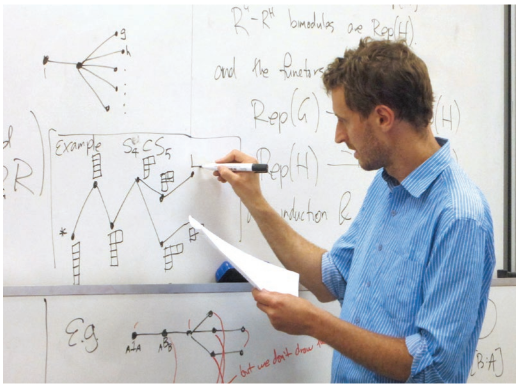
Advocacy

Australian Mathematical Sciences Institute



Discipline Profile of the Mathematical Sciences 2014

AMSI

AUSTRALIAN MATHEMATICAL SCIENCES INSTITUTE

DISCIPLINE PROFILE OF THE MATHEMATICAL SCIENCES 2014

1. Introduction

The mathematical sciences play a pivotal role in today's knowledge economy. The discipline has a significant presence at all levels of the education system with flow on effects to many parts of Australian life, employment, research, business and government.

For the last three years AMSI has produced a Discipline Profile of the Mathematical Sciences. The intention of these objective profiles is to provide evidence and inspiration for policy development by AMSI, government, business and various stakeholder groups.

We identify trends in Australian school education, higher education, research and research training, as well as in potential career prospects for graduates. The overall picture, nationally and internationally, is one of extremes with deeply troubling problems in Australia's schools but extraordinary research performance. Around 40% of our Year 7–10 maths classes are not taught by trained maths teachers, far in excess of any other subject. Yet in 2013 Professor Terry Speed, statistician at the Walter and Eliza Hall Institute, was awarded the Prime Minister's Prize for Science and Professor John Croucher, statistician at Macquarie University, won the Prime Minister's Award for University Teacher of the Year. And the ARC created the $20m Centre of Excellence for Mathematical and Statistical Frontiers.

Preliminary data from the 2013 AMSI Member Survey can be found throughout this report, along with new data on research, ARC success rates and research publications.

This third edition also contains:

- Updated NAPLAN results,
- Results from the latest PISA survey,
- Detailed data from the 2011 TIMSS survey,
- Results of a new international survey into adult numeracy.

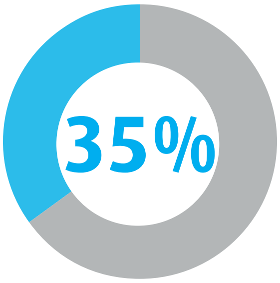
This profile should be read in conjunction with AMSI's policy document *Dealing with Australia's Mathematical Deficit* **www.amsi.org.au/policy-document-2014**.

Editor: Maaike Wienk

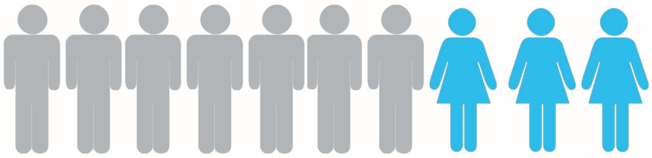
Published May 2014

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.

Headline trends



International students make up around 35% of all PhD enrolments in the mathematical sciences with domestic enrolments in decline (page 25)

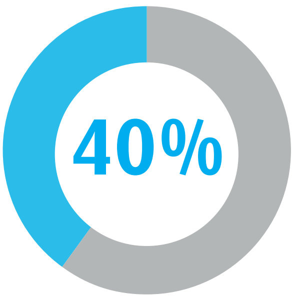


Females make up only **30%** of undergraduate and postgraduate enrolments in mathematics (page 21, 25)

The mathematical sciences
is one of Australia's **most successful research disciplines** with an international performance comparable to medical research (page 31)

Undergraduate and postgraduate enrolments in mathematics and statistics have been **stagnant for the last 3 years** (page 21)

Year 7-10 maths classes

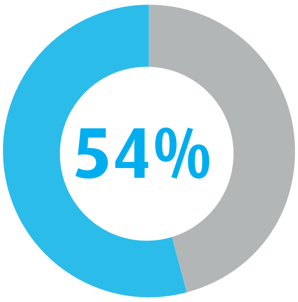


are without a qualified mathematics teacher, roughly **3 times** the international average and roughly **twice** the estimated rate for Year 7-10 science classes (page 11)

Year 12 advanced maths enrolments have dropped by **22%** from 2000 to 2012 (page 9)

and by **34%** from 1995 to 2012 (page 9)

The mathematical sciences has a **higher sustained success rate** for research grants from the Australian Research Council than any other discipline (page 27)



of Australian adults have only basic numeracy skills at best, below the OECD average (page 14)

Australia's international position in school mathematics performance has **declined** sharply (page 6)

Regional and socio-economic inequality in the mathematical performance of school students is **worsening** (page 7)

Australia's PhD graduation rate in the mathematical sciences is **one of the lowest** in the OECD and at **half the OECD average** (page 26)

2. School education and numeracy

2.1. Student performance in numeracy and mathematics

Despite the introduction of programs to improve mathematical ability, NAPLAN national reports show that student performance in numeracy in Years 3, 5, 7 and 9 has not lifted at all over the past 6 years. Figure 2.1.1. shows the achievement by year, with the mean numeracy score in the upper band, and the percentage of students scoring at or above the national minimum standard in the lower band. Between 2008 and 2013 most scores show no significant difference, except for Year 9, which shows a moderate decline in the percentage of students scoring at or above the national minimum standard.

Figure 2.1.1.

NAPLAN Numeracy

Figure TS.N1: Achievement of Students in Numeracy, Australia, 2008–2013.

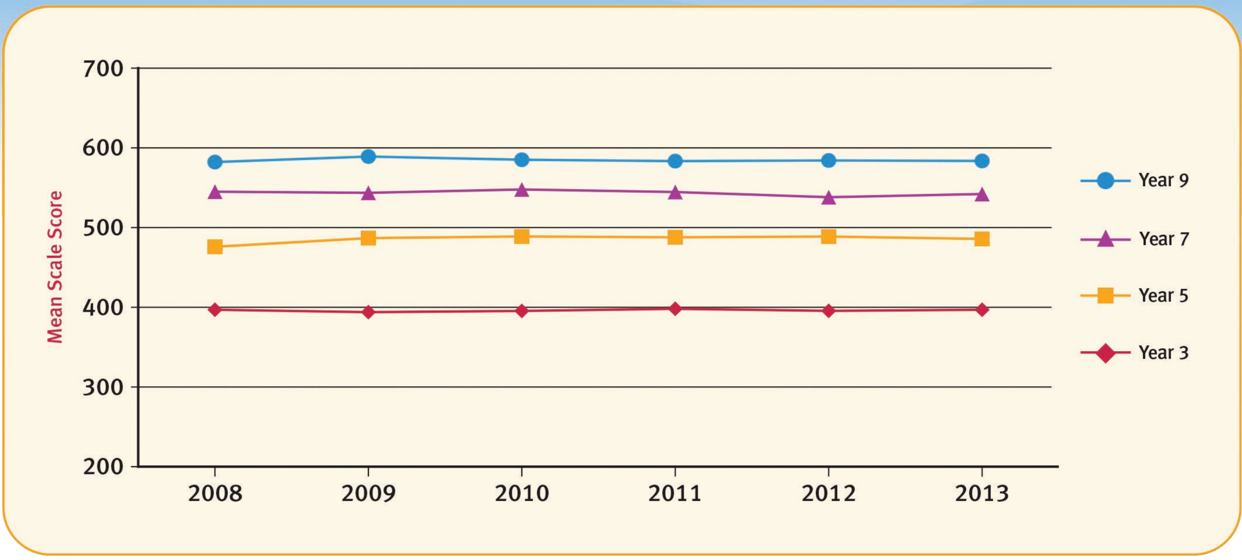


Table TS.N1: Achievement of Students in Numeracy, Australia, 2008–2013.

Students		2008	2009	2010	2011	2012	2013	Nature of the difference	
								2008 vs. 2013	2012 vs. 2013
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)	583.6 (82.2)	■	■
	% at or above NMS	93.6	95.0	93.1	93.0	93.7	90.6	▽	▽
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)	542.1 (71.4)	■	■
	% at or above NMS	95.4	94.8	95.1	94.5	93.8	95.0	■	■
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)	485.8 (71.5)	■	■
	% at or above NMS	92.7	94.2	93.7	94.4	93.3	93.4	■	■
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)	396.9 (65.8)	■	■
	% at or above NMS	95.0	94.0	94.3	95.6	93.9	95.7	■	△

NMS: national minimum standard
Source: NAPLAN, 2013 National Report, Table TS.N1

Figure 2.1.2. depicts the gains in numeracy skills over a 4-year period for 2 cohorts: the students who were in Year 3 in 2009 and progressed to Year 7 in 2013, and the students who were in Year 5 in 2009, and progressed to Year 9 in 2013. In the first cohort (N1. 3_5_7) the highest achievement gain took place between Year 3 and 5, and the lowest between year 5 and 7; in the second cohort (N1. 5_7_9), the achievement gain between Year 5 and 7 was higher than between Year 7 and 9. Both cohorts gained about the same between Years 5 and 7.

Figure 2.1.2.

NAPLAN Achievement of Students in Numeracy

Figure N1.3_5_7: Achievement of Year 3 (2009), Year 5 (2011) and Year 7 (2013) Students in Numeracy, by State and Territory.

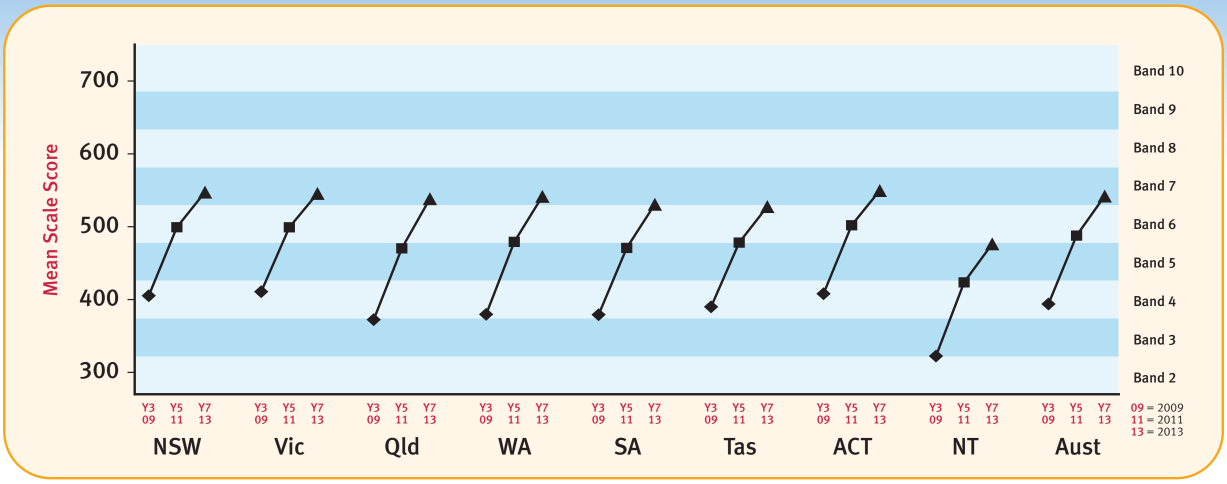


Figure N1.5_7_9: Achievement of Year 5 (2009), Year 7 (2011) and Year 9 (2013) Students in Numeracy, by State and Territory.

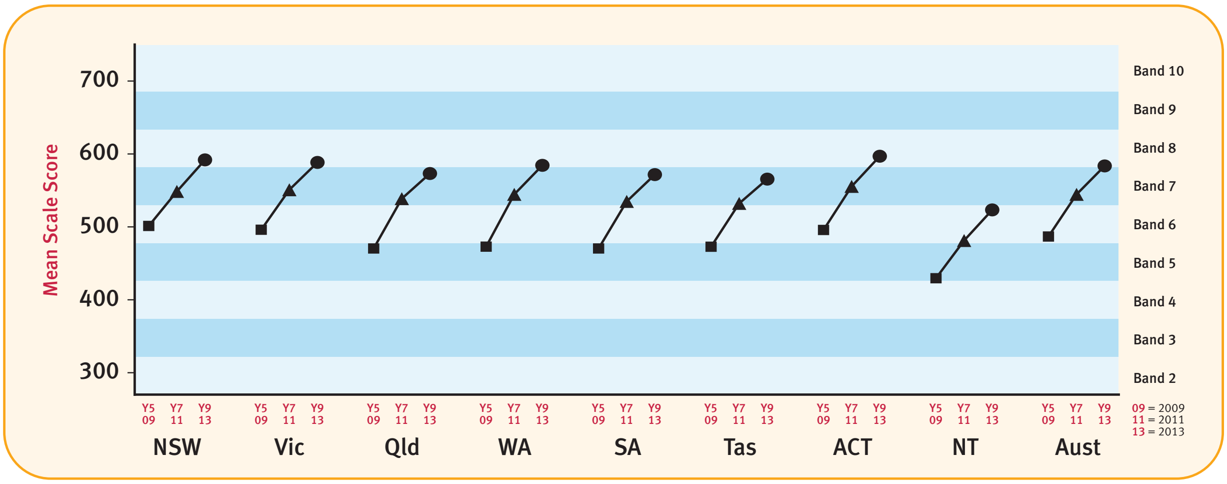


Table N1.2009_2011_2013: Achievement of Students in Numeracy from Year 3 (2009), Year 5 (2011) and Year 7 (2013), and from Year 5 (2009), Year 7 (2011) and Year 9 (2013), by State and Territory.

