

Australian Mathematical Sciences Institute



AMSI is the Australian Mathematical Sciences Institute — a national collaborative venture of 31 Australian universities, four government agencies and three learned societies. It is the first national institute for the mathematical sciences in Australia.

Established in 2002, AMSI's core mission is the radical improvement of mathematical sciences capacity and capability in the Australian community through:

- the support of high quality mathematics education for all young Australians
- improving the supply of mathematically well-prepared students entering tertiary education by direct involvement with schools
- the support of mathematical sciences research and its applications including cross-disciplinary areas and public and private sectors
- the enhancement of the undergraduate and postgraduate experience of students in the mathematical sciences and related disciplines.

In its short life the Institute has become an important central voice for the mathematical sciences in Australia,

achieving a strong track record of delivering effective programs that seek to integrate research, education and industry involvement to provide a strong base for national innovation.

Access to AMSI activities brings immediate benefits to members in mathematical sciences departments and agencies. This applies especially to early career researchers, postgraduate and honours students, including those from cognate disciplines as well as support for cross-disciplinary research.

The Institute conducts a wide range of public engagement activities touching on all stages of life from school and tertiary student, parenthood, and industry and academia to name a few. Such activities include scientific workshops, distinguished visiting lectureships and public lectures, short courses, industry internships and professional development in schools.

Research Program

The AMSI Research program supports Australia's academic community, fostering the critical links



between researchers in universities, government agencies and business.

The Institute is dedicated to facilitating collaborative mathematical research through an internationally recognised program of scientific events providing a platform for promoting collaborative mathematical research. Each year, AMSI's *Scientific Workshop* program awards \$120,000 in sponsorship for 25 scientific workshops, international and local conferences and provides \$50,000 in travel support for students and researchers from around Australia. In addition, each year the program sponsors 50 international experts to visit Australia.

AMSI's push for more collegial and collaborative teaching across its membership brought about the launch of the Advanced Collaborative Environment (ACE) network in 2013, connecting mathematicians and statisticians nationally. In collaboration with learned societies, the ACE network enables the interactive broadcast of meetings, seminar series and lecture courses linking students with a wider range of specialist subjects in the field.

The research community and the general public are engaged and inspired by the AMSI Lecture and Mahler Lecture Tours. Run nationally, audiences have the opportunity to hear top academics in the fields of both pure and applied mathematics speak about their research. The tours run in conjunction with the

Australian Mathematical Society (AustMS), Statistical Society of Australia (SSAI) and Australian and New Zealand Industrial and Applied Mathematics (ANZIAM) and feature eminent lecturers — in 2014 the Prime Minister's Science Prize winner and one of Australia's most eminent statisticians, Professor Terry Speed.

And with an aim to build industry linkages, the annual *Mathematics and Statistics in Industry Study Group (MISG)* event provides a platform for business to have current problems solved by one of the world's longest running mathematics think tanks, in a five day intensive workshop.

Recently AMSI Research successfully led the Australian effort for the International Year of Mathematics of Planet Earth (MPE) delivering a scientific program funding 24 national events with 3,235 attendees. An MPE Network has since been established connecting 16 universities and five government agencies improving student retention in the mathematical sciences.

Looking ahead, a National Research Centre for the Mathematical Sciences will be launched as the premier centre for collaborative research. The centre will span all branches of mathematical sciences and facilitate breakthroughs in mathematics leading to progress in science, technology, medicine and economics.



Higher Education Program

AMSI's Higher Education program plays a vital role in enhancing the experience of Australian university students in the mathematical sciences. *AMSI Summer* and *Winter Schools* and *BioInfoSummer* are major annual events training more than 2,500 students from across Australia to date. Students develop their skills over two to four week programs taking specialist subjects from experts in the field, meet potential employers, build networks and establish research collaborations.

Recent subjects include:

- Optimisation
- Analysis of multivariate and high-dimensional data
- Conformal Field Theory and String Theory for Mathematicians
- Nonparametric curve estimation
- Next-generation DNA sequencing and sequence evolution

The Institute is dedicated to training the next generation of researchers, each year 50 undergraduate students receive Vacation Research Scholarships (VRS) to experience life as a researcher. Over six weeks, students work closely with a supervisor on real life research problems and polish their presentation skills when presenting their findings at the *Big Day In* event.

