (in absolute numbers) at the semester one 2012 census date by gender and domestic/international status

	Honours					**Masters by Coursework**				
	Total	Domestic %		International %		Total	Domestic %		International %	
		Male	Female	Male	Female		Male	Female	Male	Female
Total Go8	112	74.11%	20.54%	3.57%	1.79%	336	44.64%	22.62%	19.94%	12.80%
Total non Go8	68	60.29%	29.41%	5.88%	4.41%	249	41.37%	14.06%	29.72%	14.86%
Total all universities	180	68.89%	23.89%	4.44%	2.78%	585	43.25%	18.97%	24.10%	13.68%

	Masters by Research					**PhD**				
	Total	Domestic		International		Total	Domestic		International	
		Male	Female	Male	Female		Male	Female	Male	Female
Total Go8	41	63.41%	21.95%	7.32%	7.32%	365	56.71%	16.99%	16.44%	9.86%
Total non Go8	27	48.15%	11.11%	25.93%	14.81%	270	34.81%	18.89%	24.81%	21.48%
Total all universities	68	57.35%	17.65%	14.71%	10.29%	635	47.40%	17.80%	20.00%	14.80%

Source: AMSI Member Survey 2012, preliminary results

In all degrees the proportion of males exceeds the proportion of females considerably. In all categories except for the domestic Masters degrees, the proportion of female students compared to male students is slightly higher at non Go8 universities. International students seem mostly interested in Masters and PhD degrees, and not so much in Honours degrees.

3.3.4. International comparison of enrolment and graduation figures

International comparison confirms that entry into mathematical university degrees is quite low in Australia: enrolment into mathematical degrees (both undergraduate and higher degrees) by men is about half of the OECD average, and by women as low as a third of the OECD average. Looking at entrance into higher degrees specifically, the same picture emerges. Only 1.4% of all entrants into an advanced research degree choose to enrol in a mathematical sciences research degree – again half of the OECD average. Even though these figures need to be read with extreme care due to the differences in higher education systems in various countries, the Australian figures are consistent with earlier OECD data collections.

Table 3.3.4.1.

Education at a Glance 2011: OECD Indicators - © OECD 2011

EXTRACT from Table A4.2b. (Web only) Distribution of tertiary new entrants, by field of education and gender (2009)

		Men						women					
		Engineering, manufacturing and construction	Science	Life sciences	Physical sciences	Mathematics and statistics	Computing	Engineering, manufacturing and construction	Science	Life sciences	Physical sciences	Mathematics and statistics	Computing
OECD	Note	(7)	(8)	(9)	(10)	(11)	(12)	(21)	(22)	(23)	(24)	(25)	(26)
Australia	1	15.5	**16.0**	4.3	2.7	0.6	8.7	3.5	**7.6**	3.8	1.9	0.3	1.6
Denmark		**17.0**	13.5	0.6	1.1	1.7	10.1	**7.9**	5.6	1.0	0.7	0.9	3.1
Finland	2	**44.8**	12.6	0.7	2.5	1.3	8.2	**7.9**	6.2	1.4	1.7	1.2	1.8
Germany	2	**28.9**	15.4	1.5	4.5	2.4	7.1	4.8	**8.9**	2.4	2.6	2.6	1.3
Ireland	2	**20.7**	15.2	3.7	1.3	2.5	7.6	2.6	**9.1**	4.6	0.9	2.4	1.2
New Zealand		11.1	**22.4**	3.8	3.4	4.1	11.1	2.6	**11.9**	4.9	2.1	1.9	3.0
Sweden		**31.1**	14.0	1.7	2.1	2.1	8.1	**8.7**	6.5	2.2	1.2	1.2	2.0
United Kingdom		15.5	**19.9**	5.2	4.8	2.3	7.6	2.6	**8.4**	3.6	2.5	1.1	1.3
OECD average		25.3	13.0	1.9	2.5	1.2	7.7	6.4	6.2	2.5	1.5	0.9	1.5
EU21 average		26.9	13.2	1.8	2.5	1.2	7.7	6.7	6.2	2.5	1.4	1.0	1.3

Notes:

1. Exclude tertiary-type B programmes.
2. Exclude advanced research programmes.

Source: selected data extracted from *Education at a Glance 2011: OECD Indicators*, Table A4.2b (Web only) Distribution of tertiary new entrants, by field of education and gender (2009)

Table 3.3.4.2.

