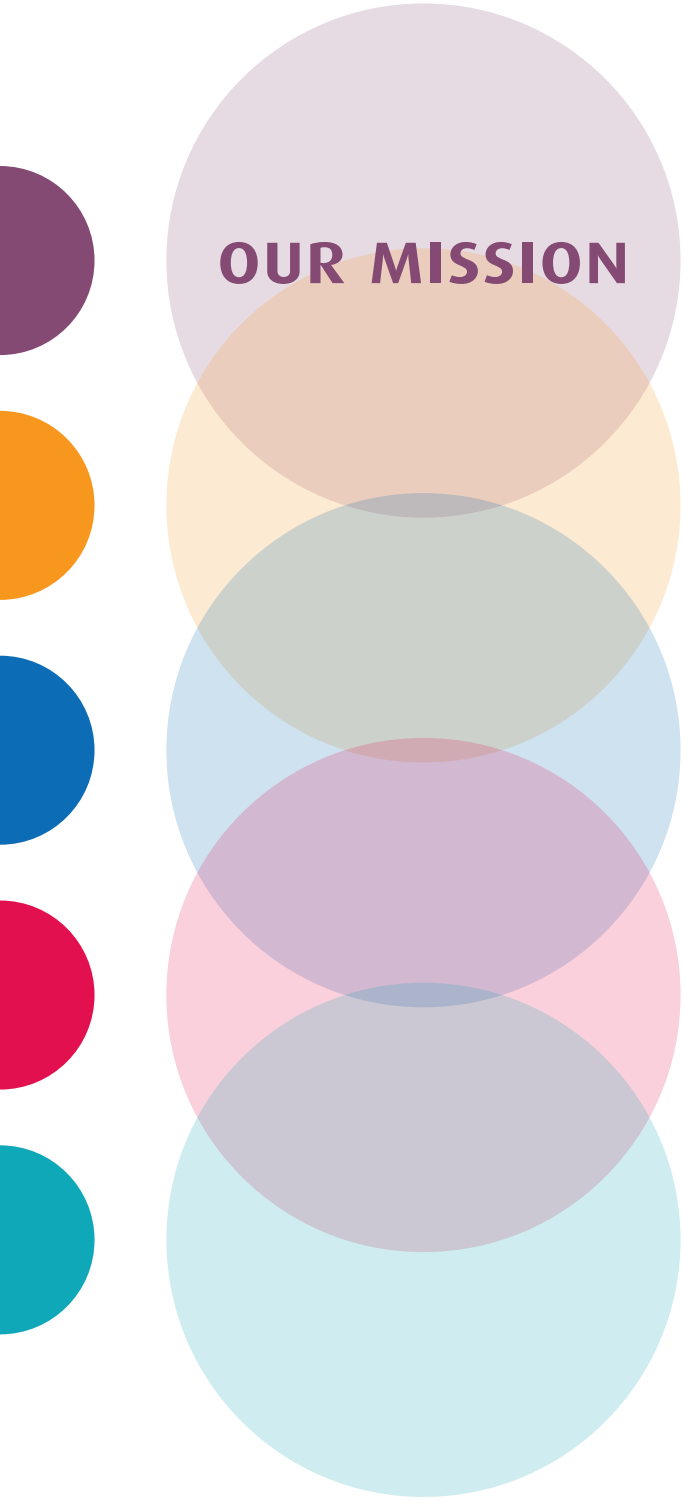
AMSI
AUSTRALIAN MATHEMATICAL SCIENCES INSTITUTE

AMSI Track Record 2015–16

OUR MISSION



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

Contents

Joining AMSI

Benefits to all AMSI members include:

- links with the national and international mathematical sciences community;
- active engagement with AMSI's advocacy agenda. This will include involvement with submissions and policy and advocacy documents, such as our annual review of the discipline;
- monetary sponsorship and support for the delivery of research activities including workshops, seminars, guest lecturers and theme programs;
- monetary sponsorship and support for the delivery of, or participation with, AMSI Higher Education flagship events; and
- access to AMSI Intern. (NOTE: it is not necessary for industry partners to be members of AMSI to engage the internship program.)

There are three membership categories:

Full members

Associate members

Societies & government agencies

Full members of AMSI are signatories to the Joint Venture Agreement (JVA) that forms the basis of AMSI's structure and governance.

Benefits to university members include:

- access to workshop funding;
- travel support for staff and students;
- careers materials and copies of *Maths Ad(d)s*;
- student access to the Vacation Research Scholarship program; and
- travel funding for students to attend AMSI's Summer and Winter Schools.

Benefits to signatories of the JVA include:

- precedence to host the AMSI Summer School and BioInfoSummer;
- increased travel allowance for students and staff; and
- input and sign off on AMSI's business plan.

Government agency, society and corporate member benefits are negotiated. They can include provision of short courses, discounted conference and event registration, advertising at AMSI events and in *Maths Ad(d)s*, as well as the opportunity to host workshops and access to travel funds.




Foreword

AMSI is Australia's mathematical sciences institute. It is the collaborative venture of the nation's universities, professional societies and government agencies.

AMSI is an important central voice for the mathematical sciences in Australia. We facilitate effective communication within the community and successfully advocate for increased government funding. Our established program of activities has created significant benefits, both tangible and intangible, for Australia's professional and aspiring mathematical scientists. AMSI has provided initiative and support for activities across research, education and industry.

Access to AMSI's 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. AMSI provides members with support for cross-disciplinary research.

AMSI offers an effective and efficient way of delivering mathematical and statistical capability to research, education and industry. It does this in a way that seeks to integrate research, education and industry involvement to provide a strong base for national innovation.

Above all, AMSI is a unique collaborative venture providing members with the structure and support that no individual entity alone could provide. It is vitally important for the mathematical sciences in Australia that AMSI continues and expands.

