THE STATE OF MATHEMATICAL SCIENCES 2024

8th Discipline Profile of Mathematics & Statistics in Australia

Summary of Findings

AMSI AUSTRALIAN MATHEMATICAL SCIENCES INSTITUTE

About **AMSI**

The Australian Mathematical Sciences Institute (AMSI) is a not-for-profit peak body for the mathematical sciences with a breadth of members including Australian universities, professional societies, government agencies and industry. We champion mathematics, statistics and data science for Australia's advancement through advocacy, facilitation, and collaboration.

The common purpose we share with our members and partners is the radical improvement of mathematical capacity and facility, both in Australia and Asia-Pacific. AMSI's impact is underpinned by our convening power across the mathematical sciences ecosystem.

AMSI's activities fall largely into three strategic areas – school education, research and higher education, and industry engagement. In school education, we focus on teacher professional development to foster teaching excellence and inspire students to study mathematics to year 12. Research and higher education delivers advanced research training and research workshops to continue the development of undergraduate and postgraduate maths students, in preparation for careers in academia and industry. Our industry division is home to the national PhD internship program, APR.Intern, which has successfully grown to an all-discipline all-sector program working with Australian universities and industry.

Vision

Australia has a vibrant mathematical culture that is valued as a national asset. That the mathematical sciences enrich Australian society and are recognised as a fundamental driver of its economy.

That all Australians have the opportunity to develop their mathematics skills and knowledge, to enhance their careers, acquire essential life skills and to enrich their lives.

Mission

Sustained advocacy of the mathematical sciences through the provision of authoritative information and influence of national policy.

Enhancing mathematical sciences education and research to support the development of world-class mathematical scientists.

Facilitating employment linkages for graduates in the mathematical sciences.

Influencing the mathematical sciences student pipeline to increase the number and diversity of students studying mathematics at school and university.

Engaging stakeholders in the mathematical sciences ecosystem to strengthen the impact of the Mission, enhance reputation and global profile.

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Australian and New Zealand Association of Mathematical Physics (ANZAMP)
Australian and New Zealand Industrial and Applied Mathematics (ANZIAM)
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Victoria University
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AMSI and its members acknowledge the significant contribution of the University of Melbourne as our Lead Agent and host.

List of members as of September 2024.

Preview of contents in the full report

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INTRODUCTION

AMSI's periodic Discipline Profile provides a detailed snapshot of the condition of the mathematical sciences in Australia at all stages of the continuum – from the classroom and higher education through to research and development, workforce utilisation and innovation by commerce and industry. The publication brings together diverse information from many sources, complemented with AMSI research.

The mathematical sciences—spanning mathematics, statistics, and data science—are critical in addressing the complex challenges of the 21st century. The discipline's role is indispensable across key industries, including finance, healthcare, artificial intelligence, and machine learning. These disciplines provide the analytical frameworks that drive technological innovation and shape decision-making processes in sectors that rely on precision, efficiency, and data insights.

AMSI's Discipline Profile 2024 details the critical role of mathematical sciences in shaping the future of various sectors in Australia, the challenges in education and workforce preparation, and the need for sustained investment in research to maintain Australia's global competitiveness. The following is a summary of findings.

SCHOOL EDUCATION CHALLENGES

Mathematics and numeracy education in Australia faces significant challenges, particularly post-COVID-19. According to the OECD's (2022) Programme for International Student Assessment (PISA) results, overall student performance has stabilised. However, disparities persist, especially among students from lower socio-economic backgrounds and regional and remote areas, and the gap between low-performing and high-performing 15-year-old students is widening, reflecting growing inequity and worsening educational outcomes.

Socio-economic background and geographic location significantly affect student performance, and students from remote areas lag up to four years behind. This particularly impacts First Nations students - although some progress has been made. More First Nations students still require additional numeracy support compared to non-First Nations students.

Gender differences are also evident, with male students generally outperforming females in mathematics. However, first-generation and foreign-born students often surpass their Australian-born peers. Independent schools show higher achievement levels, but these differences diminish when socio-economic factors are considered.