			NSW	Vic	Qld	WA	SA	Tas	ACT	NT	Aust
Mean scale score / (S.D.)	Year 3	2009	405.3 (73.6)	410.8 (68.3)	372.4 (66.6)	379.7 (71.5)	379.2 (68.9)	390.0 (73.3)	408.0 (68.9)	322.4 (98.3)	393.9 (72.9)
Mean scale score / (S.D.)	Year 5	2011	499.3 (72.5)	499.2 (64.7)	470.3 (59.8)	479.2 (66.3)	470.9 (60.8)	478.2 (65.2)	502.0 (63.9)	423.6 (79.0)	487.8 (68.2)
Mean scale score / (S.D.)	Year 7	2013	547.5 (77.4)	545.7 (67.7)	538.5 (65.7)	541.7 (71.1)	530.8 (64.6)	527.7 (65.1)	549.7 (66.7)	476.5 (82.3)	542.1 (71.4)
Mean scale score / (S.D.)	Year 5	2009	501.3 (72.9)	496.1 (62.3)	470.4 (61.7)	472.9 (63.9)	470.4 (60.5)	472.8 (63.2)	495.8 (63.5)	429.6 (83.2)	486.8 (67.8)
Mean scale score / (S.D.)	Year 7	2011	548.6 (79.5)	550.9 (70.0)	538.7 (68.3)	544.6 (72.0)	534.9 (67.9)	532.2 (70.5)	555.5 (71.8)	481.3 (90.1)	544.6 (73.7)
Mean scale score / (S.D.)	Year 9	2013	591.9 (90.7)	588.4 (77.9)	573.2 (74.5)	584.4 (80.9)	571.7 (72.3)	565.5 (73.5)	596.9 (80.3)	523.3 (94.9)	583.6 (82.2)

Source: NAPLAN, 2013 National Report, page 352

The international surveys Trends in International Mathematics and Science Study (table 2.1.1.) and Programme for International Student Assessment (table 2.1.2.) indicate that the average mathematical performance of Australian teenagers has declined, while at the same time other countries, mainly in the Asia-Pacific region, have managed to significantly improve students' mathematical proficiency across the board.

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; Sue Thomson et al., Highlights from TIMSS and PRLS from Australia's perspective, ACER 2012

Table 2.1.2. Student performance in the mathematical sciences among 15-year olds: selection of data from OECD PISA reports over the period 2000-2012

	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, Liechtenstein, Switzerland, Japan, Canada, Netherlands, Macao-China
2012	504	613	368	Above average	16	Shanghai-China, Singapore, Hong Kong-China, Chinese Taipei, Korea, Macao-China, Japan, Liechtenstein, Switzerland, Netherlands, Estonia, Finland, Canada, Poland, Belgium, Germany

Source: Selected data from PISA 2000, 2003, 2006, 2009 and 2012; Sue Thomson et al., PISA 2012: How Australia measures up, ACER 2013

2.2. Distribution of mathematical achievement

More worrying still is the fact that there is significant inequality in performance among Australian students: between students in metropolitan areas and remote areas; between states and territories, and between top performers and low performers. Starting with the latter, the 2012 PISA survey shows that since 2003 the number of students performing very well in mathematics is dropping, while the number of low performers is rising. The percentage of Australian students reaching the two highest levels of proficiency is slightly under 15%; the OECD average is 12.6%. In 2003, this percentage was approximately 20%, equating to a 5% drop over 9 years. In comparison there has been a 5.3% increase in our low performing (below proficiency level 2) students. In 2003 only 15% of Australian students were considered as underperforming, that number is currently at 20% (source: PISA 2012, Volume I, page 70).

The TIMSS results from 2011 (Figures 2.2.1. and 2.2.2.) show that the distribution of higher and lower performers differs substantially between states and territories. The Northern Territory has the highest percentages of low proficiency.

Figure 2.2.1.

International median: median score of countries participating in TIMSS

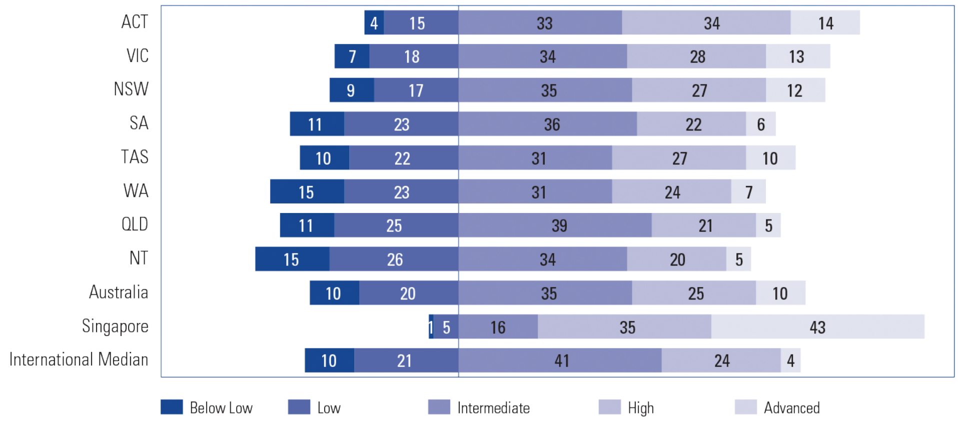


Figure 14 Percentages of students reaching the international benchmarks for mathematics achievement by state, Year 4

Source: Sue Thomson et al., Highlights from TIMSS and PIRLS 2011 from Australia's perspective, ACER 2012

Figure 2.2.2.

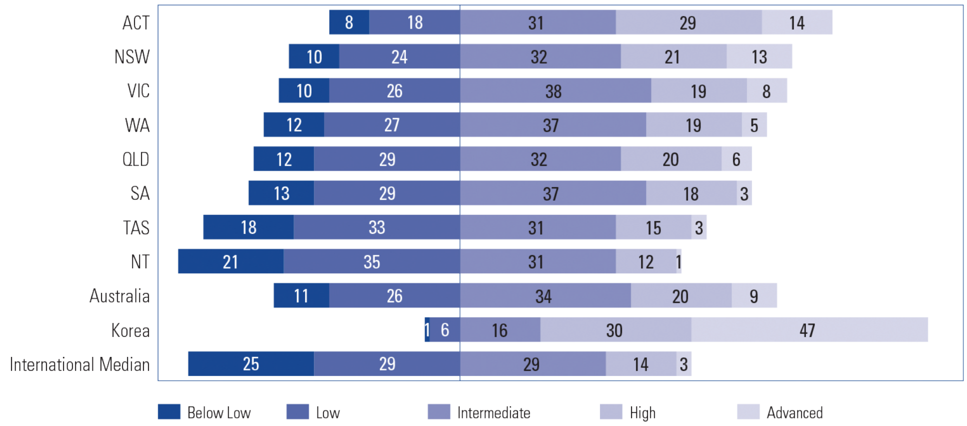


Figure 16 Percentages of students reaching the international benchmarks for mathematics achievement by state, Year 8

Source: Sue Thomson et al., Highlights from TIMSS and PIRLS 2011 from Australia's perspective, ACER 2012

Thirdly, the achievement level of students is also highly correlated with their location: students in metropolitan areas generally perform best; followed by students in provincial, then remote, and then very remote locations. Table 2.2.1. outlines the achievement by geolocation of year 9 students according to the 2013 NAPLAN survey.

Table 2.2.1.

NAPLAN Year 9 Numeracy

Table 9.N5: Achievement of Year 9 Students in Numeracy, by Geolocation, by State and Territory, 2013.

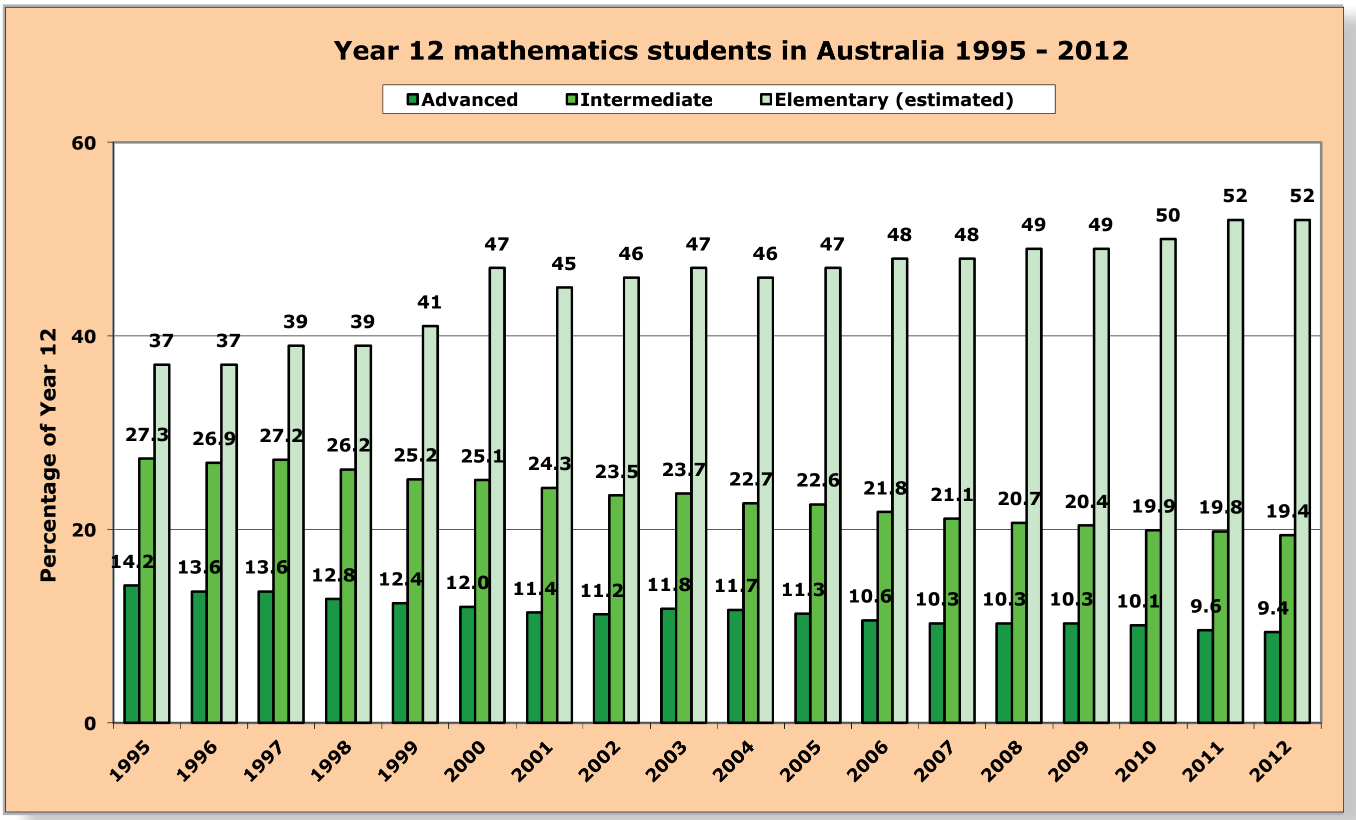
State/ Territory	Geolocation	Mean scale score	Below national minimum standard (%)		At national minimum standard (%)	Above national minimum standard (%)				At or above national minimum standard (%)
			Exempt	Band 5 and below	Band 6	Band 7	Band 8	Band 9	Band 10	
NSW	*Metro*	601.0	1.3	7.0	16.2	22.1	20.7	15.1	17.6	91.7
	Provincial	564.8	1.3	11.6	22.1	26.5	20.8	11.3	6.4	87.1
	Remote	515.8	4.3	29.2	30.6	18.7	11.1	3.9	2.0	66.4
	Very Remote	509.2	1.3	36.0	24.5	15.8	12.3	5.0	5.3	62.8
Vic	*Metro*	593.0	2.2	5.3	15.8	25.4	24.0	15.1	12.1	92.5
	Provincial	574.6	1.9	7.0	19.7	28.9	23.4	12.3	6.8	91.1
	Remote	588.2	0.0	2.4	18.5	35.1	20.5	13.7	9.8	97.6
	Very Remote	-	-	-	-	-	-	-	-	-
Qld	*Metro*	578.9	1.4	7.3	18.9	27.2	23.2	13.6	8.4	91.3
	Provincial	561.8	1.7	9.7	23.6	29.0	21.3	10.3	4.3	88.5
	Remote	526.0	2.2	22.8	28.9	26.3	13.2	4.8	1.7	74.9
	Very Remote	499.5	2.0	40.3	27.6	16.1	10.4	3.0	0.6	57.7
WA	*Metro*	592.7	1.4	6.2	16.1	24.2	23.4	15.8	12.8	92.4
	Provincial	569.4	1.0	9.3	20.9	27.5	22.9	12.1	6.2	89.7
	Remote	544.5	1.4	17.4	24.9	25.6	18.7	8.7	3.3	81.3
	Very Remote	497.1	1.3	42.7	21.1	16.8	11.6	4.5	1.9	56.0
SA	*Metro*	576.0	1.8	7.6	19.8	27.5	22.9	12.8	7.6	90.5
	Provincial	561.6	2.0	8.6	23.5	30.6	22.0	9.4	3.8	89.4
	Remote	561.4	1.3	8.7	22.8	31.8	22.5	9.7	3.3	90.1
	Very Remote	518.5	0.6	28.0	27.3	23.8	13.5	6.5	0.3	71.4
Tas	*Metro*	569.1	1.5	10.4	21.1	26.4	21.6	11.8	7.1	88.1
	Provincial	562.9	1.4	10.7	23.0	27.4	21.4	10.7	5.3	87.8
	Remote	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.
	Very Remote	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.	n.p.
ACT	*Metro*	596.9	1.5	5.5	14.4	24.7	23.9	16.0	13.9	92.9
	Provincial	-	-	-	-	-	-	-	-	-
	Remote	-	-	-	-	-	-	-	-	-
	Very Remote	-	-	-	-	-	-	-	-	-
NT	*Metro*	-	-	-	-	-	-	-	-	-
	Provincial	554.5	2.6	14.1	23.1	27.5	18.2	9.3	5.3	83.3
	Remote	522.6	2.6	30.2	23.3	18.5	14.5	7.7	3.2	67.2
	Very Remote	427.4	3.0	74.4	13.0	5.1	2.0	1.6	0.8	22.6
Aust	*Metro*	591.2	1.6	6.6	16.9	24.7	22.6	14.7	12.9	91.8
	Provincial	566.2	1.6	9.7	21.9	28.1	21.7	11.2	5.7	88.7
	Remote	537.6	2.0	20.2	25.6	25.0	16.8	7.5	2.9	77.8
	Very Remote	478.6	1.9	50.3	21.1	13.6	8.5	3.4	1.2	47.8

Source: NAPLAN, 2013 National Report. page 242

2.3. Student numbers and participation rates

Year 12 mathematics participation rates have been tracked since 1995. The below graph illustrates clearly that the proportion of students choosing intermediate and advanced mathematics subjects is declining.