Education at a Glance 2011: OECD Indicators - © OECD 2011

EXTRACT from Table A4.2c. (Web only) Distribution of new entrants into advanced research programmes, by field of education (2009)

	Engineering, manufacturing and construction	Science	Life sciences	Physical sciences	Mathematics and statistics	Computing
OECD	(7)	(8)	(9)	(10)	(11)	(12)
Australia	16.2	**23.2**	10.3	7.8	1.4	3.7
Denmark	**25.0**	20.3	n	n	20.3	n
New Zealand	14.5	**30.1**	13.9	9.6	1.9	4.7
Sweden	25.0	19.9	6.1	7.5	2.4	3.9
United Kingdom	14.2	**27.1**	7.9	12.2	2.6	4.4
OECD average	15.2	**21.8**	8.4	7.3	2.8	2.9
EU21 average	17	21	8	6	3	4

Source: selected data extracted from *Education at a Glance 2011: OECD Indicators*, Table A4.2c (Web only) Distribution of new entrants into advanced research programmes, by field of education (2009)

The number of graduates in mathematical sciences degrees is also about half of the OECD average. The percentage of mathematics graduates also compares very unfavourably compared to other scientific disciplines in Australia such as Engineering and Science.

Table 3.3.4.3.

Education at a Glance 2011: OECD Indicators - © OECD 2011

EXTRACT from Table A4.3b. (Web only) Distribution of tertiary-type A and advanced research programmes graduates, by field of education (2009)

		Engineering, manufacturing and construction	Science	Life sciences	Physical sciences	Mathematics and statistics	Computing
OECD	Note	(7)	(8)	(9)	(10)	(11)	(12)
Australia	1	7.2	**10.6**	3.4	1.9	0.5	4.9
Canada	1	8.5	**13.0**	6.6	2.9	1.4	2.1
Denmark		**11.1**	8.2	1.9	1.9	1.1	3.3
Finland		**20.6**	7.6	1.5	2.0	0.9	3.0
Germany		12.3	**16.5**	3.6	5.1	3.0	4.8
Ireland		8.1	**11.6**	3.9	1.7	0.9	3.6
New Zealand		6.3	**12.5**	5.3	2.5	1.3	3.9
Sweden		**16.4**	7.4	2.8	1.6	0.7	2.3
United Kingdom		9.2	**13.6**	4.3	3.8	1.5	4.1
OECD average		12.0	9.3	2.8	2.2	1.0	3.3
EU21 average		11.4	8.7	2.5	2.0	0.9	3.2

Note:

1. Year of reference 2008.

Source: selected data extracted from *Education at a Glance 2011: OECD Indicators*, Table A4.3b (Web only) Distribution of tertiary-type A and advanced research programmes graduates, by field of education (2009)

3.3.5. Demand for PhD graduates

A Monash CoPS data projection dating back to 2007 indicates strong growth in the demand for PhD graduates in the mathematical sciences to 2020.

Table 3.3.5.1.