Prof. Geoff Prince
Director

Dr Ron Sandland
Chair, AMSI Board




AMSI Members

Full Members

Australian National University

La Trobe University

Monash University

QUT

RMIT University

The University of Adelaide

The University of Melbourne

The University of Newcastle Australia

UNSW Australia

The University Of Queensland Australia

The University of Sydney

The University of Western Australia

Associate Members

Charles Sturt University

Curtin University

Deakin University

Federation University Australia

University of Wollongong

Flinders University

James Cook University Australia

Macquarie University

Swinburne University of Technology

University of New England

University of South Australia

University of Southern Queensland

University of Tasmania

UTS University of Technology, Sydney

Victoria University

University of Western Sydney

Bringing knowledge to life

Government Agencies

Australian Bureau of Statistics

Australian Government Bureau of Meteorology

CSIRO

Australian Government Department of Defence

Defence Science and Technology Organisation

Society Members

Australian Mathematics Trust

Aust MS Australian Mathematical Society

ANZIAM

AMSI Members

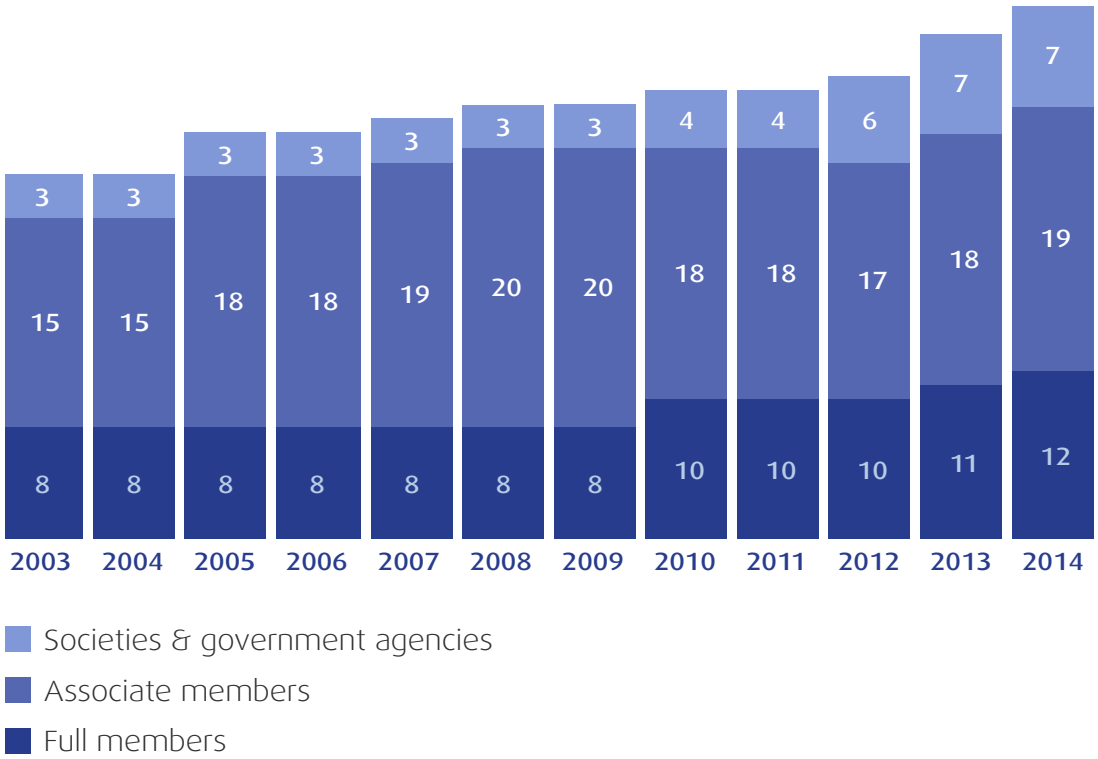
AMSI member growth

AMSI has made, and continues to make, a significant contribution to furthering the interests of the mathematical sciences in Australia. AMSI's initiatives and programs are important parts of an overall strategy to enhance the standing and health of mathematics and statistics across the Australian community.

We strive to improve the appreciation of policy makers and politicians of the importance of mathematics in a sophisticated economy and community. A strong and diverse membership base is key to AMSI's endeavours in lobbying for government and business support of programs to advance capacity and capability in the mathematical sciences.

AMSI is critically dependent upon the support of its member institutions. Without this support, both financial and via active participation in AMSI's enterprise, the institute would not be able to provide its many services that are of direct benefit to the mathematical sciences.

We all reap the benefits of the investment of AMSI's members' subscriptions and corporate contributions.



Achievements at a glance

2008 AMSI won the National Innovation Award for Science Innovation.

2008 The Carrick Institute of Learning and Teaching (now the Office for Learning and Teaching) provided $100k for the year-long project Mathematics for 21st Century Engineering Students.

2004 $7.8m from the Department of Education, Science and Training established the International Centre of Excellence for Education in Mathematics (ICE-EM). This funding supported a range of initiatives aimed at strengthening education in the discipline of mathematics and its contemporary applications - pg 11.

2005 $750k funding provided through ICE-EM for the installation of Access Grid Rooms in 11 member universities - pg 23.

2005 1st edition of ICE-EM Mathematics textbooks written.

2002 AMSI established through a $1m grant from the Victorian government's Science, Technology and Innovation infrastructure grants program.

2002 2003 2004 2005 2006 2007 2008

2003 AMSI was a collaborating partner and significant influence in the set up of the Centre of Excellence for Mathematics & Statistics of Complex Systems (MASCOS). Out of an Australian government grant of $10.9m, $2.2m was jointly administered by AMSI and MASCOS.

2006 AMSI supported the Australian Academy of Science's National Strategic Review of the Mathematical Sciences in Australia.

2007 AMSI awarded a $2m Collaborative and Structural Reform (CASR) grant to fund a number of flagship programs in Higher Education, including the graduate schools. It also funded industry collaboration through workshops and the establishment of AMSI Intern.

2009 AMSI awarded a $2m grant from the Department of Education, Employment and Workplace Relations (DEEWR) for The Improving Mathematics in Schools (TIMES) project - pg 13.

2009

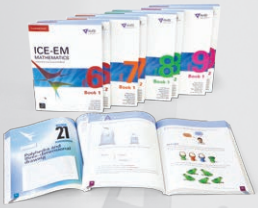
2010

2010 AMSI Intern expanded through a $1.7m three year partnership with Enterprise Connect, an initiative of the Department of Innovation, Industry, Science and Research - pg 6.

2010 A wide-ranging, transparent, external review of AMSI was undertaken. This review led to the revision of AMSI's mission statement and expansion of the board.

2011 Dr Jim Lewis stepped down as chair of the AMSI Board. Dr Ron Sandland AM picks up the torch.

2011 ICE-EM Mathematics textbooks entered their 2nd Ed. and Cambridge University Press distribution began - pg 12.



2011

2012

2012 AMSI awarded $750k contract from Education Services Australia to develop electronic resources to support the senior national curriculum for Australia - pg 13.

2012 AMSI held the national forum *Maths for the future: keep Australia competitive* - pg 7.

2012 AMSI's Research and Higher Education flagship programs receive $2m from the Department of Education and Training, enabling expansion of our flagship events - pg 17.

Australian Government
Department of Education and Training

2013 AMSI Intern became a supplier for the Victorian Department of State Development, Business and Innovation Voucher program - pg 27.

2013 AMSI led the Australian effort for the International Year of Mathematics of Planet Earth - pg 7.

Maths of Planet Earth

2013 AMSI Schools boosted with funding from Boeing, The William Buckland Foundation and an AMSPP grant in partnership with Regional Universities Network to deliver professional development to mathematics teachers around Australia - pg 12.

2013

2014

2014 AMSI Intern established partnerships with key national associations: the Defence Science Institute and the Australian Centre for Financial Services - pg 25.

2014 AMSI Intern secured a co-investment scheme with eight member institutions worth a total of $6.7m over three years - pg 25.

2014 AMSI's Higher Education program doubled student participation in flagship events since funding began in 2012 - pg 17.

2014 AMSI quoted in 43 news articles appearing across 25 unique publications - pg 7.

2015 $22m from the BHP Billiton Foundation for a five year national program to turn around public perception of the mathematical sciences as a career choice for girls and young women - pg 15.

2015

MONASH University
LA TROBE UNIVERSITY
THE UNIVERSITY OF SYDNEY
SWINBURNE UNIVERSITY OF TECHNOLOGY
RMIT UNIVERSITY
DEAKIN UNIVERSITY
THE UNIVERSITY OF MELBOURNE
UTS UNIVERSITY OF TECHNOLOGY, SYDNEY

Professor Simon Levin,
Princeton University,
MPE launch 2013

AMSI'S MISSION TO RADICALLY IMPROVE MATHEMATICAL SCIENCES CAPACITY AND CAPABILITY IN THE AUSTRALIAN COMMUNITY IS UPHELD IN LARGE PART THROUGH OUR ACTIVE **ADVOCACY** AGENDA.

Policy & Advocacy

Key aims

For thirteen years the importance, the strengths and the vital benefits of the field have been disseminated to the community at large through:

- policy advice;
- outreach events;
- reviews of the discipline;
- engagement with politicians;
- answering calls for submissions;
- communication of our activities through targeted marketing; and
- building relationships with the media.