Figure 2.3.1.



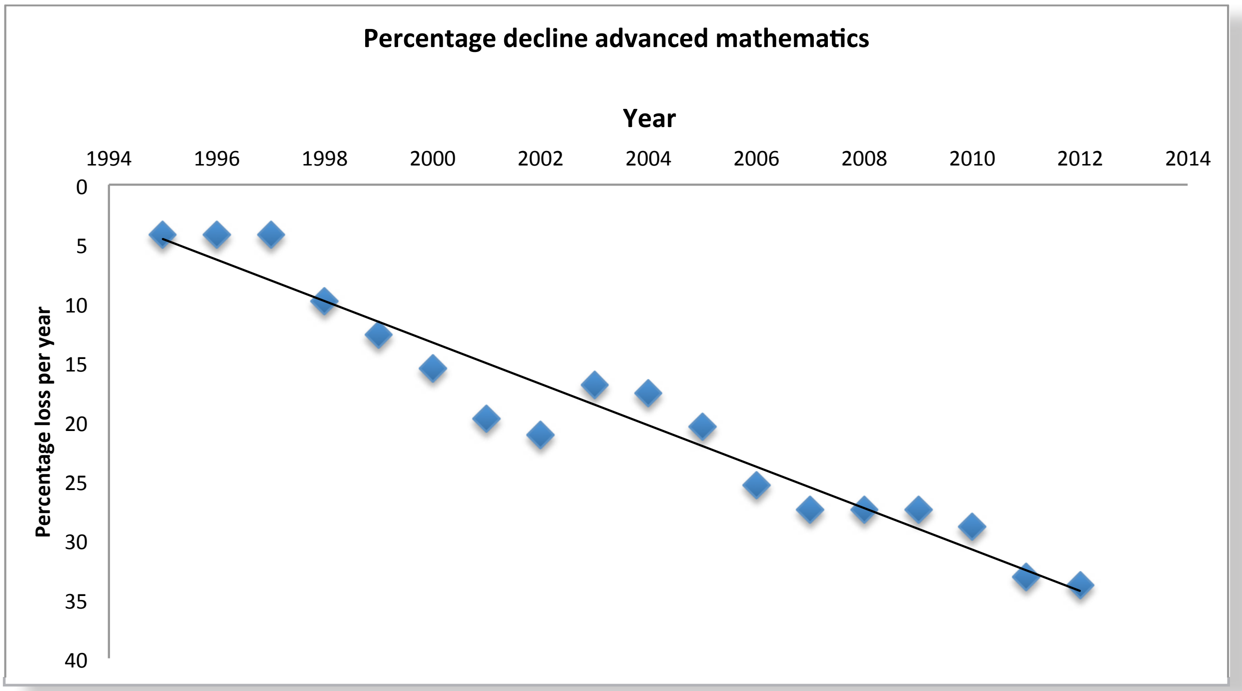
Source: Frank Barrington, Year 12 Mathematics Participation Rates in Australia, data collection provided to AMSI

The above summary includes all Year 12 mathematics students enrolled through the secondary boards of studies and the Australian International Baccalaureate (IB) in all states and territories, for the years 1995 to 2012.

The number of Australian Year 12 students studying advanced mathematics rose from 20,608 in 2011 to 20,786 in 2012. The number of intermediate students (those enrolled in an intermediate mathematics subject but NOT enrolled in an advanced mathematics subject) also rose, from 42,548 in 2011 to 42,689 in 2012. Nonetheless, when measured against the ever-increasing Australian Year 12 population, there is a persistent and ongoing decline in the percentages of Year 12 students taking advanced and intermediate mathematics. In 2012 Year 12 population was just under 220,000, compared with approximately 200,000 in 2007.

The number of elementary mathematics students (those enrolled in an elementary mathematics subject but NOT enrolled in either an intermediate or advanced mathematics subject) increased very slightly between 2011 and 2012 with the proportion remaining at about 52%. The proportion of Australian Year 12 students studying SOME mathematics in Year 12 has remained at about 80% over the past eighteen years; however, it is the level of mathematics studied that has dropped considerably. Figure 2.3.2. below illustrates how large the drop in students studying advanced mathematics has been since 1994: Year 12 advanced maths enrolments have dropped by 22% from 2000 to 2012 and by 34% from 1995 to 2012.

Figure 2.3.2.



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

2.4. Student attitudes towards learning mathematics

Achievement in mathematics (among other things) is related to students' self-confidence and attitude towards learning. Table 2.4.1 below sets out students' attitudes towards mathematics and science in Year 8. According to the TIMSS 2011 results, Australian students' self-confidence, and the value they place on learning mathematics, lie close to the international average. However, Year 8 students in Australia are not as fond of mathematics as their international counterparts; 45% of Australian Year 8 students do not like mathematics, compared to 31% internationally. Australian students do however value mathematics – much more than science, which is valued much less than the international average.

Table 2.4.1. Student attitudes towards mathematics: selection of data from TIMSS 2011

% of students who like science and mathematics						
	Like		Somewhat like		Do not like	
	Science	Mathematics	Science	Mathematics	Science	Mathematics
Australia	25	16	42	40	33	40
International Average	35	26	44	42	21	31
% of students who are confident in science and mathematics						
	Confident		Somewhat confident		Not confident	
	Science	Mathematics	Science	Mathematics	Science	Mathematics
Australia	16	17	49	46	35	37
International Average	20	14	49	45	31	41
% of students who value science and mathematics						
	Value		Somewhat value		Do not value	
	Science	Mathematics	Science	Mathematics	Science	Mathematics
Australia	25	46	31	40	44	14
International Average	41	46	33	39	26	15

Source: TIMSS 2011, selected data from Exhibits 8.1 to 8.5; Sue Thomson et al., Monitoring Australian year 8 student achievement internationally: TIMSS 2011

2.5. Teacher profiles and qualifications

Research has consistently shown that there are not enough teachers qualified to teach mathematics in Australian high schools. The commonly accepted definition of being qualified in a discipline is to have completed methodology training in the area. In 2010, the available data on qualifications of mathematics teachers in secondary education suggested the following (see table 2.5.1.):

- Only 60.4% of Year 7-10 teachers teaching mathematics have completed methodology training in the area, suggesting that nearly 40% of these teachers are not fully qualified. In Years 11-12 this percentage goes down to a (still very significant) 23.7%.
- Only 64.1% of Years 11 and 12 mathematics teachers had at least 3 years tertiary education in the field, down from 68% in 2007.
- Only 45.8% of Years 7 – 10 mathematics teachers had at least 3 years tertiary education, down from 53% in 2007.

Table 2.5.1.

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

Note: 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 2.5.1. does not contain data on science teachers' qualifications in Years 7-10, making a comparison with mathematics teachers difficult. However, data provided by the Queensland Audit office indicate that the shortage of qualified mathematics teachers is much more serious than the shortage of science teachers (see table 2.5.2.). In Years 8-10, 20.3% of teachers teaching science have no specialist qualification, against 36.5% of maths teachers.

Table 2.5.2.

Subject and level		Teachers with no specialist subject area qualification and teaching %
Maths	All maths subjects	33.3
	Years 8–10	36.5
	Mathematics A	32.5
	Mathematics B	12.5
	Mathematics C	8.8
Science	All science subjects	14.5
	Years 8–10	20.3
	Chemistry	9.80
	Physics	17.0
	Biology	7.8

Source: Queensland Audit Office, Supply of specialist subject teachers in secondary schools, Report to Parliament 2: 2013-2014, page 19

Seen from an international perspective the Australian situation looks dismal as well. Compared to the international average of 12%, a staggering 34% of Australian Year 8 students are being taught mathematics by a teacher without a solid mathematical background, according to the 2011 TIMSS survey (Table 2.5.3.). Furthermore, this has an effect on student performance: the average achievement of students in classes with a teacher without a major in either Mathematics or Mathematics education in 2011 was 500 – 5 points lower than the national average achievement of 505 points (see table 2.1.1.), whereas the achievement of students with a teacher with a mathematical background was the same or higher than the national average.

Table 2.5.3. Teachers Majored in Education and Mathematics (8th Grade): extract from TIMSS 2011 Exhibit 7.4

	Major in Mathematics and Mathematics Education		Major in Mathematics Education but no Major in Mathematics		Major in Mathematics but no Major in Mathematics Education		All Other Majors	
	% of students	Average Achievement	% of students	Average Achievement	% of students	Average Achievement	% of students	Average Achievement
Australia	37	505	9	522	21	519	34	500
International Average	32	471	12	470	41	468	12	462

Source: TIMSS 2011 Exhibit 7.4: Teachers Majored in Education and Mathematics

Teacher-training levels differ significantly between metropolitan, provincial and remote areas (see table 2.5.4.). The percentage of teachers with three years or more tertiary education in mathematics in Years 7 to 10 is 45% in metropolitan areas. This falls to 37% and 40% in provincial and remote areas respectively. For Years 11 and 12, 57% of teachers in provincial and 43% in remote areas have comparatively less tertiary education background in mathematics, compared to their counterparts in metropolitan areas with 64%. In the other sciences depicted in this table, only biology shows a good supply of qualified teachers – unfortunately very few biology teachers are also qualified to teach mathematics.

Table 2.5.4.

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

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

Studies have shown that available teaching positions in mathematics are more likely to remain unfilled than any other teaching positions. In 2007, 10% of schools reported at least one unfilled vacancy for a mathematics teacher at the start of the school year, increasing to 13% at the time of the survey (the survey being conducted between August and December of the same year), see table 2.5.5. In 2010, this situation seemed to have improved as at the start of the school year, 8.3% of schools reported at least one vacancy in mathematics, decreasing to 7.6% at the time of the survey. However, the amount of unfilled vacancies was roughly the same in 2007 and 2010, and compared to other subjects mathematics teaching positions remained the most difficult to fill in both years.

Table 2.5.5.

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

The difficulty in filling these vacancies leads to teachers teaching outside their field of expertise; retired teachers being hired on short-term contracts; or, in acute shortages, teachers not fully qualified in subject areas being recruited to teach these subjects. Note that there are significant differences in the prevalence of teacher shortages as well as the strategies to deal with shortages, between government, catholic and independent schools (see table 2.5.6). Teaching out-of-field and recruiting not fully qualified teachers are the most prevalent solutions in catholic schools; principals in government schools mostly opt for teaching out-of-field and recruiting retired teachers on short-term contracts. Over half of independent schools do not report having recent teacher shortages; of those who do, the most popular solutions are recruiting retired teachers as well as combining classes within subject areas. Teaching out-of-field is much less prevalent in independent schools.

Table 2.5.6.

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

	Secondary			
Which of the following strategies do you use to deal with teacher shortages at your school?	**Govt %**	**Cath %**	**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

It is also interesting to note that compared to the international average, students in Year 8 are being taught mathematics by teachers who are less than satisfied with their career.

Table 2.5.7. Teacher Career Satisfaction in 8th Grade: extract from TIMSS 2011 Exhibit 7.16

	Satisfied		Somewhat satisfied		Less than satisfied	
	% of students	Average Achievement	% of students	Average Achievement	% of students	Average Achievement
Australia	42	516	43	505	15	487
International Average	47	473	45	464	7	462

Source: TIMSS 2011 Exhibit 7.16: Career Satisfaction in 8th Grade

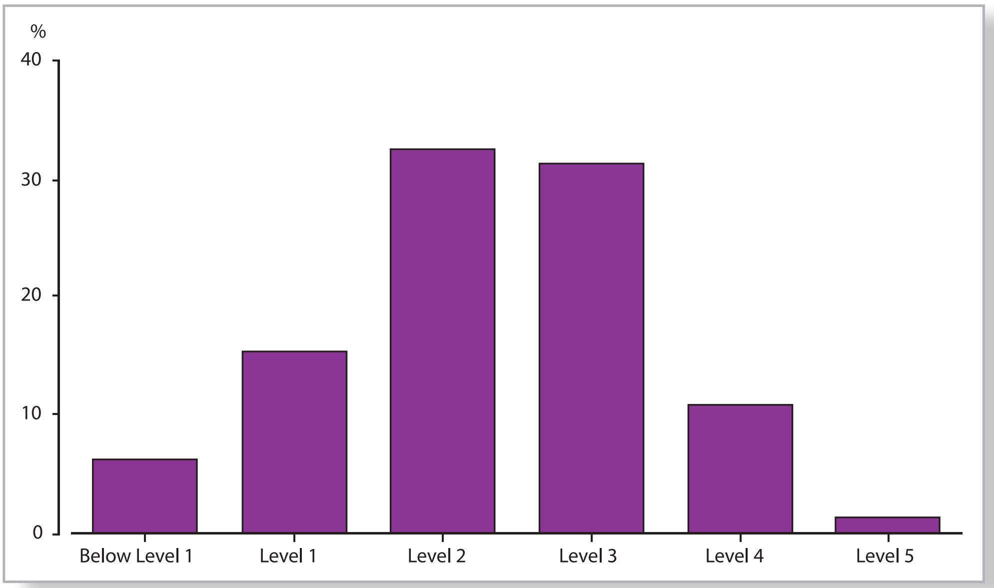
2.6. Adult Numeracy

According to the Programme for the International Assessment of Adult Competencies (PIAAC), the numeracy skills of just over half the Australian population (53.5%) falls at level 2 or below. The IPAAC has a scale with six levels – level 5 the highest and below level one the lowest.