TABLE 14: PROJECTIONS OF SIZE OF DOCTORATES EMPLOYED, BY DETAILED FIELD OF EDUCATION, 2007-08 TO 2019-20, AUSTRALIA

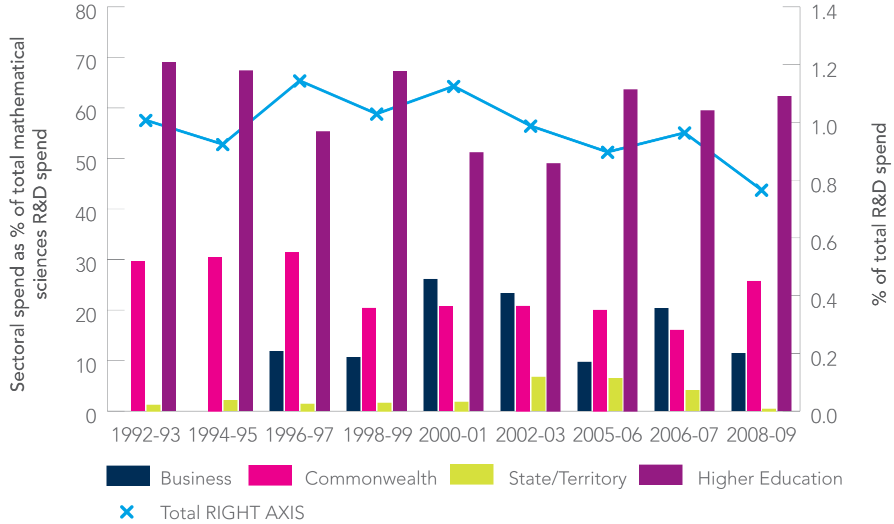
	Size of employed workforce				Change 2007-08 to 2019-20	
Field of qualification (ASCED)	**2007-8**	**2011-2**	**2015-6**	**2019-20**	**Number**	**Per cent**
Biological Sciences	20,878	23,489	26,637	29,957	9,079	43.5
Other Natural and Physical Sciences	8,477	9,896	11,865	14,075	5,598	66.0
Chemical Sciences	6,674	7,171	8,136	9,181	2,507	37.6
Medical Studies	7,303	7,809	8,372	8,957	1,654	22.6
Studies in Human Society	4,796	5,443	6,286	7,185	2,389	49.8
Mathematical Sciences	4,610	5,226	6,144	7,173	2,563	55.6
Process and Resources Engineering	4,533	5,276	6,082	6,946	2,412	53.2
Philosophy and Religious Studies	3,784	4,344	5,040	5,820	2,036	53.8
Behavioural Science	3,735	4,123	4,776	5,501	1,766	47.3
Physics and Astronomy	3,707	3,909	4,582	5,376	1,669	45.0
Computer Science	2,846	3,265	3,859	4,530	1,684	59.2
Other Education	2,460	2,821	3,265	3,725	1,266	51.5
Earth Sciences	2,629	2,871	3,273	3,703	1,075	40.9
Business and Management	1,997	2,238	2,583	2,949	952	47.7
Law	1,586	1,875	2,257	2,696	1,110	70.0
Economics and Econometrics	2,036	2,090	2,294	2,485	449	22.1
Language and Literature	2,463	2,421	2,467	2,479	16	0.7
Political Science and Policy Studies	1,279	1,542	1,915	2,346	1,067	83.5
Environmental Studies	1,316	1,541	1,863	2,215	899	68.3
Other Engineering and Related Technologies	1,416	1,572	1,785	2,020	604	42.7

Source: CoPS, *MONASH* forecasts, March Quarter 2009 customised data and ACER adjustments

4. Research in the mathematical and statistical sciences

4.1. Research funding

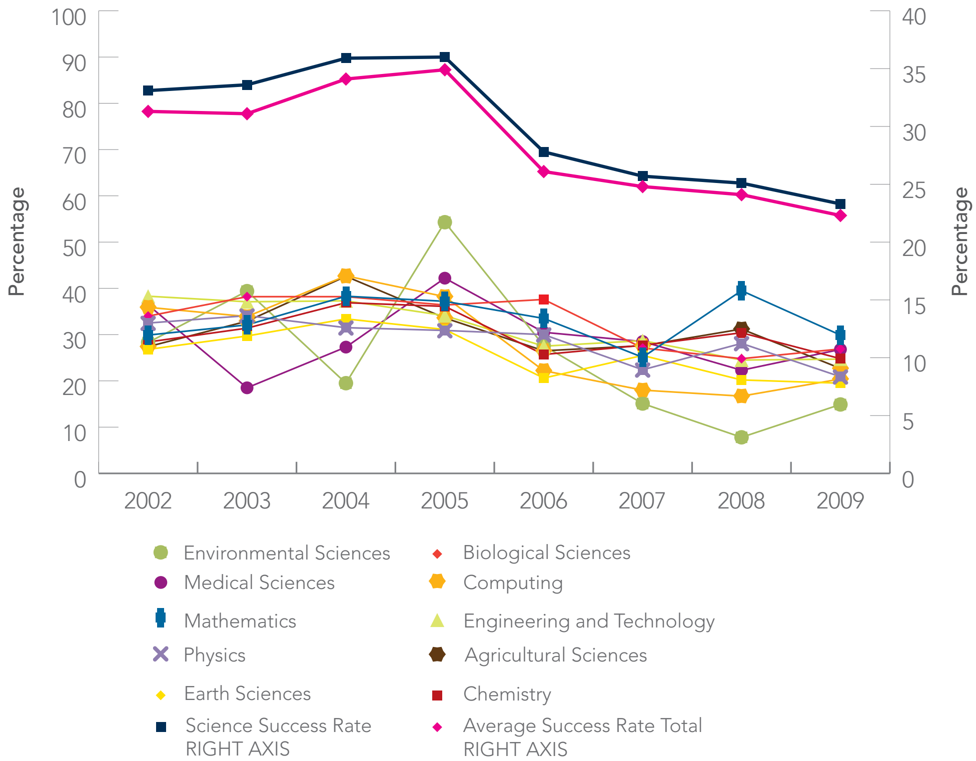
Figure 4.1.1.
Sectoral spending as a proportion of total spending on Mathematical Sciences R&D and total spending on Mathematical Sciences R&D as a proportion of total spending on all R&D