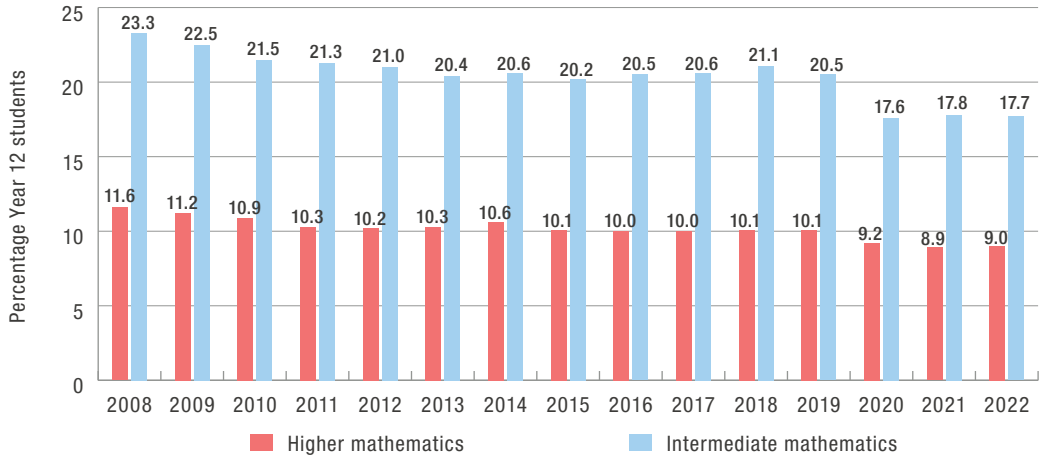
Out-of-field mathematics teaching remains a significant issue in secondary schools, with up to 40 percent of teachers delivering mathematics without proper qualifications. This contributes to lower student engagement, with half of Year 8 students in Australia reporting they do not enjoy studying mathematics. There is a direct correlation between enjoyment and achievement in mathematics, making it crucial to improve the quality of instruction and student attitudes toward the subject.

Year 12 participation rates in higher and intermediate level mathematics are at an all-time low. With mathematics a fundamental component of STEM degrees and careers, this long-term trend of declining enrolment needs urgent attention if Australia is to meet future workforce demands and maintain its competitive edge globally.

From 2010 to 2019, the participation rate in intermediate mathematics subjects stabilised at around 20 percent of all Year 12 students, while participation in higher mathematics subjects was about 10 percent. Unfortunately, both rates dropped further from 2020 onwards, with a notable decrease in 2020 (see Figure 1).

Participation in higher mathematics fell below 10 percent for the first time in 2020 and has since remained between 8.9 and 9.2 percent. The number of students enrolled in higher mathematics dropped to fewer than 19,000 in 2022, down from an average of around 21,000 per year in the preceding decade. Similarly, participation in intermediate mathematics decreased to 17.6 percent in 2020, where it has largely remained, well below its previous rate of over 20 percent. The number of students in intermediate mathematics fell to between 37,000 and 38,000 from 2020 to 2022, compared to an average of nearly 43,000 students per year from 2008 to 2019.

Figure 1 Year 12 participation rates in higher and intermediate mathematics in Australia (2008–2022)



Source: *Marchant & Kennedy (2024), AMSI collection of State Government data (2008–2022).*

Note: *The following (non-exhaustive) key for basic, intermediate and advanced level mathematics applies:*
Elementary - VIC Further Maths, NSW Mathematics Standard 1 & 2, SA/NT General Maths, ACT Further Maths, TAS General Maths, QLD General Maths (Maths A), WA Maths Applications
Intermediate - VIC/TAS/ACT/WA/SA/NT Math Methods, NSW Mathematics Advanced, QLD Maths Methods (Maths B)
Advanced - VIC/ACT/SA/NT/WA Specialist maths, NSW Extension 1+2, TAS Specialised maths, QLD Specialist Maths (Maths C).