Tasks that fall in level two are: calculation with whole numbers and common decimals, percentages and fractions, and the interpretation of relatively simple data and statistics in texts, tables and graphs. This means that most Australian adults only have basic numeracy skills at best.

On a positive note, 31% (5.2 million) of the Australian population has a numeracy level at Level 3, 11% (1.8 million) at Level 4 and 1.4% (230,000) at Level 5. Also, seen in an international context, the Australian adult numeracy levels are slightly lower, but very close to the international average.

Figure 2.6.1. Proportion of Australian population at each numeracy level 2011–12



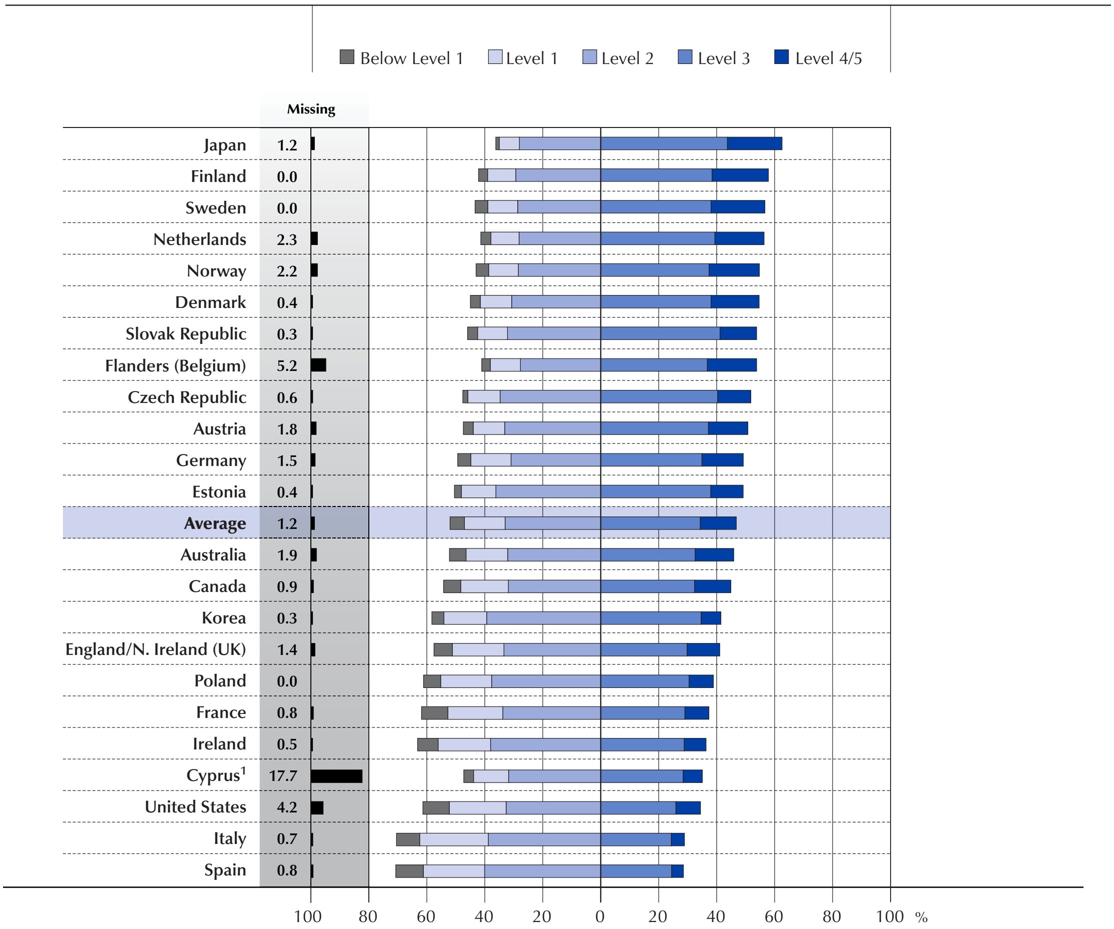
Source: ABS, Programme for the International Assessment of Adult Competencies, Australia, 2011-2012

Figure 2.6.2.

■ Figure 2.5 ■

Numeracy proficiency among adults

Percentage of 16-65 year-olds scoring at each proficiency level in numeracy



1. See notes at the end of this chapter.

Notes: Adults in the missing category were not able to provide enough background information to impute proficiency scores because of language difficulties, or learning or mental disabilities (referred to as literacy-related non-response).

Countries are ranked in descending order of the combined percentage of adults scoring at Level 3 and Level 4/5.

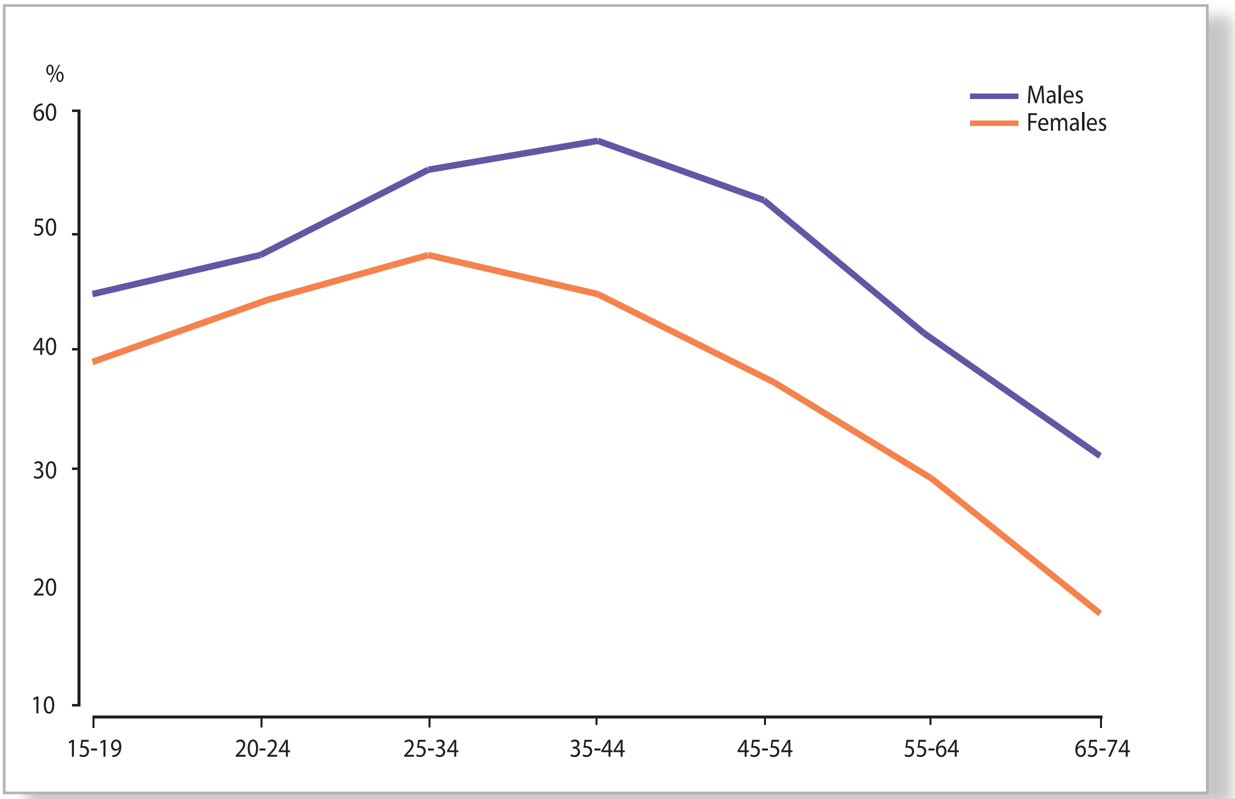
Source: Survey of Adult Skills (PIAAC) (2012), Table A2.5.

StatLink http://dx.doi.org/10.1787/888932900479

Source: OECD Skills Outlook 2013, First results from the Survey of Adult Skills (Programme for the International Assessment of Adult Competencies), page 75

Numeracy competency is very closely related to age and gender, see figure 2.6.3.; numeracy skills tend to drop after reaching a peak in the 35-44 years age group, and are at their lowest in people of retirement age (65 years and over). There are also significant gender differences in numeracy skills in the general population.

Figure 2.6.3. Proportion at numeracy level 3 or above, by sex and age group 2011–12



Age group (years)
Source: ABS, Programme for the International Assessment of Adult Competencies, Australia, 2011-2012

3. Higher education

3.1. Staffing at mathematics departments

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

	2013				
	Teaching only	Research only	Teaching & Research	All Staff	Average number of staff members
Total Go8*	18.8	147.52	203.4	369.72	52.82
Total non Go8 AMSI members	33.3	64.2	255	352.5	22.03
Total non Go8 non-AMSI members	9.8	2	34.05	45.85	4.59
Total all universities	61.9	198.72	460.45	721.07	21.85

* 7 out of 8 of the Group of Eight Universities have participated in the AMSI Member Survey 2013
Source: AMSI Member Survey 2013, preliminary results

In 2013, participating mathematical sciences departments in Australia (AMSI members as well as non-member departments) reported employing slightly over 721 staff (in FTE) in 2013 (See table 3.1.1.). Overall staff numbers in universities who have participated in both surveys (the 2012 survey also covered 2011) have been stable between 2012 and 2013, albeit with changes in the staff composition (table 3.1.2.). The average number of staff in mathematics and statistics departments in 2013 was 21.85 – but the average number of staff differs greatly between Group of Eight universities and non-Group of Eight universities, as well as between AMSI member and non-member universities (see table 3.1.1.).

Table 3.1.2. AMSI Member Survey: number of staff reported at universities who participated in both the 2012 and the 2013 survey

	2011				2012				2013			
	Teaching only	Research only	Teaching & Research	All Staff	Teaching only	Research only	Teaching & Research	All Staff	Teaching only	Research only	Teaching & Research	All Staff
Total all universities who participated in both surveys	19.3	183.45	438.6	641.35	23.3	217.62	429.55	670.47	52.1	196.72	421.4	670.22

*The 2012 AMSI Member Survey covered both 2011 and 2012.
Source: AMSI Member Survey 2012 and 2013, preliminary results

Figure 3.1.1.