A monetary value cannot be placed on AMSI's contributions in this arena. We will continue undertaking this important work; the breadth and quality of our services, however, relies on continued funding from our various stakeholders.

The International Year of Mathematics of Planet Earth (MPE)

Scientific societies, universities, research institutes and foundations from all corners of the globe banded together and dedicated 2013 to the Mathematics of Planet Earth.

AMSI teamed up with members and other societies and organisations to spread the word about the role mathematics and statistics has in understanding the challenges of our planet. Engaging the general public and our youth was an important factor of the year. MPE was also committed to highlighting the underlying mathematics of current global issues and to increasing the research efforts of these problems.

The year provided a platform to illustrate the wide and varied role that mathematics plays in all aspects of life.

The theme ran throughout 2013, with a dedicated website, a major research conference in July and a host of other workshops, seminars and public events.
mathsofplanetearth.org.au

Accelerate Australia

Held in February 2013, the forum featured talks by Professor Aidan Byrne, CEO of the Australian Research Council, Professor Arvind Gupta, the then CEO of Mitacs, and Australia's Chief Scientist, Professor Ian Chubb. This one-day event focused on issues relating to productivity, industry engagement and the work-readiness of PhD students. Further details outlined on page 26.
amsiintern.org.au/accelerate-australia

Maths for the future: keep Australia competitive

Held in February 2012, *Maths for the future* aimed to publicise both the state of the discipline and its importance to future growth. With an impressive line-up of speakers and extensive media coverage, our discipline's voice was heard loud and clear at a time when policymakers were keen to listen.
amsi.org.au/mathsforthefuture.php

"Most of the great innovations that have changed the way people live over the past two centuries were enabled by mathematics."

Professor Ian Chubb, Chief Scientist for Australia.

Professor Dame Celia Hoyles,
University of London

Professor Ian Chubb,
Australia's Chief Scientist

Professor Jean-Marie De Koninck,
Université Laval, with Janine McIntosh
and Professor Geoff Prince

Professor Denise Cuthbert
RMIT University

Strategic connections

By engaging with the government and actively providing submissions and policy advice, AMSI continues to be a strong public voice for the mathematical sciences.

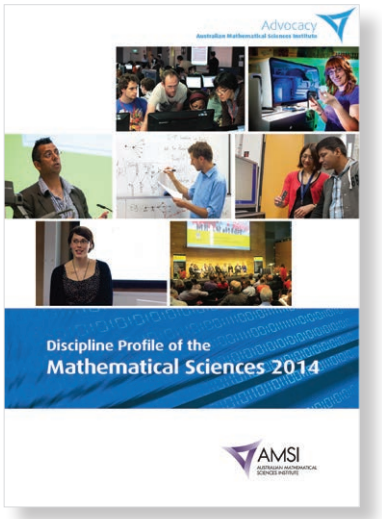
We have been recognised as one of the chief advocates on issues related to the mathematics pipeline, from education and research, to workforce supply. AMSI was heavily engaged with the Research Workforce Strategy project undertaken by the Department of Innovation, Industry, Science and Research and regularly engages with Australia's Chief Scientist.
amsi.org.au/publications/amsi-publications

National partnerships

AMSI partners with CSIRO and the ABS in a number of programs. We also work with the Bureau of Meteorology, Australian Mathematical Society (AustMS), Defence Science and Technology Organisation (DSTO), Defence Science Institute (DSI), several Australian Research Council Centres of Excellence and the Statistical Society of Australia Inc. (SSAI).

AMSI currently lends support to the National Committee for the *Decadal Plan of the Mathematical Sciences* and supports the annual meeting of the Australian Council of Heads of Mathematical Sciences (ACHMS). Representatives from all Australian mathematical science departments and societies, as well as government agencies and research groups make up the ACHMS.

Discipline Profile



The Discipline Profile of the Mathematical Sciences is an annual publication highlighting trends and developments in school education, higher education, research, research training and career prospects in the mathematical sciences. The discipline profile will be in its fourth year of publication in 2015. It is complemented by a policy document in which we outline key priorities for intervention. Our *Discipline Profile* is relied upon by media, policy makers and those interested in the state of the field.
amsi.org.au/discipline-profiles

International linkages

AMSI has established and maintained strong partnerships and open communications with many international organisations. We have had a firm link with Mitacs, the Canadian national research organisation that operates a highly successful intern program, for the duration of AMSI Intern. AMSI is a founding member of the Pacific Rim Mathematical Association and has links with the Pacific Institute for the Mathematical Sciences. We also maintain strong connections with prominent overseas mathematicians involved in school mathematics.

Public engagement

The mathematical sciences lies hidden most of the time. AMSI's mission to lift it from the shadows is accomplished through our advocacy work and by involving the general public in our events. Public lectures by distinguished speakers are held in conjunction with AMSI's flagship events, conferences and sponsored workshops.

We have a broad target market, from primary and secondary students, teachers and parents, university students, to the AMSI membership, government and industry. Our position as an authority on the state of the mathematical sciences in Australia has been growing throughout our 13 years; it was cemented in 2014 when we were asked for comment in 43 news items appearing across 25 print and digital publications.

Our public lectures appeal to those in the mathematical sciences community, families, mathematics teachers searching for fresh approaches to inspire their students and to anyone seeking to stretch their minds and learn something new.

Notable academics, such as Terry Speed, Simon Levin and Celia Hoyles and pop-culture mathematicians—Simon Singh, Simon Pampena and Keith Devlin—have given AMSI public lectures. They have all brought the serious and exciting aspects of mathematics to an Australian audience. Attendance growth has been exponential, as has the diversity of the crowds; we owe this to our reputation with the general public as well as our collaborative work within academia.

AMSI Gender Report

AMSI undertook an international literature survey and reported the results in the AMSI Gender Report 2014. This research provides the evidence base for the design of the BHP Billiton Foundation program. Further details outlined on page 13.
Review our gender report online:
amsi.org.au/genderreport2014

AMSI'S DIRECT INVOLVEMENT WITH **SCHOOLS** SUPPORTS HIGH QUALITY MATHEMATICS EDUCATION FOR ALL YOUNG AUSTRALIANS, IMPROVING THE SUPPLY OF MATHEMATICALLY WELL-PREPARED STUDENTS ENTERING TERTIARY EDUCATION.

Schools

Key achievements

2015 BHP Billiton Foundation invests $22m for a five year national program

2014 AMSPP grant of $200k funds Warialda and Dalby/Oakey clusters

2013 The William Buckland Foundation grant of $450k funds Geelong cluster

2013 DEECD grant of $100k funds Gippsland cluster

2013 Production of *Maths Delivers* videos

2012 Online resources support the new national mathematics curriculum

2011 Second edition of the ICE-EM textbooks published and distributed by CUP

2009 Australian Government grant of $2m for TIMES project

2007 BlueScope Steel grant of $150k supports teachers in the Illawarra

2005 Face-to-face professional development for mathematics teachers

2005 Mathematics textbooks and teacher resources for Years 5–12

2004 Federal Government invests $7.8m to establish ICE-EM

PROGRAM MANAGER

Janine McIntosh
janine@amsi.org.au

AMSI's Schools program has been supporting Australian mathematics teachers and students for over a decade. Face-to-face professional development is delivered through workshops, in-class support, modelled lessons, digital and print resources and program development support. Materials are in line with the Australian curriculum and are tailored to meet the needs of individual schools—our team are experienced primary or secondary teachers.

schools.amsi.org.au

Strengthening Schools

The International Centre of Excellence for Education in Mathematics (ICE-EM), was established in 2004 with assistance from the federal government.