Recent VRS projects include:

- Optimising potential Australian high-speed railway station locations
- Markov decision processes and the modelling of patient flows
- Predicting match and tournament outcomes in professional golf
- Topological graph theory: Conway's Thrackle Conjecture
- Lines and circles in the three-dimensional Heisenberg group

The program also encourages diversity in the mathematical sciences through support of the Woman in Maths event that highlights the contribution of women in mathematics and provides a forum for discussion of career paths.

Industry Internship Program

Placing over 100 interns into Australian industry, AMSI Intern drives industry engagement for the Institute by connecting highly qualified PhD researchers — from across all disciplines within AMSI member institutions — with industry partners to address a research challenge facing their business.

Full time research projects typically run between four to five months in which the student and academic mentor receive funding for the research project, and



importantly, the student is not listed on the company 'books'. SMEs can also access local voucher schemes to offset costs.

Industry partners also receive additional specialist knowledge from the students' academic mentor and, importantly, all IP remains with the business.

Recent PhD intern research projects include:

- Mathematics used to unlock mobile tracking information for applications on handheld devices. (Telecommunications Broadband)
- Optimisation techniques used in logistics: helping reduce exhaust emissions and running costs. (Logistics)
- Stochastic models strengthen insurance estimates by reducing prediction errors. (Finance/Actuary)
- Intern produces mathematical solutions to optimise network design — from postal routes to laying out fibre optic cable. (Telecommunications/Broadband)
- Statistical analysis uncovers trends in Melbourne rugby league membership and game day attendance. (Professional Sports)
- Town planners analyse foot traffic on Melbourne streets using statistics to improve impacts of major events. (Town Planning)

AMSI Intern is dedicated to building this outreach capacity to cement a clear pathway for PhD researchers — from within Australian universities —

into Australian industry. Growth of the AMSI Intern program has been significant in the past two years, partnerships with key national industry associations including the Australian Centre for Financial Studies, the Defence Science Institute and Veski have been established offering funding schemes to a wide range of sectors and addressing gender equity within these sectors and disciplines.

The value of this program is to provide industry placement opportunities for the higher degree research students whilst at the same time increasing the quality and quantity of university led collaborations which have a long lasting transformative effect on the nation's productivity and innovation.

Schools Program

AMSI Schools has been in operation since AMSI's inception in 2002, providing mathematics programs that benefit school students, their teachers and parents. The intention is to enhance the mathematics teacher skill-base for both primary and secondary teachers, whilst increasing awareness of the importance of mathematics in a range of interesting careers.

In 2004, the International Centre of Excellence for Education in Mathematics (ICE-EM) was established followed by a national series of successful mathematics textbooks spanning years 5–10. These provide a coherent and solid development of mathematics ideas

to support the transition from Primary to Secondary schooling.

Together with an accompanying professional development and school visit program, the textbook program has set a high benchmark for the teaching and learning of mathematics across the country. Aligned with Australian Curriculum version, and published by Cambridge University Press, the books form the backbone of our programs for schools.

A suite of careers materials highlighting people who use maths in their profession or trade have been designed to increase school and student and parent awareness of the breadth of careers available to them if they pursue mathematics.

Online materials are increasingly becoming part of our efforts to support teachers. Our new teacher resource portal, *Calculate*, allows teachers to freely access our online materials — aligned with the Australian Curriculum — arming teachers with professional development (PD) handouts, videos exploring real-life mathematics applications and student exercises.



Through these resources the Schools program inspires teachers to extend their understanding of mathematics and arms them with the answers to the age-old question “Why should I study maths?”

Funding for the program is provided through the sale of the ICE-EM Mathematics textbook series and by securing grants from government and industry partners. To date we have secured support from the Victorian Government, BlueScope Steel Pty. Ltd. the Australian Government, Boeing and The William Buckland Foundation.

In 2015, the program will extend across Australia, using the *Calculate* website as a platform for all teachers who participate in the Schools program PD sessions.



Professor Geoff Prince

BSc (Hons), DipEd, PhD, FAustMS
Director of AMSI from September 2009

Prior to joining AMSI again in 2009, Geoff was Head of the Department of Mathematics and Statistics at La Trobe University, sat on the board of the Australian Centre of Excellence for Risk Analysis (2006–2009) as AMSI’s representative, and was Vice President of the Australian Mathematical Society (2008–2009). Geoff’s involvement with AMSI dates to 2004–2006 when he was Deputy Director, Executive Director, Acting Director, and Access Grid Room coordinator. His research interests are in the field of applications of differential geometry to ordinary and partial differential equations, uncovering results in electrodynamics through to highway design.