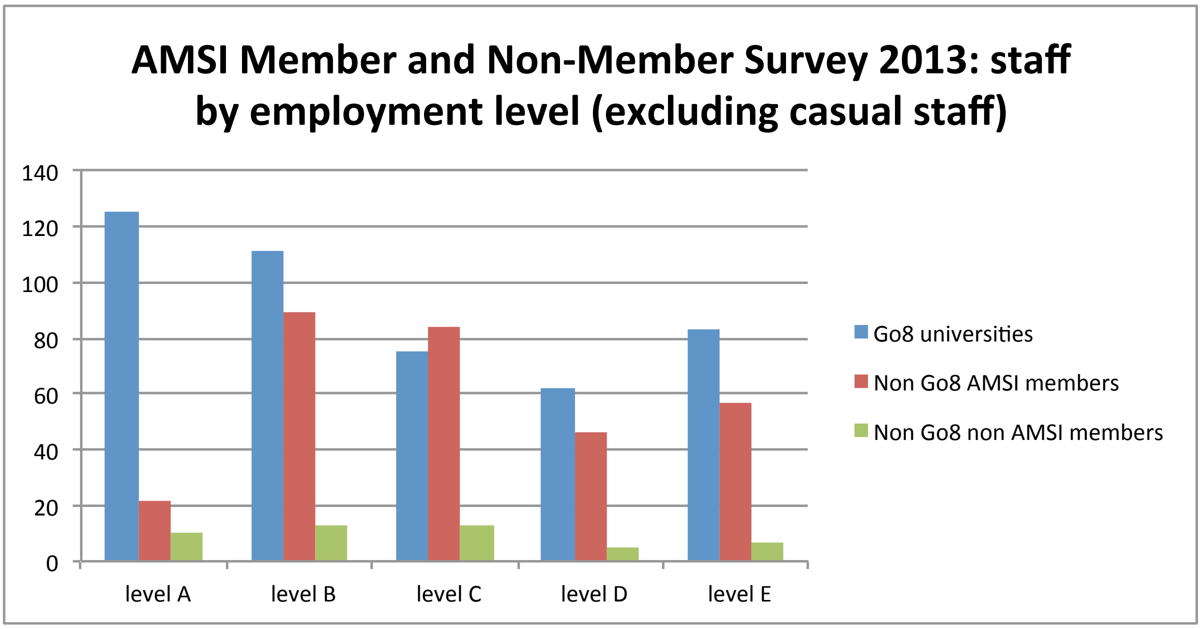
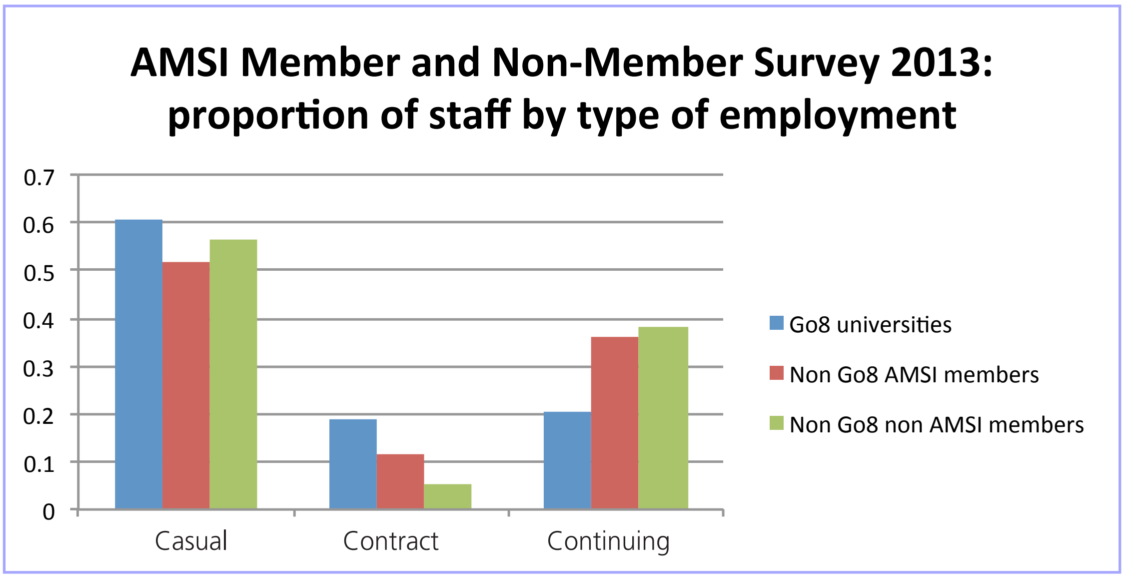


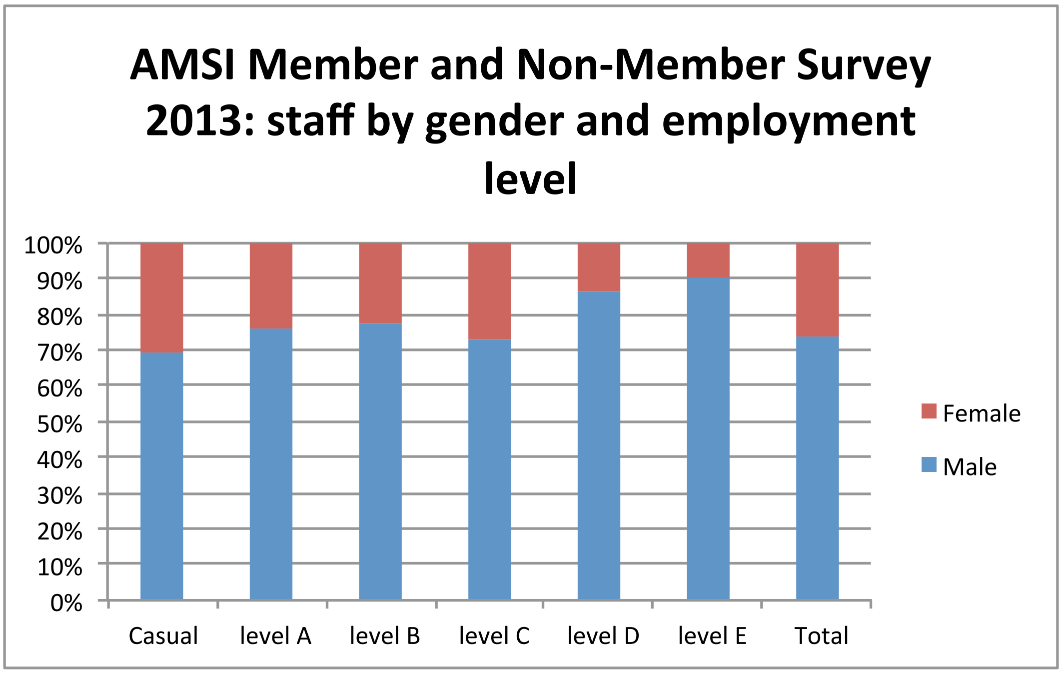
Figure 3.1.1. shows that the staffing profile is slightly "top-heavy" with a relatively large number of staff employed at level E, and a low level of employment at the entry level A at the non Go8 universities. The Go8 universities employ many more junior researchers at level A – a function of the much higher ARC research revenue that they generate.

Figure 3.1.2.



Maths departments employ casual staff in large numbers (see figure 3.1.2.). There is a substantial difference between the numbers of staff on fixed-term contracts between Group of Eight and non-Group of Eight universities; this is, of course, a consequence of the higher number of research-only staff at Group of Eight universities.

Figure 3.1.3.



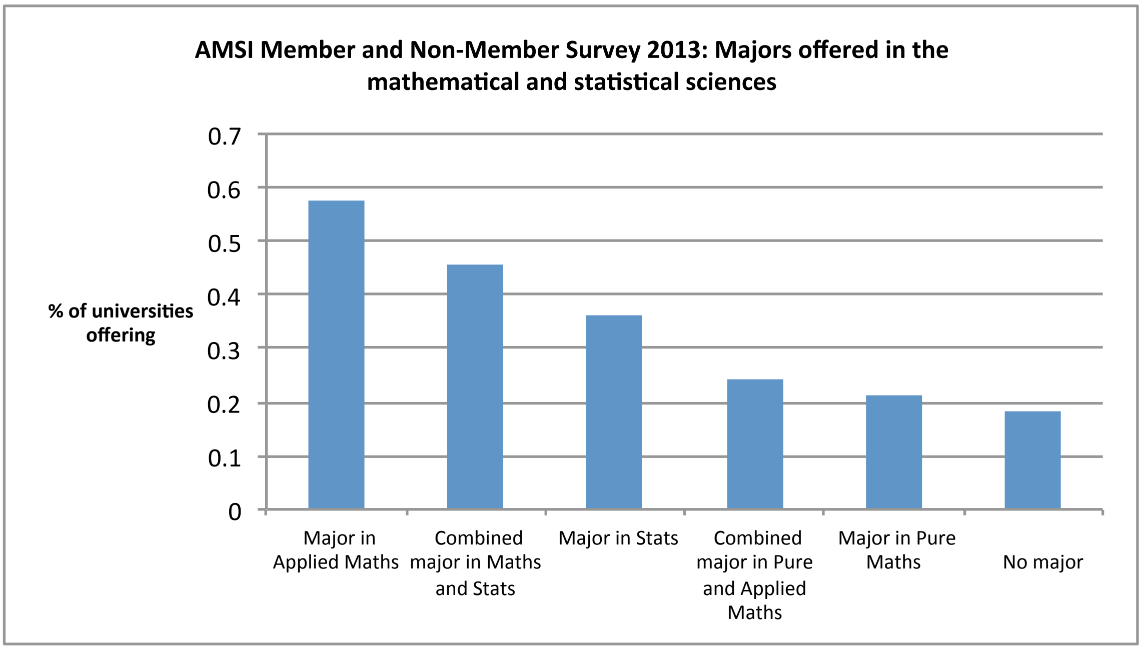
Source: AMSI Survey 2013, preliminary results

It is clear from figure 3.1.3. that the academic workforce is predominantly male, and that the proportion of females reduces with the level of seniority. In 2013, about 30% of reported casuals were female which decreased to 24% at level A, 22.5% at level B, and only rose at level C with 27%. This drops significantly to 13% at level D and 10% at level E. Overall, only 26% of the academic workforce in mathematics and statistics is female.

3.2. Mathematics teaching at universities

In 2013, the most prevalent major offered to mathematical and statistical science students was in Applied Mathematics, which was offered by 58% of all surveyed universities. Second most prevalent is a combined major stream in Mathematics and Statistics (45%), followed by a major in Statistics (36%). Of the 33 departments providing data for this survey, 6 departments – mostly small departments in non-AMSI member universities - reported not offering a major at all in the mathematical and statistical sciences.

Figure 3.2.1.



Source: AMSI Member and Non-Member Survey 2013

Mathematics is an essential element of many disciplines and mathematics departments supply service teaching to many other departments and faculties. According to the table below, mathematical sciences (including statistics) are the second most important service discipline after biological sciences. They supply to disciplines as varied as IT, Engineering, Agriculture and Environment, Health, Society and Culture and Management.

Figure 3.2.2.

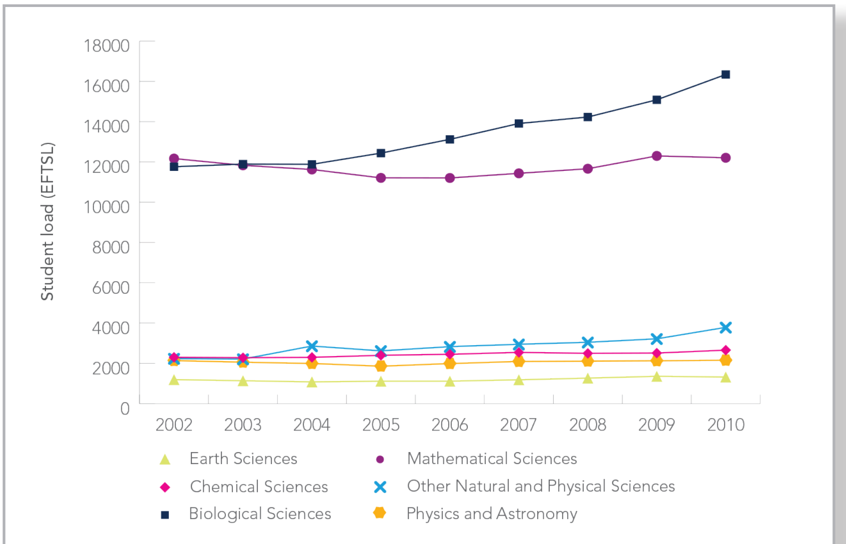
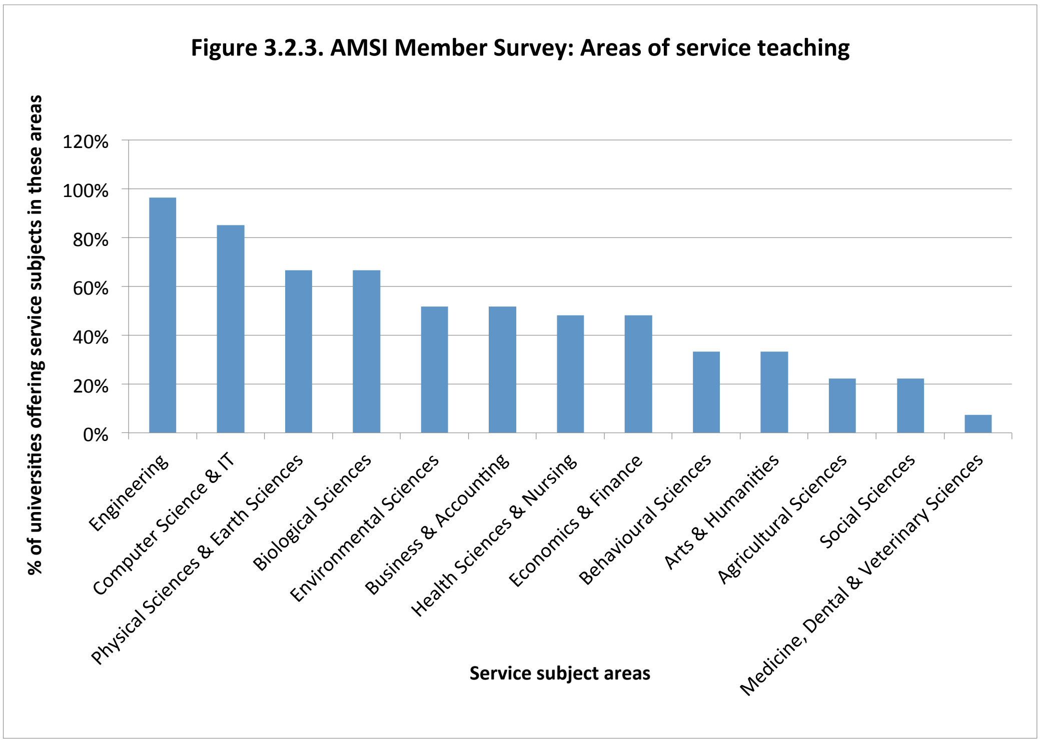


Figure 4.4.16 Undergraduate science service teaching: narrow disciplines

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

All mathematics departments of member universities who responded to this question supplied service teaching to other disciplines in 2013 (see Figure 3.2.3.). Most departments supplied teaching to at least 2 or 3 other areas; some even offer teaching to up to 12. The average number of subject areas serviced by mathematics departments is 6.4. Engineering, Computer Science and IT, Biological Sciences and Physical and Earth Sciences are the most serviced disciplines.