Through ICE-EM, high-quality mathematics texts, teacher resources and PD were developed for Years 5–10. The ICE-EM resources covered the curricula of all states and territories at these levels.

Support from BlueScope Steel allowed ICE-EM to provide texts and teacher professional development to schools in the Illawarra region throughout 2007.

In 2009 the then Department of Education, Employment and Workplace Relations provided funding for the extension of ICE-EM activities under TIMES (The Improving Mathematics Education in Schools). This allowed us to: expand our reach across the country; further develop digital and print teacher resources for Years 5–10; and produce *Maths: Make your career count*—materials that show how mathematics is used daily in many careers.

Dr Frank Barrington, Dr Michael Evans and Peter Brown work with us to collect and publish data on national enrolments in mathematics at Year 12. This work also makes careful state-by-state comparisons of the Year 12 curricula, and is the benchmark study of this kind. The data appears in AMSI's discipline profile each year.

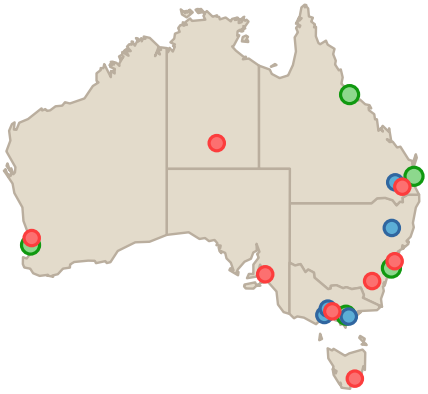
"Every day, every school we visit, teachers are so excited to tell us what their students are gaining from participation in AMSI Schools outreach work."

Janine McIntosh, Program Manager (Schools)

Teacher professional development nation wide

AMSI delivers professional development for mathematics teachers across Australia. We rely heavily on our funding partners: BHP Billiton Foundation, Boeing, The William Buckland Foundation, the Victorian Department of Education and Early Childhood Development (DEECD) and the Australian Government through the Australian Maths and Science Partnership Project (AMSPP) with Regional Universities Network (RUN). Under these partnerships we worked with five clusters of schools—Warialda (NSW), Oakey/Dalby (QLD), Geelong (VIC), Gippsland (VIC) and Yarraville/Footscray (VIC). The Schools outreach program provides targeted support for primary and secondary mathematics teachers through workshops, in-class support, modelled lessons and program development.

Ongoing funding from our partners ensures expansion of our work in metropolitan and remote areas. The ongoing thanks we receive from teachers, students and parents attest to the quality and importance of our work.



"The PD modules are widely used by teacher educators across Australia who regard them as a valuable resource."

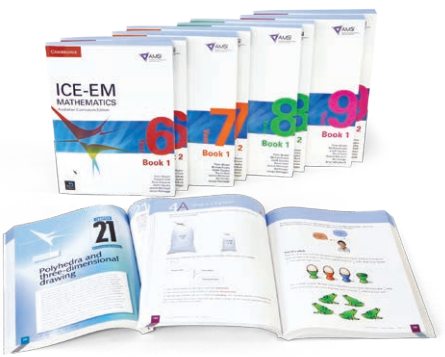
Independent review of AMSI 2010

Australian Curriculum: Mathematics

The Australian Curriculum, Assessment and Reporting Authority (ACARA) actively consult AMSI. Janine McIntosh and Dr Michael Evans were appointed to the 10-member mathematics F–10 writing team by ACARA. AMSI facilitated consultation between ACARA and the Australian Council of Heads of Mathematical Sciences. This connection is extremely valuable: academics aware of where the field is headed are in direct conversation with those establishing mathematics education at its roots. Dr Michael Evans was lead consultant on the Year 11 and 12 curriculum to be implemented from 2016.

ICE-EM Mathematics textbooks

The second edition of the ICE-EM series has been available through Cambridge University Press since 2011. This full-colour edition retains the structure, depth and approach of the first edition but was rewritten to remain in-line with changes to the Australian Curriculum: Mathematics. It covers all required content, as well as providing additional topics relevant and essential for a robust understanding of the curriculum. Coherently written, the series spans Years 5–10, to support the transition from primary to secondary schooling. Review online: **icemaths.org.au**



Online resources for teachers

AMSI Schools has been developing modules that expand and cement teachers' content knowledge for many years. The modules support the implementation of the Australian curriculum in mathematics and are available on our websites and through Scootle—an online resource from Education Services Australia (ESA). Review these resources online: **schools.amsi.org.au/times-modules**

Supporting Australian Mathematics (SAM) is a suite of open-access digital resources developed by AMSI in collaboration with ESA. The resources are aligned with the Australian curriculum and help teachers and students deepen their mathematical content knowledge.

- SAM Middle Years provides teachers and students with access to 45 packages that explain concepts from the mathematics curriculum for Years 5–9. Included are interactive student exercises and teacher resources formed from the Australian curriculum content descriptors. **amsi.org.au/SAM-middleyears**

- SAM Senior Years has been developed for teachers and consists of 25 packages that cover all topics from Years 11 and 12 curricula. Included are interactive animations and screencasts. **amsi.org.au/SAM-senioryears**

The entire collection of resources—available through AMSI's website and ESA's Scootle—provides teachers with focused and reliable reference material, equipping them with tools to engage their students and teach with enthusiasm.

As part of the SAM project, we created four videos that expose students to enticing and exciting applications of mathematics. The videos were professionally produced by Chrissie McIntyre (Catalyst, ABC) and narrated by Lily Serna (Letters and Numbers, SBS). The videos are freely accessible through the SAM website. They look at gene mapping, cryptography, braking distance, and the Google PageRank algorithm. Each video is accompanied by a comprehensive set of notes explaining the mathematics underlying these everyday activities. **amsi.org.au/mathsdelivers**

In conjunction with ESA, AMSI developed material for the *Improve* program which provides students, teachers and parents with an online learning environment to familiarise themselves with NAPLAN-style questions. The aim is to guide students on their approach to the questions this allows them to gain a deeper understanding of NAPLAN expectations.

Our Calculate website provides an online hub for our community. We add new teacher and student resources regularly. **calculate.org.au**

In 2014, ATSE (Australian Academy of Technological Sciences and Engineering) approached AMSI Schools to assist in producing materials as part of the STELR (Science and Technology Education Leveraging Relevance) project. This collaboration promotes links between the science, geography and mathematics curricula. View the materials online: **stelr.org.au/maths-of-solar-panels**

"Any head of mathematics or mathematics teacher who really values the mathematical education of our children and the future of our economy should be using these resources."

Otieno Ogunah, Southern Highlands Christian School, NSW

AMSI Gender Report

AMSI undertook an international literature search on gender bias in the mathematical sciences and reported the results in the AMSI Gender Report 2014. The research articulates the underlying causes of under representation of women in STEM fields, particularly mathematics, and outlines effective measures for causing change. This research provides the evidence base for the design of the BHP Billiton Foundation program. Review our gender report online: **amsi.org.au/genderreport2014**

Resources available through TES Australia

We were invited to share our online teacher resources on the TES Australia website. This site is the Australian division of TES Connect—the world's largest digital network of teachers—that currently boasts 3.6 million registered users in Australia and first published the TIMES Educational Supplement over 100 years ago. The TES Australia site provides teachers with free access to over 500,000 resources, lesson plans, worksheets and activities. AMSI became a member of TES Australia in 2013. Since then there has been a staggering 23,985 unique views of the 100 resources we shared.