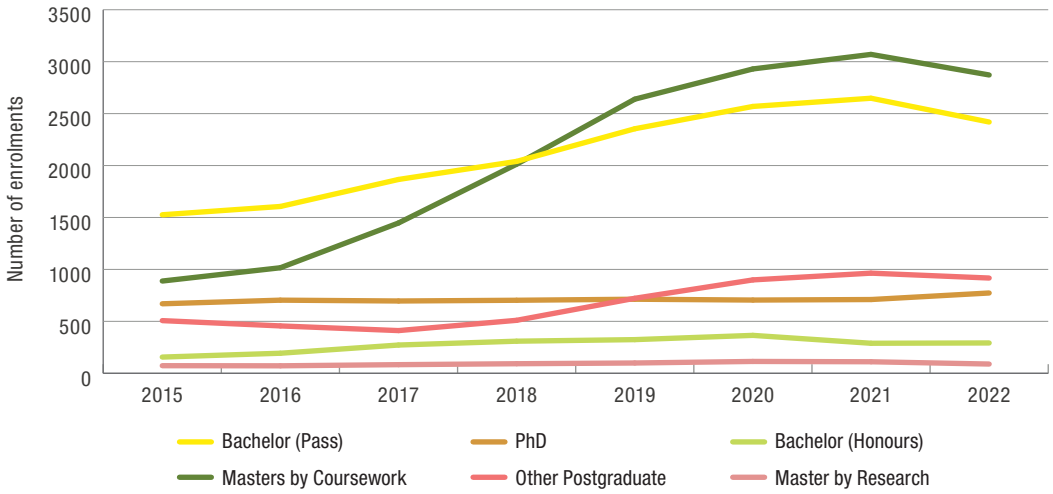
HIGHER EDUCATION TRENDS

In higher education, there has been a positive increase in the number of students enrolling in mathematical sciences degrees, particularly at the postgraduate level. Most of this growth is attributable to international students.

Since 2015, the total number of enrolments in mathematical sciences degrees has nearly doubled (see Figure 2). Enrolments in bachelor and Honours degrees increased by 59 percent and 87 percent, respectively, while research degree enrolments (PhD and research masters) grew by 16 percent and 22 percent. In contrast, enrolments in coursework masters degrees surged by a substantial 223 percent, and other postgraduate enrolments (such as graduate certificates and diplomas) rose by 81 percent.

The rapid growth in coursework masters degrees has introduced a new pathway in the study pattern, complementing the traditional bachelor-to-honours-to-PhD sequence. In 2022, bachelor enrolments accounted for 33 percent of all mathematical sciences degree enrolments, down from 40 percent in 2015. Meanwhile, coursework masters enrolments increased from 23 percent of enrolments in 2015 to 39 percent in 2022.

Figure 2 Enrolments in mathematical sciences degrees (all universities) (2015–2022)



Source: *Department of Education Higher Education Statistics, provided to AMSI.*

The growth of data science degrees reflects the increasing recognition of the value of these interdisciplinary fields. Despite the pandemic's impact on international student numbers and departmental teaching loads, enrolments are recovering. However, international student caps introduced in 2024 threaten to further impact mathematical sciences departments.

Challenges also remain in student engagement. While mathematical sciences students report high satisfaction with teaching quality, engagement and skills development are consistently rated lower compared to other fields. Gender disparities also persist in mathematical sciences departments, although there has been an increase in female representation at senior academic levels.

WORKFORCE IMPACT

The workforce landscape for mathematical sciences is evolving rapidly. Occupations in data science and other information-related professions have grown by nearly 1300 percent over the past five years, and mathematical sciences graduates are seeing substantial increases in starting salaries, particularly those with master's degrees.

Table 1 Top 20 occupations of persons with a mathematical sciences qualification in 2021, change since 2016 and outlook to 2026

	Top 20 occupations of persons with a qualification in the mathematical sciences in 2021	Number of mathematicians/ statisticians in these occupations	% change since 2016	Projected employment growth for these occupations 2018–2023 (%)
1	Other Information and Organisation Professionals*	3004	1284%	26.2%
2	Software and Applications Programmers*	2443	50%	27.0%
3	Secondary School Teachers**	1601	-7%	3.7%
4	University Lecturers and Tutors	1444	7%	16.6%
5	Actuaries, Mathematicians and Statisticians	1297	5%	11.0%
6	Management and Organisation Analysts*	903	30%	32.2%
7	ICT Managers	800	19%	17.7%
8	Professionals, nfd***	650	-28%	6.9%
9	ICT Business and Systems Analysts*	562	32%	12.9%
10	Sales Assistants (General)	406	22%	1.7%
11	Accountants	400	10%	9.2%
12	Database & Systems Admins, and ICT Security Specialists*	360	28%	38.9%
13	Contract, Program and Project Administrators	357	11%	9.3%
14	General Clerks	350	15%	12.9%
15	ICT Support Technicians	326	34%	17.4%
16	Financial Dealers	324	31%	1.7%
17	Advertising and Marketing Professionals	324	33%	11.4%
18	Advertising, Public Relations and Sales Managers	315	38%	4.4%
19	Retail Managers	287	13%	0.3%
20	Private Tutors and Teachers	287	14%	13.6%
	Total	**16440**		
	Average projected growth top 20 occupations of mathematicians and statisticians			13.8%