Note: Gross expenditure on R&D by sector, 1992–93 to 2008–09.
From: Office of the Chief Scientist, *Health of Australian Science*, May 2012, page 169.

In 2008-2009, about 0.8% of total spending on research and development was spent on mathematical sciences; Higher education funding is the main source of R&D income, followed by Commonwealth funding.

Figure 4.1.2.
Success rates for science fields and overall in selected schemes in the ARC competitive grants program, 2001 to 2008



From: Office of the Chief Scientist, Health of Australian Science, May 2012, page 129.

In terms of ARC grant success rates, the mathematics discipline has held its own in the period 2002-2009 and in fact has been relatively quite successful in 2008 and 2009, while overall success rates for competitive ARC research funding have declined.

4.2. Research output and quality

Table 4.2.1.

Table 6.7.1 Outputs and relative impacts of Australian natural and physical science publications, 2005 to 2010

Field	Number of Publications	Number of Citations	Relative citation impact
Physical Sciences	14 158	94 987	1.42
Environmental Sciences	6 195	37 106	1.25
Earth Sciences	9 639	52 743	1.23
Mathematical Sciences	9 955	42 662	1.2
Agricultural and Veterinary Sciences	13 397	61 245	1.17
Technology	3 197	15 656	1.14
Chemical Sciences	12 938	83 765	1.11
Medical and Health Sciences	65 339	463 124	1.11
Engineering	29 907	144 414	1.05
Biological Sciences	28 881	212 411	1.0
Information and Computing Sciences	4 739	10 030	0.99

Note: Relative citation impact represents the ratio of average citations per paper divided by the global average of citations per paper in that field.
Source: InCites/Thomson–Reuters (2011).

From: Office of the Chief Scientist, Health of Australian Science, May 2012, page 151

In terms of volume output, mathematical and statistical sciences research is one of the smaller research areas. Citations per paper are usually lower than in other research areas. However, over the period 2005 to 2010 the relative citation impact has remained healthy, with a relatively high ratio of average citations per paper compared to the global average of citations per paper in the field.

Table 4.2.2.