Andrew Mackenzie, CEO BHP Billiton

Careers

Addressing the skills deficit

The mathematical sciences can have a significant impact on enhancing national productivity by addressing our country's challenges in areas as disparate as health care, the development of new industries, taming the data deluge and national security.

Australia has been running a mathematical deficit for years; the fundamental role played by mathematical scientists must enter the limelight; the demand for these professionals must cease to outstrip supply.

All four of AMSI's portfolios work together to bring, the often hidden, mathematics into full view: we developed *Maths: make your career count* resources that highlight a variety of careers where maths is used and have a stand at *The Age Careers Expo* each May; we host careers events that explore the diverse perspectives organisations have of maths in industry, as well as inviting alumni, researchers and professionals to talk at careers panels—the panels allow smaller groups of students to come together for intimate and informal discussions about paths they can take; and we place postgraduate students into industry, to address the work-readiness of research students and provide opportunities for students to network and form contacts with potential employers.

BHP Billiton Foundation digs deep with $22m invesment

Launched in April 2015, this five-year national program will turn around public perception of mathematics and statistics as a career choice for girls and young women

Working from the ground up, the partnership begins with a focus on mathematics education in primary and secondary schools. The BHP Billiton Foundation has contributed $22 million toward the partnership, which will enable AMSI Schools to expand its outreach capacity across Australia.

The program will contribute to the health of the mathematics pipeline from school through university and out to industry and the workplace by providing:

- mathematics-ready teacher professional development in 120 schools across Australia and resources for every school in the country;
- developing a national mathematical sciences careers awareness campaign;
- establishing an "inspiring women in mathematics network"; and
- holding annual BHP Billiton awards for excellence in the teaching and learning of mathematics.

Research-based strategies for encouraging girls and young women into mathematics and STEM-related courses will be core to the program. The large-scale careers awareness campaign will be driven by research into community perceptions about mathematics.

Top right: Andrew Mackenzie and Michelle Raftus from BHP with Janine McIntosh, Program Manager (Schools)
Right: Lily Serna, mathematician and TV personality

"AMSI is a leader in the field of STEM and I'm proud that we're able to partner in developing this targeted and sustainable program to address the gender dynamic in the teaching and learning of maths."

Andrew Mackenzie, CEO BHP Billiton

Maths Ad(d)s

Part of AMSI's careers outreach is to inform teachers, parents, career advisors, school students and university students of the breadth of careers that involve mathematics and statistics. In conjunction with La Trobe University, we produce *Maths Ad(d)s*. This booklet gathers together job advertisements that have recently appeared online. The common theme of the ads is mathematics and statistics, but the actual jobs range from manufacturing to academia, and everything in between.

2014 saw us publish the 17th edition of *Maths Ad(d)s*. The Hon Christopher Pyne, MP, Minister for Education, endorsed this edition and the PDF was distributed to Australian high schools with the assistance of the Australian Association of Mathematics Teachers (AAMT). AMSI has been aiming for an increase in the awareness of possible careers available to those who include mathematics or statistics in their degrees—the popularity and reach *Maths Ad(d)s* currently holds is achieving this mission.

AMSI also has a dedicated careers website. Here the general public can find out about careers in mathematics and, mathematics in careers. Orders can also be placed on this site for *Maths Ad(d)s* and the *Maths: make your career count* materials.
careers.amsi.org.au/mathsadds

"I commend AMSI for this publication [Maths Ad(d)s], which is an example of its leadership in mathematical education."

The Hon Christopher Pyne MP, Minister for Education and Training

Assoc. Prof. Zhiyong Chen,
The University of Newcastle,
2015 Summer School

AMSI'S **HIGHER EDUCATION** PROGRAM PURSUES OUR MISSION TO ENHANCE THE UNDERGRADUATE AND POSTGRADUATE EXPERIENCE OF STUDENTS IN THE MATHEMATICAL SCIENCES AND RELATED DISCIPLINES.

Key achievements

2014 96 per cent increase in participation since 2012
2014 Partnership with the ABACBS
2014 Ongoing funding agreement for annual AMSSC begins
2013 Partnership with the AustMS WiMSiG
2012 Department of Education and Training invests $2m
2011 National bioinformatics partnership with EMBL Australia and BioPlatforms Australia
2008 Grant for *Mathematics for 21st Century Engineering Students* reserach project
2007 ACE (formerly AGR) broadcasts courses and provides remote access to honours subjects
2005 Inaugural AMSI Winter School
2003 Department of Education and Training invests $7.8m
2003 Annual BioInfoSummer symposium begin
2002 Launch of the annual AMSI Summer School and VRS

Higher Education

PROGRAM MANAGER
Simi Henderson
simi@amsi.org.au

STEM disciplines are the building blocks for future technologies and the ideas that will improve Australian lives and the country's prosperity. Our flagship research training schools, scholarships and graduate courses have built student networks and created the vibrant young community of researchers so important for innovation in the public and private sectors.

highered.amsi.org.au

Enhancing the student experience

AMSI's flagship events bring together students from around Australia to develop and cement their talents. Students take specialist subjects taught by experts in the field, meet potential employers, build networks and establish research collaborations.

Since 2007 AMSI has delivered 136 honours subjects remotely using the ACE network. The shared honours program ensures students enrolled at any AMSI member institution can remotely access a wider range of honours courses. This is of significant benefit to AMSI's smaller member institutions as it supports their honours program.

The national upgrade from AGR to ACE, in 2015, will give greater access to our members and make remote collaboration more user-friendly.

Our support of the Australian Mathematical Sciences Student Conference (AMSSC) assists Australian students to communicate their work and it encourages collaboration within an informal setting. The conference is run annually for students by students.

96%
increase in participation across our flagship events since DoET funding began in 2012

"The Australian Government is proud to invest in the valuable work done by AMSI to support students to get the very best start in their maths and science education and careers."

Senator the Hon Scott Ryan, Parliamentary Secretary to the Minister for Education and Training


2,500
likes on Facebook

9,200
e-news subscribers

Positive steps to encourage female participation

Currently women make up less than 30 per cent of undergraduate and postgraduate enrolments in the mathematical sciences. We have introduced a number of measures to support female participation in our programs, including embedded women in maths events, in collaboration with the AustMS Women in Mathematics Special Interest Group (WiMSiG), targets for participation and increased female representation among speakers.

We have seen a 133 per cent increase in female participation across our flagship events since 2011—testament to our positive actions.

"The best thing about the graduate theme program was being exposed to fields far from my own and being taken out of my comfort zone."

Chris Chapman, Australian National University

Winter School

Our Winter School is based on successful European and US models. Themed each year the intensive two-week program offers courses in advanced postgraduate mathematics. It is designed for graduate students and postdoctoral fellows in the mathematical sciences and cognate disciplines and is hosted by one of AMSI's full member institutions in Queensland.

The first week provides an overview of the topic; the second week comprises in-depth specialist lectures from eminent national and international academics.

Recent themes have included:

- contemporary aspects of cryptography;
- geometric partial differential equations;
- global optimisation; and
- graphs, networks and designs.

306
students supported over 9 Winter Schools

Summer School

1,664
students attended over the last 13 Summer Schools

Each year a different AMSI member institution hosts Summer School; over the last 13 years 1,664 students have attended the four-week residential school. Students have the opportunity to tackle one or two intensive subjects that may not be available at their home institution.

Classes are chosen from eight honours level subjects in pure and applied mathematics and statistics. Academic work is complemented by enrichment lectures, social events, careers information sessions and other special events. Summer School is a fantastic opportunity for students to be immersed in the mathematical sciences. It is the largest maths and stats event for students in Australia and attracts international students each year.