Source: AMSI Member Survey 2012 and 2013

Table 3.2.1. AMSI Member Survey: Teaching by academic and casual staff in 2013

	tutorial hours all staff	tutorial hours casual staff	% of total taught by casuals
Average Go8 universities	250.76	168.34	67.13%
Average non Go8 universities	84.97	60.28	70.95%
Average all universities	135.42	93.17	68.80%

	lecture hours all staff	lecture hours casual staff	% of total taught by casuals
Average Go8 universities	109.03	3.85	3.53%
Average non Go8 universities	56.51	7.92	14.02%
Average all universities	72.50	6.68	9.22%

Source: AMSI Member Survey 2013, preliminary results

According to the data in table 3.2.1., casual staff perform the majority of tutorial teaching. There has been a slight increase in these numbers from 2012 (64.34%) to 2013 (68.80%). The proportion of lecture teaching by casuals also increased very slightly, from 8.94% in 2012 to 9.22% in 2013.

3.3. Student numbers

3.3.1. Undergraduate enrolments and completions

Table 3.3.1.1. AMSI Member Survey: Undergraduate enrolments in 2013 (in EFTSL)

	2013		
	3rd year	2nd year	1st year
Total Go8 universities	619.15	1703.86	3969.33
Total non Go8 universities	333.2595	1062.24	2892.053
Total all universities	952.445	2766.1	6861.383

Source: AMSI Member Survey 2013, preliminary results

In 2013, first year mathematics subjects accounted for about 6,800 EFTSL. For second year this dropped to around 2,700 EFTSL and plummeted to approximately 950 in third year subjects – figures provided by the AMSI member universities. The average number of enrolments per university in the period 2011-2013 has seen an increase overall, especially in first and second year.

Table 3.3.1.2. AMSI Member Survey: Average number of undergraduate enrolments in EFTSL 2011-2013

	2011	2012	2013
1st year			
Average Go8	551.23	539.54	567.05
Average non Go8 universities	166.69	165.68	222.47
Average all universities	294.87	290.30	343.07
2nd year			
Average Go8	229.36	247.02	243.41
Average non Go8 universities	66.09	87.44	81.71
Average all universities	120.51	140.63	138.31
3rd year			
Average Go8	79.35	85.83	88.45
Average non Go8 universities	79.02	30.00	25.64
Average all universities	45.80	48.61	47.62

Source: AMSI Member Survey 2012 and 2013, preliminary results

Interestingly, an increase in enrolment does not seem to have led to an increase in average undergraduate student load per teaching staff. If the number of staff has remained fairly stable, it is likely that casual staff did more of the teaching in 2013.

Table 3.3.1.3. AMSI Member Survey: Total undergraduate load in EFTSL per EFT teaching staff (excluding casuals) 2011-2013

	2011	2012	2013
Average Go8	24.14	25.10	25.96
Average non Go8 universities	27.94	27.38	25.16
Average all universities	26.71	26.65	25.46

Source: AMSI Member Survey 2012 and 2013, preliminary results

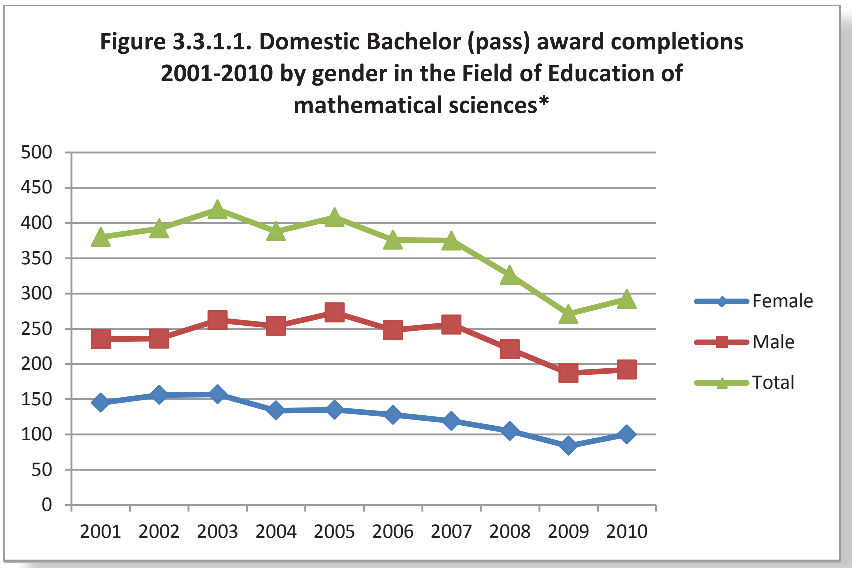
In 2013, a significant number of universities reported difficulties in obtaining reliable undergraduate enrolment numbers (other than in EFTSL). In the universities who were able to report undergraduate student numbers, an estimated 32,000 students enrolled in one or more undergraduate mathematics subjects. Keeping in mind that not all participating universities were able to provide a breakdown of male/female or domestic/international numbers (or both), the male/female distribution among mathematics students is roughly 70:30. The proportion of international students in 2013 was nearly 19%.

Table 3.3.1.4. AMSI Member Survey: Undergraduate student profile (in absolute numbers) by gender and domestic/international status

	Enrolment numbers (all)	Male %	Female %	Domestic %	International %
Total Go8 universities	20,113	69.02%	30.98%	80.59%	19.41%
Total non Go8 universities	11,988	71.63%	28.37%	84.71%	17.71%
Total all universities	32,101	69.99%	30.01%	82.11%	18.78%

Source: AMSI Member Survey 2013, preliminary results

Due to the important part played by service teaching in mathematical sciences, it is clear that a large number of Australian students complete at least some mathematics and statistics subjects during their studies. However, the number of students who complete a bachelor degree in mathematical sciences is substantially lower. According to DEEWR data, the number of domestic graduates in mathematical sciences has declined – see table below. The bachelor graduate figures in the table below are not quite accurate, 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, it identifies a worrying trend.



*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

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: mathematics (%)	42.8	50.3	**45.3**
Available for full-time employment: chemistry (%)			**36.8**
Available for full-time employment: computer science (%)			**76.6**
Available for full-time employment: accounting (%)			**79.3**
Available for full-time employment: all fields of education (%)			**64.7**
In further full-time study: mathematics (%)	44.8	32.7	**40.7**
In further full-time study: chemistry (%)			**52.9**
In further full-time study: computer science (%)			**10.8**
In further full-time study: accounting (%)			**8.1**
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: chemistry (%)	66.4	71.6	**68.8**
In full-time employment: computer science (%)	73.6	71.4	**73.3**
In full-time employment: accounting (%)	78.6	79.5	**79.1**
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

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

Compared to other areas of study, a very high percentage of bachelor graduates in the mathematical sciences do not make themselves available for full-time employment, but proceed to further full-time study (males significantly more so than females). The 2010 figures, in table 3.3.2.1. above, indicate that approximately 45% of graduates were available for full-time employment after finishing their degree. Of those who sought full-time employment 66.8% were employed within four months of graduating – a relatively low percentage compared to other disciplines – which is probably why the percentage of graduates proceeding to further study is relatively large. For accounting and computer science graduates it appears to be much easier to find a job with a bachelor degree only – which is probably why a much lower percentage of these graduates go on to further study.

In 2013, the numbers of mathematics graduates who continued with further study after completing a bachelor degree was again almost double that of other disciplines – just under 40%. The National Graduate Survey found that of the students available for fulltime employment 67.2% were employed. Looking at the rate of employment of bachelor graduates across all disciplines this number was 71.3%. (Source: Graduate Careers Australia, GradStats 2013 and GradFiles 2012)

In 2013, the average starting salary for mathematics bachelor graduates was $55,000.

3.3.3. Honours and Higher Degree enrolments and completions

Table 3.3.3.1. AMSI Member Survey: Honours and Higher Degree enrolments in 2013

	PhD	Masters by Coursework	Masters by Research	Honours
Total Go8 universities	254.66	111.87	26.75	91.85
Total non Go8 universities	228.292	254.95	20.9	66
Total all universities	482.952	366.82	47.65	157.85

Source: AMSI Member Survey 2013, preliminary results

The substantial increase in enrolment numbers in masters-by-coursework degrees in 2013 (see table 3.3.3.2.) can be attributed to some universities replacing honours degrees with masters-by-coursework degrees – this move has proved popular with students. If we take into account the lower response rate for the 2013 survey, honours enrolments, on average, have not seemed to decline. Total enrolments (in EFTSL) in masters-by-research remained low in 2013 and PhD enrolments remained steady.

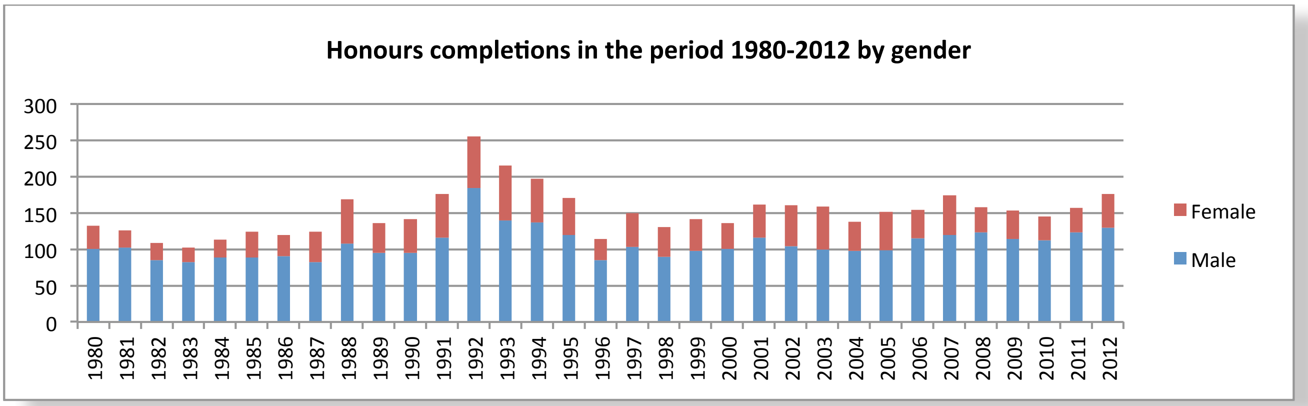
Table 3.3.3.2. AMSI Member Survey: average Honours and Higher Degree enrolment numbers 2011-2013

	2011	2012	2013
Honours			
Average Go8	14.94	14.19	13.12
Average non Go8 universities	2.88	3.30	4.13
Average all universities	6.45	6.52	6.86
Masters by Coursework			
Average Go8	19.57	19.41	15.98
Average non Go8 universities	8.01	9.15	15.93
Average all universities	11.13	11.91	15.95
Masters by Research			
Average Go8	4.48	3.58	3.82
Average non Go8 universities	1.32	1.37	1.31
Average all universities	2.25	2.02	2.07
PhD			
Average G08	35.18	37.41	36.38
Average non Go8 universities	13.39	14.71	14.27
Average all universities	19.85	21.01	21.00

Source: AMSI Member Survey 2012 and 2013, preliminary results

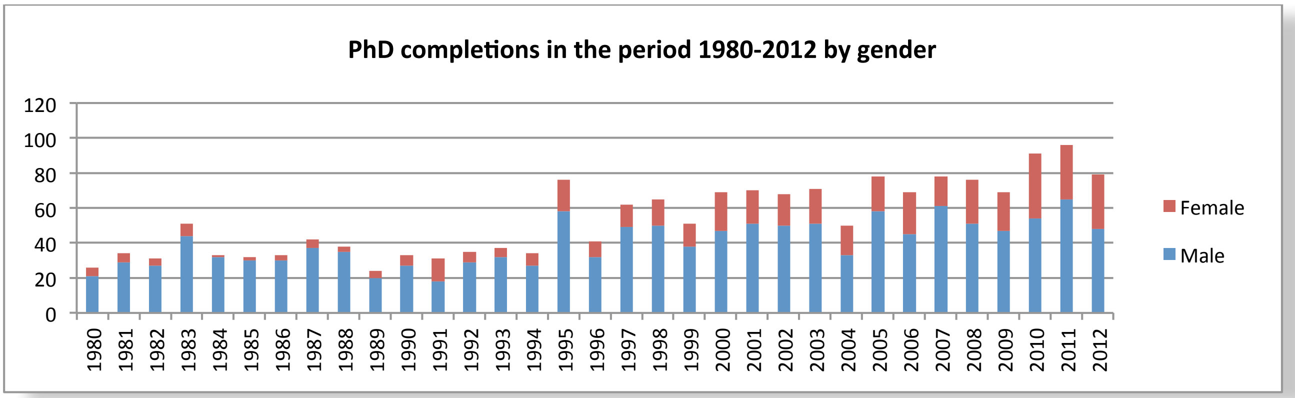
Peter Johnston at Griffith University has, on behalf of the Australian Mathematical Society, assembled longitudinal data on honours degree completions in Australia for many years. Despite spikes upwards and downwards, completions in mathematics and statistics have been fairly stable since 1980. There has been a rise in honours completions over the past three years. (Please note that, for the time being, the two-year coursework Masters degree offered at Melbourne University have been merged with the Honours data). The proportion of females completing honours degrees had increased slightly since 1980 but has not been impressive in the last few years: in the 1980s the average proportion of females completing an honours degree was 25.79%, in the 1990s this increased to 30.93%, levelling off to 29.39% in the first decade of this century. However, in the period 2010-2012 the proportion of female honours completions decreased to a disappointing 23.52%.