Notes:

** The occupational classification in use up to and including 2021 did not include the relatively new occupations of "data analyst", "data scientist" and related. These new occupations are likely to have been classified in the various categories "Other Information and Organisation Professionals", "Software and Applications Programmers", "Management and Organisation Analysts", ICT Business and Systems Analysts", "Database and Systems Administrators and ICT Security Specialists" and "Professionals, nfd", some of which have experienced explosive growth in the past five years.*

*** Secondary school teachers with a mathematical sciences qualification are only a small subset of all mathematics teachers in Australia — the vast majority of whom are likely to have indicated they have an Education qualification. Also note that the projected employment growth 2021–2026 covers all secondary school teachers — there will likely be differences between teachers in different subject specialisations.*

**** nfd: Not further defined*

Source: *ABS (2021); National Skills Commission (2021).*

The average projected growth rate for the top 20 jobs for mathematicians by 2026 is 13.8 percent, significantly outpacing the 9.1 percent growth forecast for all Australian jobs. This upward trend is expected to continue well into the foreseeable future.

The National Skills Commission anticipates strong employment growth across many of the top 20 jobs for mathematical scientists (NSC 2021). Notably, roles such as Database and Systems Administrators, ICT Security Specialists, Information and Organisation Professionals, and Software and Applications Programmers rank among the top 10 percent of Australian jobs with the highest expected growth.

This increasing demand translates into favourable employment prospects and competitive salary levels for new university graduates with degrees in mathematical sciences, particularly those with a masters degree.

The ageing workforce is being revitalised by young professionals, many of whom are international students who have pursued their education in Australia. Despite these positive developments, gender imbalances continue, with fewer females entering mathematical sciences careers compared to male counterparts.

Strong numeracy skills are linked to better employment prospects, higher wages, and improved health outcomes. Although most Australian adults possess basic numeracy skills, a significant gap exists between those with low and advanced skills, highlighting the need for improved educational outreach and training.

RESEARCH AND FUNDING CONCERNS

The decline in research funding is an ongoing challenge. Higher Education Research and Development (HERD) funding for mathematical sciences has dropped to its lowest level since 2008, representing just 1.26 percent of total funding in 2022. Industry contributions to mathematical sciences research is minimal, despite growing scope and demand for mathematical expertise in various industry sectors.

Figure 4.1 Research and development expenditure in the mathematical sciences

Source: *Australian Bureau of Statistics (2009–2023), (2010–2024a), (2010–2024b).*

An analysis of Research and Development (R&D) expenditure over time by the business, government, and higher education sectors (see Figure 3) shows that business allocates well below 1 percent of its funding to the mathematical sciences, with only a temporary increase in investment during 2017/18. Government funding for the mathematical sciences, on the other hand, has steadily increased since 2014/15, receiving additional boosts during the 2020/21 and 2022/23 periods.

In contrast, HERD funding for the mathematical sciences has declined in recent years. Between 2018 and 2022, this funding dropped by nearly $50 million, reaching just 1.26 percent of total funding—the lowest percentage since 2008. Furthermore, over the last decade, the proportion of HERD expenditure directed toward applied research has increased, while funding for pure basic and strategic research has decreased across all scientific disciplines (de Gier et al., 2024).

The number of Australian Research Council (ARC) funded projects in the mathematical sciences has declined by 53 percent since 2012. This reduction in support is especially apparent in pure and applied mathematics research, which have seen funding decline the most since 2012.

Nevertheless, Australian universities continue to excel in mathematical sciences research. Institutions such as the University of New South Wales, Australian National University, The University of Melbourne, and Monash University are consistently ranked among the top in Australia for mathematics and statistics, according to the 2024 QS World University Rankings.

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