01 MATHEMATICAL SCIENCES

Institution	01 Mathematical Sciences	0101 Pure Mathematics	0102 Applied Mathematics	0103 Numerical and Computational Mathematics	0104 Statistics	0105 Mathematical Physics	0199 Other Mathematical Sciences
Australian Catholic University	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Australian National University	4	5	4	n/a	3	5	n/a
Batchelor Institute of Indigenous Tertiary Education	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Bond University	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Central Queensland University	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Charles Darwin University	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Charles Sturt University	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Curtin University of Technology	3	n/a	3	3	2	n/a	n/a
Deakin University	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Edith Cowan University	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Flinders University	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Griffith University	n/a	n/a	n/a	n/a	n/a	n/a	n/a
James Cook University	2	n/a	n/a	n/a	n/a	n/a	n/a
La Trobe University	2	2	3	n/a	n/a	n/a	n/a
Macquarie University	2	3	n/a	n/a	2	n/a	n/a
Melbourne College of Divinity	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Monash University	3	3	4	n/a	2	n/a	n/a
Murdoch University	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Queensland University of Technology	4	n/a	4	3	3	n/a	n/a
RMIT University	2	n/a	3	n/a	n/a	n/a	n/a
Southern Cross University	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Swinburne University of Technology	n/a	n/a	n/a	n/a	n/a	n/a	n/a
University of Adelaide	3	4	3	n/a	3	n/a	n/a
University of Ballarat	2	2	n/a	n/a	n/a	n/a	n/a
University of Canberra	n/a	n/a	n/a	n/a	n/a	n/a	n/a
University of Melbourne	5	4	4	n/a	4	5	n/a
University of New England	4	4	n/a	n/a	n/a	n/a	n/a
University of New South Wales	4	3	4	5	3	4	n/a
University of Newcastle	3	3	5	n/a	n/a	n/a	n/a
University of Notre Dame Australia	n/a	n/a	n/a	n/a	n/a	n/a	n/a
University of Queensland	4	3	4	5	5	4	n/a
University of South Australia	3	3	3	n/a	n/a	n/a	n/a
University of Southern Queensland	3	n/a	n/a	n/a	n/a	n/a	n/a
University of Sydney	5	4	4	3	3	5	n/a
University of Tasmania (inc. Australian Maritime College)	3	2	n/a	n/a	n/a	n/a	n/a
University of Technology, Sydney	3	n/a	3	n/a	n/a	4	n/a
University of the Sunshine Coast	n/a	n/a	n/a	n/a	n/a	n/a	n/a
University of Western Australia	4	5	4	n/a	3	n/a	n/a
University of Western Sydney	3	3	n/a	n/a	n/a	n/a	n/a
University of Wollongong	3	3	3	n/a	2	n/a	n/a
Victoria University	2	1	3	n/a	n/a	n/a	n/a
Total UoEs evaluated	**24**	**18**	**17**	**5**	**12**	**6**	**0**

Source: ARC/ERA, *Section 4, ERA 2010 Institution Report*, page 264

Table 4.2.3.

01 Mathematical Sciences

Institution	01 Mathematical Sciences	0101 Pure Mathematics	0102 Applied Mathematics	0103 Numerical and Computational Mathematics	0104 Statistics	0105 Mathematical Physics	0199 Other Mathematical Sciences
Australian Catholic University	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Australian National University	5	5	4	n/a	n/a	4	n/a
Batchelor Institute of Indigenous Tertiary Education	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Bond University	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Central Queensland University	5	n/a	5	n/a	n/a	n/a	n/a
Charles Darwin University	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Charles Sturt University	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Curtin University of Technology	3	n/a	3	3	n/a	n/a	n/a
Deakin University	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Edith Cowan University	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Flinders University	2	n/a	n/a	n/a	n/a	n/a	n/a
Griffith University	n/a	n/a	n/a	n/a	n/a	n/a	n/a
James Cook University	3	n/a	3	n/a	n/a	n/a	n/a
La Trobe University	2	2	2	n/a	n/a	n/a	n/a
Macquarie University	2	3	n/a	n/a	2	n/a	n/a
MCD University of Divinity	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Monash University	3	3	4	n/a	3	n/a	n/a
Murdoch University	2	n/a	n/a	n/a	n/a	n/a	n/a
Queensland University of Technology	4	n/a	3	4	4	n/a	n/a
RMIT University	3	n/a	4	n/a	n/a	n/a	n/a
Southern Cross University	n/a	n/a	n/a	n/a	n/a	n/a	n/a
Swinburne University of Technology	n/a	n/a	n/a	n/a	n/a	n/a	n/a
University of Adelaide	4	4	4	n/a	4	n/a	n/a
University of Ballarat	2	2	2	n/a	n/a	n/a	n/a
University of Canberra	n/a	n/a	n/a	n/a	n/a	n/a	n/a
University of Melbourne	4	5	4	n/a	4	4	n/a
University of New England	3	4	n/a	n/a	n/a	n/a	n/a
University of New South Wales	4	4	4	3	3	3	n/a
University of Newcastle	3	3	5	n/a	4	n/a	n/a
University of Notre Dame Australia	n/a	n/a	n/a	n/a	n/a	n/a	n/a
University of Queensland	4	4	4	5	5	3	n/a
University of South Australia	4	3	3	n/a	n/a	n/a	n/a
University of Southern Queensland	3	n/a	n/a	n/a	n/a	n/a	n/a
University of Sydney	5	4	3	3	4	4	n/a
University of Tasmania (inc. Australian Maritime College)	3	n/a	3	n/a	n/a	n/a	n/a
University of Technology, Sydney	3	n/a	4	n/a	n/a	3	n/a
University of the Sunshine Coast	n/a	n/a	n/a	n/a	n/a	n/a	n/a
University of Western Australia	3	4	3	n/a	n/a	n/a	n/a
University of Western Sydney	4	3	4	n/a	n/a	n/a	n/a
University of Wollongong	4	3	4	n/a	4	n/a	n/a
Victoria University	3	1	4	n/a	n/a	n/a	n/a
Total UoEs evaluated	27	17	22	5	10	6	0