BioInfoSummer

BioInfoSummer is the major annual bioinformatics event in Australia. This exciting area of science blends technologies from mathematics, statistics and computing to solve biological problems.

Two hundred students and researchers from the public and private sectors gather at BioInfoSummer to learn about the latest developments in bioinformatics. In 2014, Senator Scott Ryan opened the conference by highlighting the importance of bioinformatics and the advanced mathematical, statistical and computational techniques that underpin it.

Each year an outstanding group of Australian and international speakers help upskill and inspire delegates through careers information, lectures and software training.

BioInfoSummer is supported by the Australian Bioinformatics and Computational Biology Society (ABACBS), EMBL Australia and Bioplatforms Australia.

ABACBS

EMBL Australia

BIOPLATFORMS AUSTRALIA

"Bioinformatics is an exciting, fascinating and high-paced field that has real potential to make a difference to people."

Dr Alicia Oshlack, Head of Bioinformatics, Murdoch Childrens Research Institute

Vacation Research Scholarships (VRS)

Each year between 50 and 60 of our brightest undergraduate students work throughout summer on a research project. Over six weeks, students experience life as a researcher, work closely with a supervisor and present their findings at the Big Day In conference. AMSI provides monetary scholarships to give students a taste of research life and encourage them to pursue mathematics as a career. Since 2002, 428 students have participated in the program.

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; and
- Lines and circles in the three-dimensional Heisenberg group.

The VRS program is essential to safeguard Australia's future supply of researchers with expertise in the mathematical sciences: it encourages students to take their studies to the next level and to pursue mathematics as a career.

Evidently, the program delivers; a generation on and several VRS students are now VRS supervisors.

428 students have completed a VRS

"Being a VRS student gave me the confidence to believe I could pursue mathematics as a career. As a VRS supervisor I can pass that message on, and tell my students that their skills are valuable."

Dr Simon James, 2006 VRS student and 2014 VRS supervisor

Melanie Kaasinen
Queensland University of Technology
CSIRO's Big Day In 2014

THE AMSI **RESEARCH** PROGRAM HAS BEEN SUPPORTING AND BUILDING AUSTRALIA'S RESEARCH BASE SINCE 2002. DELIVERING ON OUR MISSION TO SUPPORT MATHEMATICAL SCIENCES RESEARCH AND ITS APPLICATIONS.

Key achievements

2014 AMSI-CARMA research collaboration begins
2014 ANU Mathematical Sciences Institute special year partnership
2013 International Year of the Mathematics of Planet Earth
2012 MISG partnership with ANZIAM
2012 National Seminar Series begins over the ACE Network
2011 AMSI, AustMS and ANZIAM scientific funding partnership
2009 Inaugural *Early Career Workshop*
2007 ACE (formerly AGR) network provides global access to seminars
2007 CASR grant of $2m to build research-industry linkages
2006 AMSI Travel Fund established
2005 Annual AMSI Distinguished Lecture Tours begin
2005 MITACS and MASCOS partnership
2004 AMSI Scientific Workshop Funding commences
2003 Partners in the establishment of MASCOS

PROGRAM MANAGER

Simi Henderson
simi@amsi.org.au

Research

AMSI's Research program has one of the nation's largest sustained workshop programs and our stewardship of the Mathematics of Planet Earth in Australia won us international acclaim.

The program facilitates national and international research collaborations and provides training and support to students and early career researchers. We also support and promote Australia's academic community, fostering the critical links between researchers in universities, government agencies and business. And we provide a platform for cross-disciplinary collaboration.

research.amsi.org.au

229
scientific events funded

460
travel grants awarded

Facilitating national & international collaboration

AMSI is acknowledged for promoting collaborative mathematical research through an internationally recognised program of scientific events. We bring together researchers from around the world to strengthen Australia's research capability.

Annually our scientific workshop program awards $120,000 in sponsorship for 20 scientific workshops, international and local conferences. We also provide 50 travel grants for AMSI members to attend these workshops.

In 2014, our workshop funding program was overhauled and we refined the delivery of the workshops to increase national benefit for our members. The workshop topics range from fractal geometry to mathematical finance.

The program has funded 229 scientific events and awarded 460 travel grants since inception.

We keep the community connected through our e-news, interactive websites and social media.

"AMSI travel funding offers great support to our young researchers helping them build their experience and networks by supporting them to attend events all around Australia."

Professor Joe Grotowski, Head, School of Mathematics and Physics, The University of Queensland

Australia New Zealand Applied Probability Workshop

Professor John A G Roberts,
The University of New South Wales,
Nonlinear Dynamical Systems Workshop

Particpants at the MPE Mathematics of Transportation Networks Workshop

Supporting Australia's young researchers

Since 2009, AustMS, ANZIAM and AMSI have put on an annual *Early Career Workshop.* The workshop has provided a forum for over 500 young researchers to build their networks and increase their skills. Attendees receive advice from experts on a broad range of topics from the secrets to grant success to effective strategies in managing time between teaching, research and administrative commitments. This workshop is part of our mission to enhance the postgraduate experience of students.

International expertise

The AMSI Distinguished Lecture Tour and the Mahler Lecture Tour, in conjunction with AustMS, ANZIAM and the SSAI, engage and inspire the research community and the general public. Each year, our scientific workshop program sponsors between 50 and 60 international academics' visits to Australia.

MPE 2013

The International Year of Mathematics of Planet Earth 2013 brought together scientific societies, universities, research institutes and foundations from all corners of the globe. AMSI Members and MPE partners, 44 organisations and groups in total, joined together to present a broad program of scientific and outreach events throughout 2013. MPE highlighted the underlying mathematics of current global issues and the research efforts tackling these problems. Further details page 11.
mathsofplanetearth.org.au

Advanced Collaborative Environment (ACE)

The National Seminar Series broadcasts specialist lectures and has included talks from Fields medalists and young prize-winning researchers. In 2014, we made a major investment to upgrade the software to enhance and simplify national collaboration. The seminars are run in collaboration with the AustMS, ANZIAM, the Australian and New Zealand Association of Mathematical Physics, the Australian Society for Operations Research and the SSAI.

Research partnerships

AMSI has established and maintained partnerships with leading research networks across Australia. These relationships provide mutual benefit by bringing the community together and increasing national participation.

The Mathematical Sciences Institute at the Australian National University and the Centre for Computer Assisted Research Mathematics and its Applications (CARMA) at the University of Newcastle, are our newest partners. These agreements will enhance and increase the reach of our individual programs.

Industry linkages

The Mathematics in Industry Study Group (MISG) is an annual collaboration of ANZIAM and AMSI, currently held at the University of South Australia. Over a hundred mathematicians and statisticians come together at MISG to apply their expert knowledge to help solve real world, relevant problems to industry.
mathsinindustry.com

ACE Network

"This new partnership provides an exciting opportunity to expand the reach of CARMA programs—delivering long-term national benefit."

Laureate Professor Jon Borwein, Director of Computer Assisted Research Mathematics and its Applications (CARMA)

Selva Murugesan,
Internship with Intelligent Energy
Systems Private Ltd (IESYS)

AMSI INTERN PROVIDES A LINK BETWEEN AMSI'S MEMBER INSTITUTIONS AND THE BUSINESS COMMUNITY. THIS SUPPORTS MATHEMATICAL SCIENCES RESEARCH BY INCREASING THE QUALITY AND QUANTITY OF INDUSTRY-ACADEMIC COLLABORATIONS.