Figure 3.3.3.1



Source: Peter Johnston, Higher Degrees and Honours Bachelor Degrees in mathematics and statistics, data collection provided to AMSI

Figure 3.3.3.2



Source: Peter Johnston, Higher Degrees and Honours Bachelor Degrees in mathematics and statistics, data collection provided to AMSI

Though PhD completions fell between 2011 and 2012, the long-term trend has been an increase. The proportion of females completing a PhD has increased markedly in the last thirty years. In the 1980s, the average proportion of females completing a PhD in mathematics and statistics was only 11.54%; in the 1990s this rose to 22.65%, and in the first decade of this century 29.38% of PhD graduates was female. In the years 2010-2012 the average female proportion rose to 37.40%.

The AMSI Member Survey 2013 results indicate that the number of PhD completions will rise again in 2013. Reported new PhD commencements were slightly down from 2012.

Table 3.3.3.3. AMSI Members Survey: PhD commencements and completions in 2012 and 2013

	PhD commencements		PhD completions	
	2012	2013*	2012	2013*
Total Go8 universities	87	76	42	55
Total non Go8 universities	66	68	35	50
Total all universities	153	144	77	105

* respondents were asked for projected 2013 figures at the time of data collection
Source: AMSI Member Survey 2013, preliminary results

Table 3.3.3.4. AMSI Member Survey: Honours and Higher Degree student profile in 2012 and 2013 by gender and domestic/international status

	2012		2013	
	Female%	**International%**	**Female %**	**International %**
Honours				
Go8 universities	22.32%	5.36%	25.96%	5.77%
non Go8 universities	33.33%	9.72%	26.74%	8.14%
Total member universities	26.63%	7.07%	26.32%	6.84%
Masters by Coursework				
Go8 universities	35.42%	32.74%	29.79%	37.76%
non Go8 universities	28.2%	44.58%	40.38%	37.85%
Total member universities	32.65%	37.76%	34.91%	37.80%
Masters by Research				
Go8 universities	29.27%	14.63%	20.45%	2.27%
non Go8 universities	25.93%	40.74%	28.00%	44.00%
Total member universities	26.94%	25.00%	23.19%	17.39%
PhD				
Go8 universities	26.85%	26.30%	26.83%	28.35%
non Go8 universities	39.36%	46.45%	41.59%	45.13%
Total all universities	32.30%	35.09%	32.85%	35.20%

Source: AMSI Member Survey 2013, preliminary results

The numbers in table 3.3.3.4. above clearly show that there are significantly more males pursuing honours and higher degree courses than females. Interestingly the percentage of females at non-Go8 universities is significantly higher. As expected, international student enrolments are highest for MA and PhD degrees. Over 35% of PhD enrolments, and 37% of Masters by Coursework enrolments come from international students.

3.3.4. International comparison of enrolment and graduation figures

Entry and graduation in mathematical sciences university degrees is very low in Australia. According to 2009 OECD data (see table 3.3.4.2.) the percentage of graduates in mathematical university degrees was roughly half 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. The 2011 OECD data again confirmed the low figures (table 3.3.4.1.). In fact, the number of entrants into a university mathematical degree in Australia was so low it was deemed negligible – i.e. less than 0.5% (which does need to take into account that Australia does not have "vocational" tertiary type b programmes in mathematical sciences)

Table 3.3.4.1.

Education at a Glance 2013 - © OECD 2013

EXTRACT from Table C3.3a Distribution of tertiary new entrants, by field of education (2011)

OECD	Note	Engineering and construction	Sciences	Life sciences	Physical sciences	Mathematics and statistics	Computing
Australia	1	9	**12**	4	2	n	4
Denmark		12	8	1	1	1	4
Finland	2	25	9	1	3	1	4
Germany	2	**16**	13	2	4	2	4
Ireland	2	11	**15**	4	2	n	6
New Zealand		6	16	5	3	3	6
Sweden		19	11	2	2	2	5
United Kingdom		8	**14**	5	4	**2**	4
OECD average		**15**	**10**	**2**	**2**	**1**	**4**
EU21 average		**15**	**11**	**2**	**2**	**1**	**4**

Note:
1. Exclude tertiary-type B programmes.
2. Exclude advanced research programmes.
n: magnitude is either negligible or zero.

Source: selected data extracted from Education at a Glance 2013: OECD Indicators, Table C3.3a (Web only) Distribution of tertiary new entrants, by field of education (2011)

Table 3.3.4.2.

Education at a Glance 2011: OECD Indicators - © OECD 2011
Indicator A4: Which fields of education do students choose?
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)

Looking at gender differences, the data show that the number of males in these fields of study significantly outweighs the number of females. Compared with international figures, the proportion of females awarded a mathematical degree (in Australia) has risen between 2000 and 2010; however it is still lagging behind the OECD average. Note that the table below shows the percentage of qualifications awarded to women (See table 3.3.4.3.).

Table 3.3.4.3.

Education at a Glance 2012 - © OECD 2012
EXTRACT from Table A4.6. Percentage of qualifications awarded to women in tertiary-type A and advanced research programmes, by field of education (2000, 2010)

		2010							2000						
		All fields	Engineering, manufacturing and construction	Science	Life sciences	Physical sciences	Mathematics and statistics	Computing	All fields	Engineering, manufacturing and construction	Science	Life sciences	Physical sciences	Mathematics and statistics	Computing
OECD	Note														
Australia	1	57	24	37	55	48	40	20	56	21	41	55	34	37	26
Denmark		60	32	37	67	38	36	21	49	26	42	60	36	41	22
Finland		60	21	46	76	50	48	28	58	19	46	69	42	46	30
Germany		55	22	44	67	43	61	15	45	20	32	55	27	42	11
Ireland		57	21	42	60	44	31	22	57	24	48	61	44	40	41
New Zealand		61	30	44	59	46	48	24	61	33	45	xc	46	56	33
Sweden		64	29	47	66	48	36	24	59	25	47	61	45	30	41
United Kingdom		55	23	38	51	43	40	19	54	20	44	62	39	38	24
OECD average		**58**	**27**	**42**	**64**	**44**	**46**	**20**	**54**	**23**	**40**	**60**	**40**	**42**	**23**
EU21 average		**60**	**28**	**42**	**67**	**45**	**49**	**19**	**55**	**23**	**40**	**61**	**40**	**44**	**21**

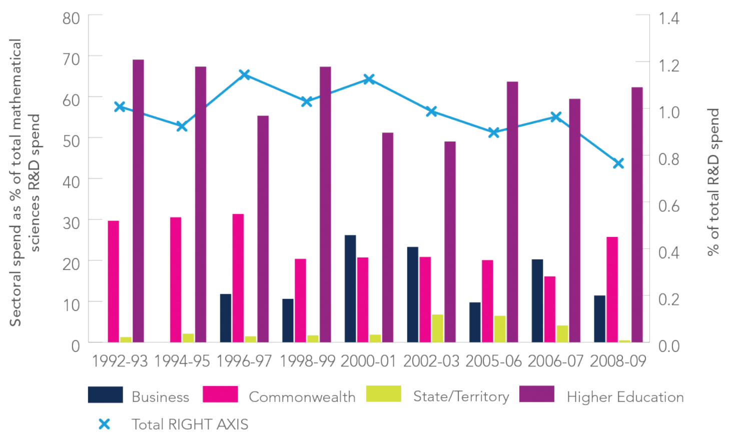
Note:
1. Year of reference 2008.

Source: selected data extracted from Education at a Glance 2012: OECD Indicators, Table A4.6 Percentage of qualifications awarded to women in tertiary-type A and advanced research programmes graduates, by field of education (2000, 2010)

4. Research in the mathematical and statistical sciences

4.1. Research funding

Figure 4.1.1.



Note: Gross expenditure on R&D by sector, 1992–93 to 2008–09.
Source: Data from Australian Bureau of Statistics.

Figure 7.3.5 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

Source: Office of the Chief Scientist, *Health of Australian Science*, May 2012, page 169

In 2008-2009, roughly 0.8% of total spending on research and development was spent on mathematical sciences (figure 4.1.1.); higher education funding is the main source of R&D income, followed by Commonwealth funding – prominently in the form of funding by the Australian Research Council (ARC).

Fortunately, the mathematical sciences have been relatively successful in obtaining ARC funding, most notably for ARC Discovery projects. A few highlights from a summary on ARC support can be found in figure 4.1.2. below.

Figure 4.1.2

TOTAL FUNDING

- From 2001 to 2011, the proportion of total ARC funding awarded to research in the Mathematical Sciences fluctuated from a low of 2.4 per cent in 2004 to a high of 5.9 per cent in 2011.
- The *Discovery Projects* scheme was the most important scheme in terms of funding with 64 per cent of total funding awarded to research projects in the Mathematical Sciences in this period awarded under this scheme

NUMBER OF CONSIDERED PROPOSALS

- From 2001 to 2011, a total of 2155 Mathematical Sciences proposals were submitted for funding under the ARC's funding schemes. The number increased by approximately 135 per cent across the period under consideration, from 138 in 2001 to 324 in 2011.

NUMBER OF FUNDED PROPOSALS

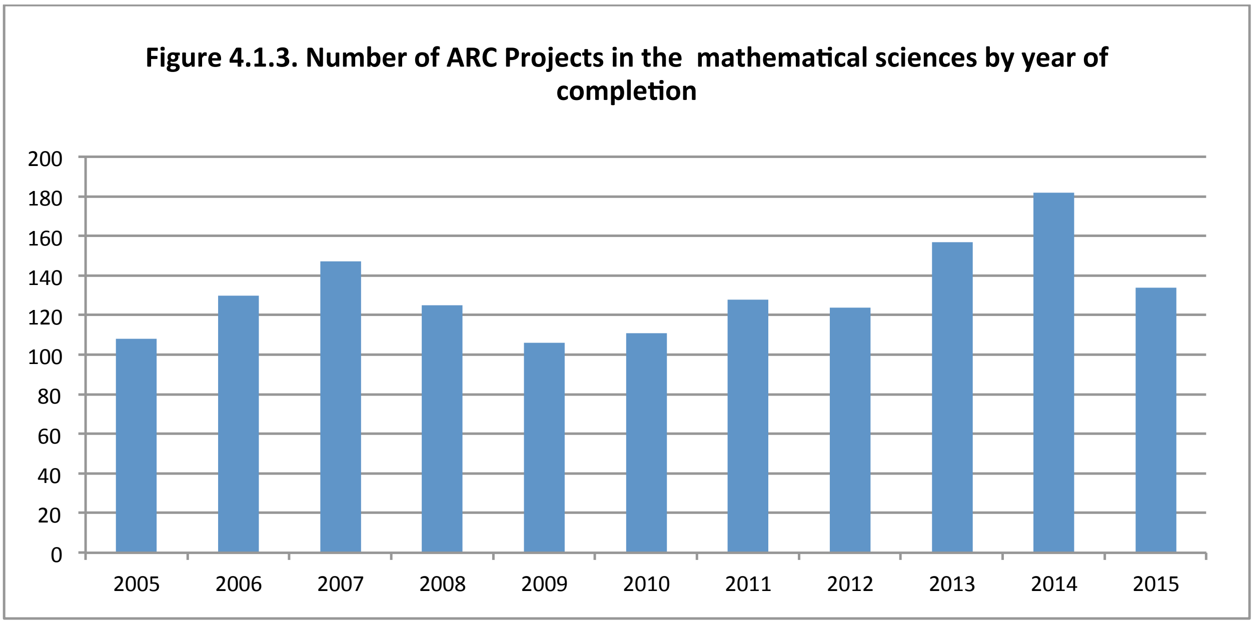
- From 2001 to 2011, the number of proposals funded in the Mathematical Sciences increased by 137 per cent, from 43 proposals in 2001 to 102 proposals in 2011. Between 2010 and 2011 the number increased from 70 to 102 primarily due to proposals funded under the *Future Fellowships* scheme.
- In the three selection rounds conducted under the *ARC Centres of Excellence* scheme (for funding commencing in 2003, 2005 and 2011) only one Centre is recorded as falling directly within the Mathematical Sciences. At least one other Centre, however, identified FoR codes relevant to research in the Mathematical Sciences.

PROPOSAL SUCCESS RATES

- From 2001 to 2011, the success rates of proposals in the Mathematical Sciences were on par with or better than those in Engineering and ICT.
- Under the *Discovery Projects* scheme, the success rate of proposals in the Mathematical Sciences exceeded the overall scheme success rate in all years during the period under consideration.

Source: Australian Research Council, ARC Support for Research in the Mathematical Sciences, a Summary of Trends – Submit Years 2001 to 2011

In comparison with other science fields, in terms of ARC grant success rates, the discipline has held its own and in fact, been relatively successful.



Source: AMSI, based on ARC datasets

The actual distribution of ARC funding among universities is another matter; the Group of Eight (Go8) universities receive the bulk of available funds (see table 4.1.1.).

Table 4.1.1 AMSI Member Survey: Number of grants held and hosted

	Discovery Projects		Linkage Projects	
	2012	2013	2012	2013
Total Go8 universities	138	157	14	12
Total non Go8 universities	41	41	10	6
Total all universities	179	198	24	18

Source: AMSI Member Survey 2013, preliminary results

On average, Go8 universities estimated their success rate in obtaining ARC funding between 2010 and 2012 to be about 34%. Other universities estimated it to be 16%. The Go8 universities are in a position to employ many more research-only staff, a very high proportion of which are employed at level A (see figure 4.1.4).