Source: ARC/ERA, *Section 4, ERA 2012 Institution report*, page 309

Compared to the ERA results of 2010, the 2012 ERA results showed an improvement overall. The total number of UoE's assessed at the two-digit and four-digit level went up, with the worrying exception of statistics: the number of UoE's assessed in statistics declined from 12 in ERA 2010 to 10 in ERA 2012. Overall, there were still 14 universities (34% of the total number of universities) which did not have sufficient (if any) research output in the mathematical sciences to be assessed. At the two-digit level, there were only 6 disciplines which had fewer UoEs evaluated, indicating that mathematical sciences remains one of the smaller research disciplines in terms of volume output. At the four-digit level all disciplines except mathematical physics stabilised or improved their ranking compared to 2010. At the four-digit level 54 out of 60 UoE's perform at or above world standard.

Looking at the trends in scientific output and impact, the volume output as a percentage of world publications increased slightly between 2002 and 2010, but less than most other selected fields of research. However, the impact of mathematical publications expressed as the ratio between the Australian and Global Impact Factor showed one of the highest increases among the selected fields of research.

Table 4.2.4. Trends in scientific output and impact: selected fields of research, 2002 to 2010

Field/Year	Total Publications	Percent international co-authored	Percent of world	Australian IF/ Global IF
Molecular Biology				
2002	387	29.5	1.9	0.93
2010	1559	56.8	2.7	1.09
Chemistry				
2002	1271	31.1	1.3	1.03
2010	3344	49.1	1.8	1.18
Computer Science				
2002	958	34.3	1.7	1.21
2010	5664	45.1	2.1	1.29
Earth and Planetary Sciences				
2002	2040	45.0	3.3	1.22
2010	3675	62.6	4.3	1.31
Engineering				
2002	2726	31.5	1.3	1.35
2010	7083	45.5	1.8	1.33
Environmental Science				
2002	1856	28.1	3.5	1.08
2010	3663	43.1	4.0	1.11
Mathematics				
2002	893	46.0	2.0	0.95
2010	3003	53.6	2.1	1.17
Medicine (non-clinical)				
2002	3950	16.8	1.2	1.09
2010	5548	36.2	0.9	1.33
Neuroscience				
2002	989	30.7	2.4	0.96
2010	2087	46.7	3.9	0.99
Physics and Astronomy				
2002	2080	42.0	1.4	1.18
2010	4948	60.0	1.9	1.29
Nuclear and High-Energy Physics				
2002	153	52.3	1.3	1.10
2010	225	62.2	1.3	1.13

Source: Office of the Chief Scientist, ***Health of Australian Science***, May 2012, EXTRACT from Table 6.7.4.

About the 2012 AMSI Member Survey

In October 2012 the AMSI member universities were sent a survey questionnaire with enquiries about their staffing situation, teaching, student numbers and a host of other data. To date, 26 respondents have participated in the survey. A slightly modified questionnaire was sent to a number of non-member institutions to be able to get a more comprehensive picture of the state of affairs of the mathematical and statistical sciences in Australia. This Discipline Profile contains the preliminary results of the Member Survey. It does not yet contain any data from non-member universities. A final report of the AMSI Member Survey 2012 will be published on the AMSI website later in 2013.

AMSI wishes to thank all respondents to date to the survey for their cooperation:

University of Western Sydney
James Cook University
University of Technology, Sydney
ADFA
University of New South Wales
Flinders University
University of South Australia
University of Western Australia
University of Southern Queensland
RMIT
Swinburne University of Technology
University of Ballarat
Macquarie University
Australian National University
University of Newcastle
Deakin University
University of Adelaide
University of Sydney
La Trobe University
University of New England
University of Melbourne
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Queensland University of Technology
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University of Wollongong

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DEEWR Higher Education Data

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