Key achievements

2015 $1.6m in intern stipend payments
2015 $630k in mentor payments
2014 Co-investment agreement with eight Australian universities
2014 Partnerships with ACFS and DSI
2014 DSTO joins AMSI membership to access internship program
2014 Service expanded to include 25 industry sectors
2014 Supplier of the NT government R&D voucher program
2013 Supplier of the VIC government DSDBI R&D Voucher Program
2013 Accelerate Australia forum
2010 Three-year Enterprise Connect funding begins
2009 Expansion to place interns from all disciplines
2007 CASR grant from the Australian Government

NATIONAL PROGRAM MANAGER

Dr Hannah Hartig
hannah@amsi.org.au

AMSIIntern

Many types of organisations contact AMSI Intern in search of help to solve problems facing their business. AMSI Intern connects these organisations with postgraduate students with the expertise needed to help solve these problems through short, focused internships.

AMSI Intern provides postgraduate students with the opportunity to apply their expertise to real world problems and to develop valuable skills to improve their work-readiness for future employment.

The student is supported throughout their internship by a supervisor from within the partner organisation, an academic mentor from an AMSI member university and an AMSI Intern facilitator.

We provide organisations with a simple, cost-effective and flexible option to obtain expert advice and research capability. An internship can be used to build continuing relationships with the university and provides SMEs, large companies and agencies access to the cutting edge expertise of academia: driving company innovation and growth.

Since the program began in 2009, over 130 interns have been placed into a variety of public and private organisations, with companies reporting a satisfaction rating of 97 per cent.

Visionary partnerships

In 2014 growth of the AMSI Intern program was significant; establishing partnerships with two key national industry associations—the Australian Centre of Financial Services (ACFS) and the Defence Science Institute (DSI). These agreements will add to our growth and reach and have been accomplished on the back of AMSI Intern's continuing success.

As of December 2014, AMSI Intern secured a co-investment partnership arrangement with six member universities in Victoria and two in NSW. The $6.7 million investment will expand and build AMSI Intern's scale with four new business development officers to help industry connect with university expertise. The co-investment will increase opportunities for PhDs to gain valuable work place experience and will improve their ability to communicate and collaborate with industry.

It is the intention to roll the program out to other states in 2016 and 2017.

"AMSI Intern is central to our strategy to build stronger industry-university connections for the benefit of defence R&D."

Assoc. Prof. Simon Ng, Assoc. Director of DSI

Intern case studies

Mathematical modelling, delivering Victoria's water future

"Sonya's work is vital for water management plans in Melbourne and Victoria, and for gaining a greater understanding of how future climate change may affect water availability."

Dr Bertrand Timbal, Bureau of Meteorology

From living at the base of the Victorian Alps to beside the waters of the southeast peninsula, Sonya Fiddes regularly swapped between skis and sails. Both activities are weather dependent and Sonya guesses these experiences inspired her to take advanced studies in weather at the University of Melbourne.

During her internship, at the Bureau of Meteorology, Sonya assisted researchers to investigate and evaluate the effect of rainfall patterns on Victorian water catchments.

"If you have a smartphone, you probably have a weather app. The chance of rain estimates on these apps are generally calculated using models that give an answer for a 5km by 5km land grid for a few days," Sonya says.

"My research is maths heavy and provides the same resolution for climate change projections on century time-scales! And, it has increased the resolution of rainfall events across the state. We can now see what is going on in different parts of a suburb; this is really important as the terrain surrounding typical Victorian water catchments is complex," she says.

You don't need to be a scientist to know this will make projections more accurate!

Intern: Sonya Fiddes, The University of Melbourne
Industry Partner: Dr Bertrand Timbal, Bureau of Meteorology (BoM)
Academic Mentor: Prof. David Karoly, The University of Melbourne

Financial investments; a modeller's minefield

"Optimo had developed a conceptual approach. The academic mentors and Wei were able to make certain the proposed approach was theoretically and practically sound and were also able to explore possible improvements."

Hugh Bannister, Optimo Financial

Budgeting, it's a cringe worthy word. Optimisation, that sounds more like it! But have you the faintest idea of what it is? And did you know that mathematicians use it to help financial planners increase the expected size of their clients' financial nest egg?

AMSI Intern, Wei Wu, is well versed in the mathematical technique of optimisation used in finance. In fact, his expertise landed him an internship at Optimo Financial.

Hugh Bannister, Principal at Optimo Financial, has been building energy and financial models using optimisation techniques for over 25 years. He believes the work completed during Wei's internship will allow Optimo to improve its offerings to the market.

Wei, a PhD candidate at the University of New South Wales, says: "People have different investment needs, some invest for the short-term, saving for a house deposit, or long term, saving for their retirement. I was able to apply my mathematical skills to help financial planners find the best investment strategies for their clients by looking at, and taking into account, numerous factors."

Intern: Wei Wu, The University of New South Wales
Industry Partner: Hugh Bannister, Principal, Optimo Financial
Academic Mentors: Prof. Ben Goldys, The University of Sydney, Assoc. Prof. Spiridon Penev, The University of New South Wales

Also in 2014, the Defence Science and Technology Organisation (DSTO) joined the AMSI membership to take advantage of our intern program. Placements have commenced with DSTO and will help to grow AMSI Intern's impact in defence R&D. The worth of the program has also been recognised by large businesses; we are currently working with Canon, NBN Co, ANZ, NAB, CSL and Telstra. In 2010, we began a successful three year partnership with Enterprise Connect—this federal government partnership subsidised the placement of 33 PhD interns into SMEs across Australia.

Voucher programs

In 2014, we become suppliers for the NT government's Innovation and Technology Vouchers. Both voucher programs provide funding to help businesses improve their competitiveness and productivity.

In July 2013, AMSI Intern became an approved supplier of the Victorian government's Business R&D Voucher Program, which provides access to innovation and R&D funding of up to $25,000 for Victorian small to medium enterprises (SMEs).

Accelerate Australia

Accelerate Australia was held in February 2013 at the National Convention Centre in Canberra. The forum acted as a platform for discussions on industry engagement and the work-readiness of PhD students. The event featured distinguished speakers from industry, government and research. Professor Arvind Gupta, Vice Chancellor and President of the University of British Colombia, the then CEO and Scientific Director of Mitacs, gave the keynote address. Professor Gupta observed: "A key factor in driving innovation in industry is strong engagement with the research community." Professors Ian Chubb and Aidan Byrne also gave rousing addresses.

"We need to build Australia's human capacity in a range of research areas by attracting and retaining the most promising research students. The AMSI Intern program shows a great deal of promise as a way to connect researchers in universities with industry to solve problems," says Professor Aidan Byrne, CEO, Australian Research Council.

"Work-readiness of our PhD students, and the links between industry engagement and national productivity, are critically important [...] We need to give our students the opportunity to undertake business-related research projects [...] The AMSI Intern program is one such shining example."