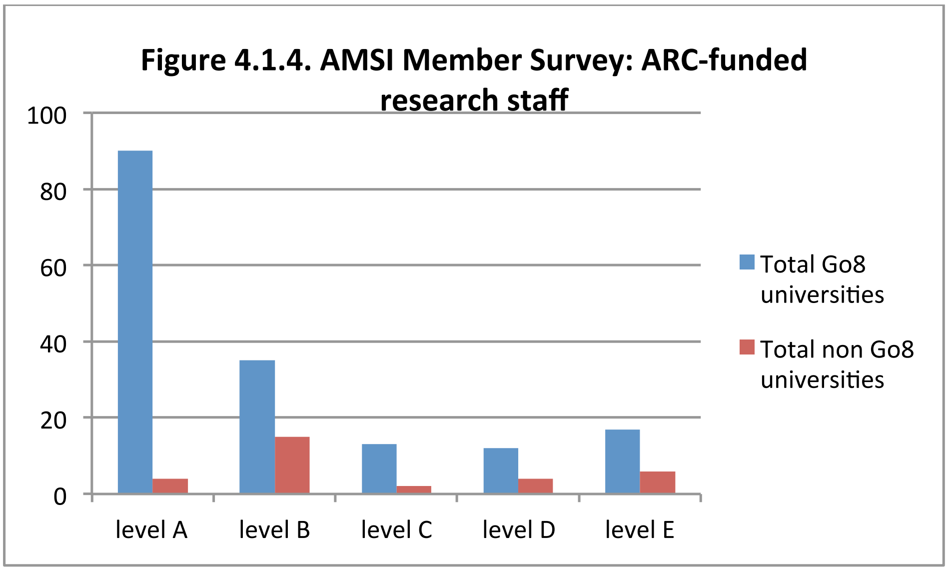
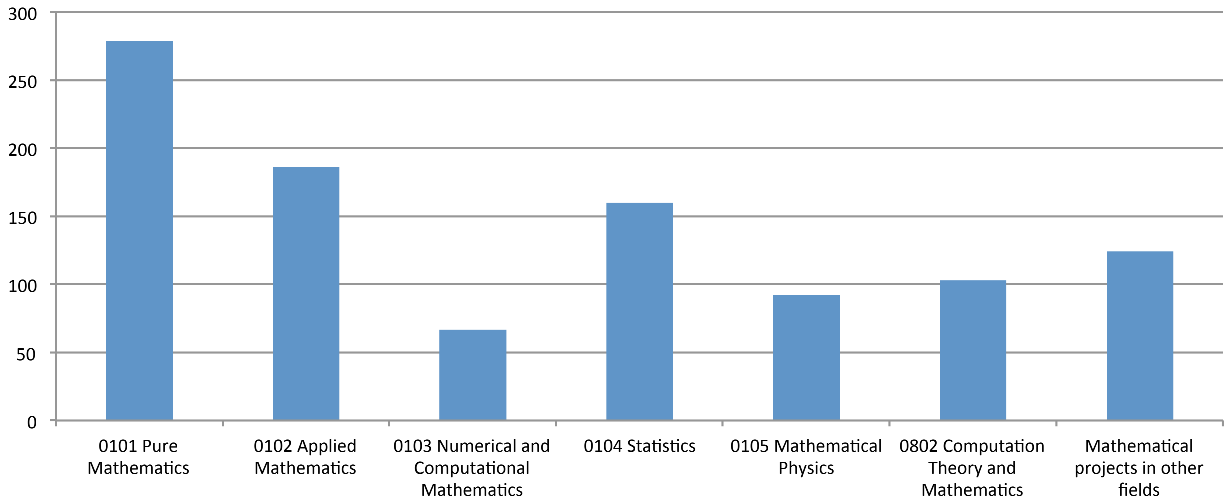


Figure 4.1.5. below shows the areas of ARC research grants given in the mathematics field of research '01' code and also highlights other fields of research given specific funding for their maths component – further details about these classifications and fields of research (FOR) codes may be found in the 2012 ERA Evaluation Handbook. Areas such as education, engineering, physics, biology and chemistry can contain research with a mathematical component – as shown by the final bar.

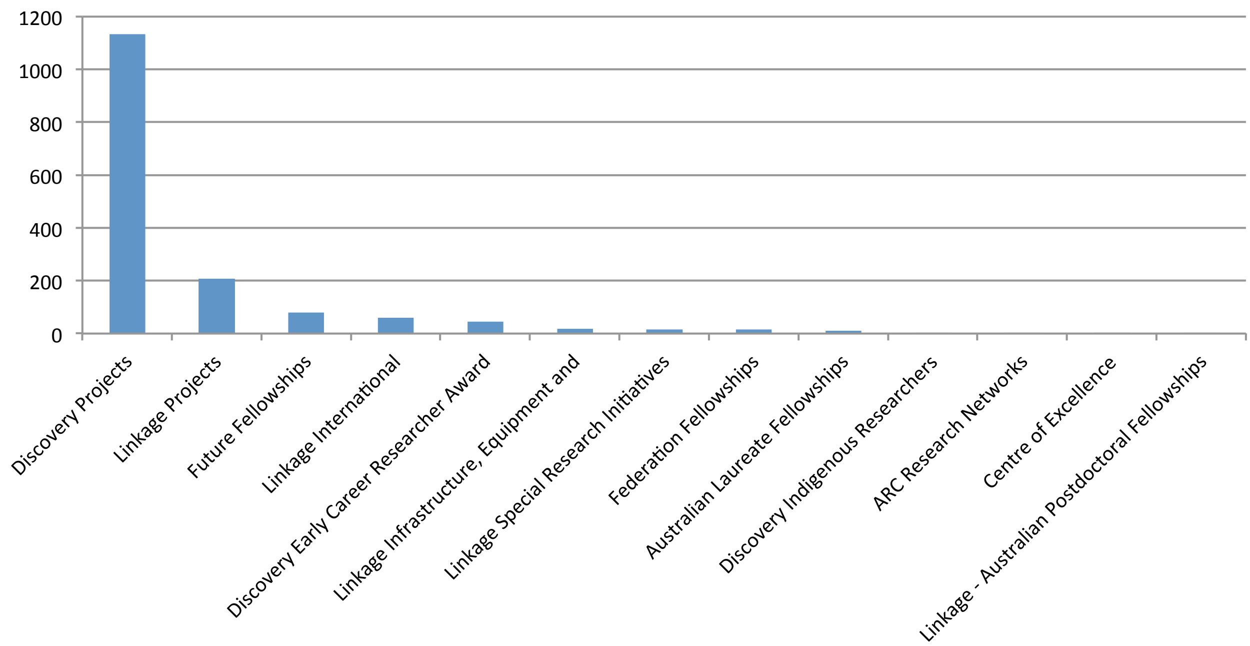
Figure 4.1.5. ARC projects in the period 2002-2017 by 4-digit FOR code



Source: AMSI, based on ARC datasets

Most ARC research funding in the mathematical sciences comes in the form of Discovery Projects (Figure 4.1.6. below). The number of Linkage Projects (joint research projects with industry and other organisations) in the mathematical sciences is surprising at first glance. However, many of these are in education, mathematics and numeracy curriculum and pedagogy. Most others are in the fields of applied mathematics, statistics or computation theory; very few Linkage Projects have a pure mathematics component.

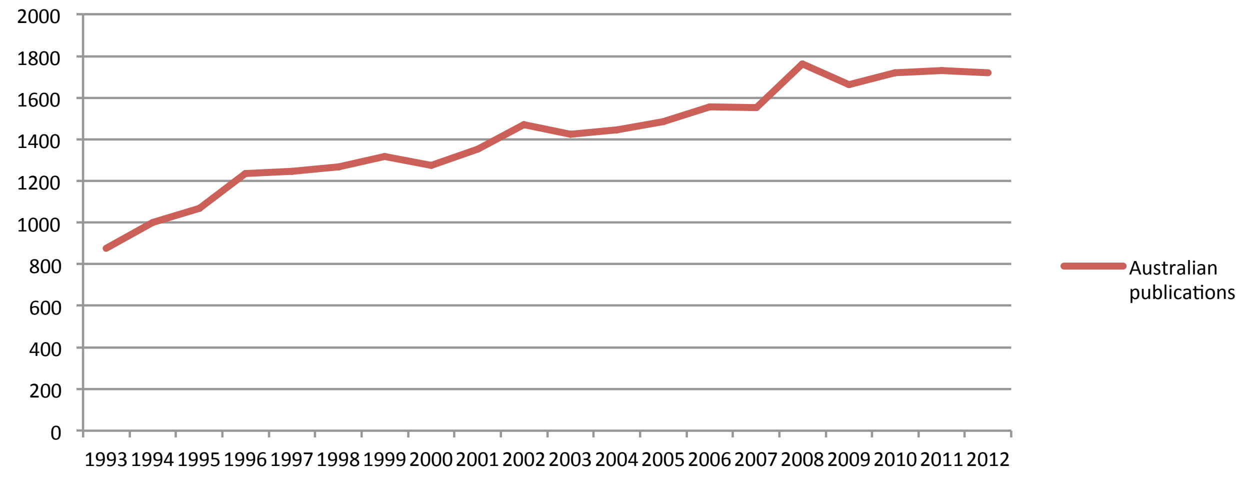
Figure 4.1.6. Number of ARC projects by project type in the years 2002-2017



Source: AMSI, based on ARC datasets

4.2. Research output and quality

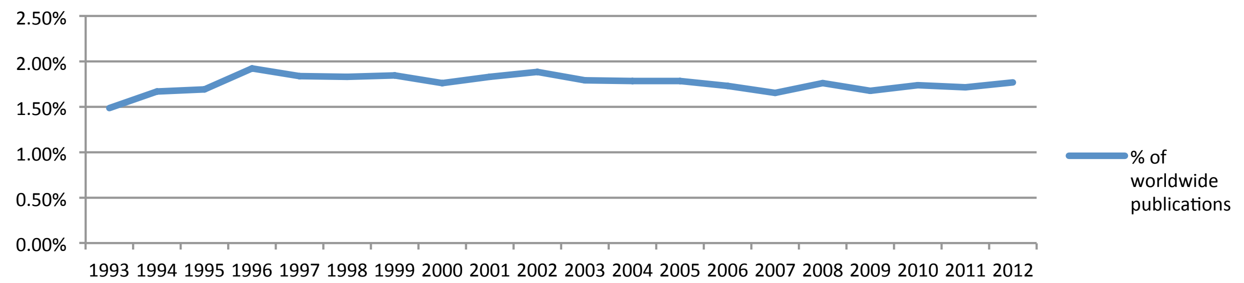
Figure 4.2.1. Australian mathematical publications (MathSciNet) in the period 1993-2012



Source: Data from MathSciNet database on publications in mathematics originating from Australian universities, 1993-2013

The number of Australian publications in MathSciNet has seen a steady rise over the last two decades (figure 4.2.1.). This rise however, is not simply due to an increase in publications, but can be partly attributed to a widening of the journal coverage of the MathSciNet database. As a proportion of mathematical publications worldwide, Australia's contribution has been fairly stable at between 1.5% and 2% (figure 4.2.2.) The overall percentage in the past decade has been slightly lower when compared to the latter half of the nineties.

Figure 4.2.2. Australian publications as a percentage of worldwide mathematical publications in the period 1993-2012



Source: Data from MathSciNet database on publications in mathematics originating from Australian universities, 1993-2013

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).

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

In terms of output volume, mathematical and statistical sciences research is one of the smaller 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 (table 4.2.1.). Australian papers have a relatively high ratio of average citations per paper compared to the global average in the same field.

Looking at the trends in scientific output and impact, the output volume as a percentage of world publications increased slightly when compared between 2002 and 2010 according to Chief Scientist data (table 4.2.2.), 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 4.2.2. 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.

4.3. Excellence in Research for Australia (ERA) 2010-2012

Table 4.3.1. ERA Results 2010

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 4.3.2. ERA Results 2012

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 Excellence in Research for Australia (ERA) results of 2010 show in Table 4.3.1., the 2012 ERA results showed an overall improvement (see Table 4.3.2.). The ERA Unit of Evaluation (UoE) represents the discipline within the institution, not individual researchers or institutional units. 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 2010 to 10 in 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 six disciplines that had fewer UoE's evaluated, indicating that the mathematical sciences remain 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 standards.

About the 2013 AMSI Member and Non-Member Surveys

In 2013 the AMSI member universities were sent a comprehensive survey questionnaire with enquiries about their staffing situation, teaching, student numbers and a host of other data. The non-member universities received a smaller survey with enquiries about their staffing and teaching. To date, 33 respondents have participated in the surveys. This Discipline Profile contains the preliminary results.

A final report of the AMSI Member and Non-MemberSurvey 2013 will be published on the AMSI website later in 2014.

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

Australian Catholic University
Australian National University
Bond University
Central Queensland University
Charles Darwin University
Charles Sturt University
Deakin University
Edith Cowan University
Flinders University
Griffith University
La Trobe University
Monash University
Murdoch University
Queensland University of Technology
RMIT University
Southern Cross University
Swinburne University of Technology
University of Adelaide
University of Ballarat
University of Melbourne
University of New England
University of New South Wales (UNSW)
UNSW Canberra (ADFA)
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University of Queensland
University of South Australia
University of Southern Queensland
University of Sydney
University of Technology, Sydney
University of the Sunshine Coast
University of Wollongong
Victoria University

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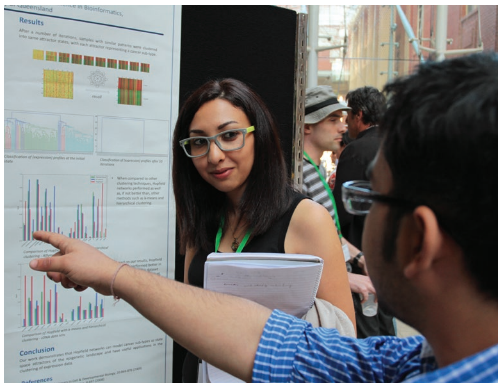

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