Prof. Ian Chubb, Chief Scientist of Australia

Parks Victoria

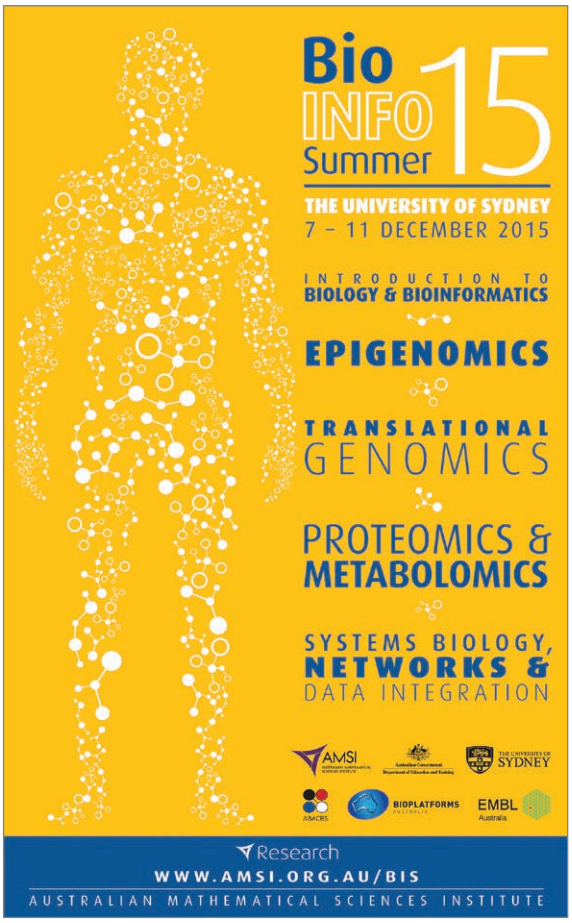
Over the last five years AMSI has been providing Parks Victoria with a consultant statistician. Presently, Kally Yuen is embedded within the organisation. Her work with Parks Victoria has had significant benefits. Kally provides advice and analysis for a range of projects across Victoria. Kally also assists with the implementation and tracking of new systems.

Throughout her time as the resident statistician at Parks Victoria Kally has: conducted a three year study of weed monitoring in the Dandenong ranges; evaluated the differences in an experimental weed management program in the Alpine National Park; been involved in remote camera monitoring across a range of parks and habitats, from this Kally co-wrote a chapter in the CSIRO publication 'Camera trapping wildlife management and research'; and she has assisted with all AMSI Interns placed at Parks Victoria.

We have developed a mutually beneficial ongoing relationship with Parks Victoria that delivers improved project outcomes and has significant benefits for the conservation of Australia's iconic flora and fauna.

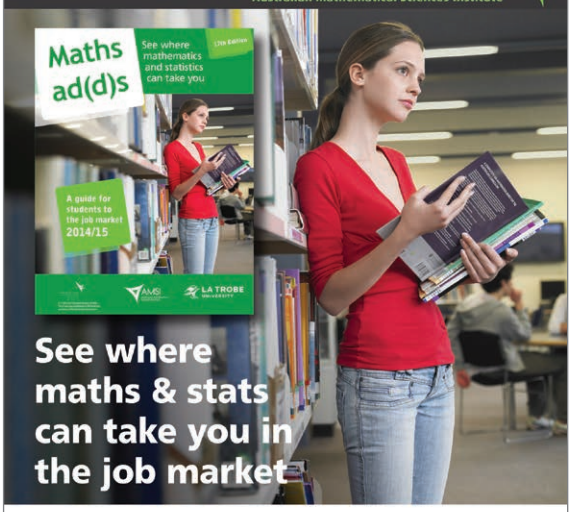
Parks VICTORIA

AMSI Communications



Careers

Australian Mathematical Sciences Institute



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Winter School 2015

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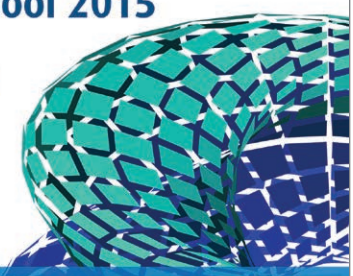

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RMIT University
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DESIGN & ANALYSIS OF EXPERIMENTS
Stelios Georgiou, RMIT University

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Stephen Davis, RMIT University

CALCULUS OF VARIATIONS: THEORY & PRACTICE
Julie Clutterbuck, The Australian National University & Anja Slim, Monash University

PROJECTIVE GEOMETRY
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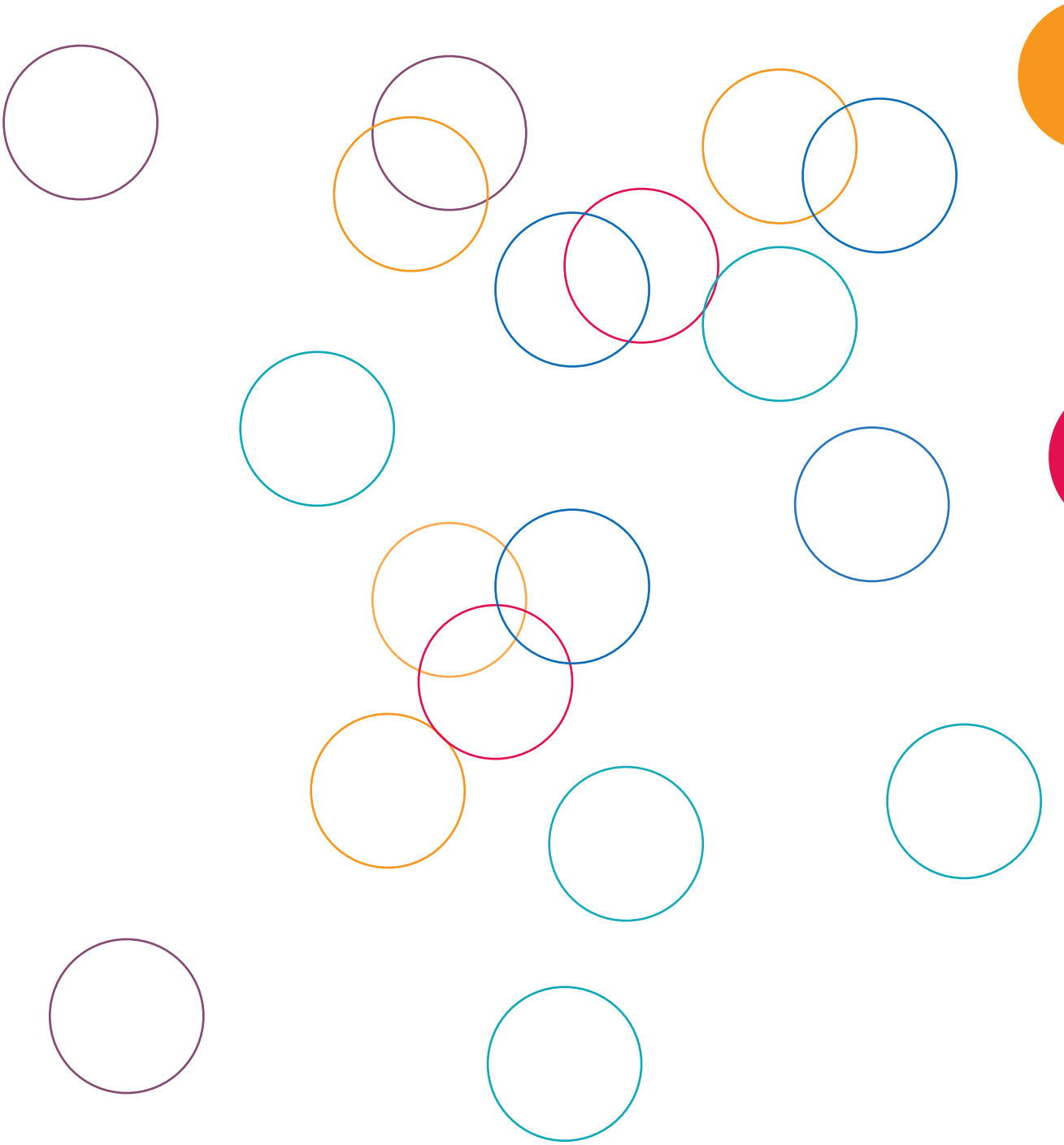

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