AMSI

AUSTRALIAN MATHEMATICAL
SCIENCES INSTITUTE

Annual Report 2010 - 2011

Contents

The AMSI Review

"The Panel was left in no doubt that the Australian mathematical sciences community is the richer for AMSI's existence."

AMSI and its members share the common aim of improving the mathematical capacity and capability of Australia in research, education and industry.

With eight years since AMSI's establishment in 2002, it was considered appropriate to undertake a formal review of the Institute's activities, structure and aspirations. The review has allowed AMSI to reflect on its successes and identify opportunities for future development.

The external review was conducted in February 2011, under the guidance of the panel's Chair, Dr Ron Sandland AM.

The panel recognised AMSI's prominent role as an advocate for the mathematical sciences discipline, as well as the achievements of the ICE-EM in improving the profile and quality of mathematics education in schools. The review panel's recommendations fell broadly into three categories: the vision and mission of AMSI, governance structures, and membership.

The panel recommended a revisitation of AMSI's mission statement to appropriately reflect the long-term aspirations of the Institute. This issue was addressed at the members' meeting in February, and AMSI now has a refined mission statement that clearly articulates its agenda in advocacy, research, education and industry.

Over the coming months, the AMSI Board will be restructured. The representation of AMSI members and key stakeholders on the Board will be increased, creating a critical, self-motivated framework upon which to monitor AMSI's activities as it carries out its mission. Additionally, the Board has resolved to renegotiate the Joint Venture Agreement in light of the evolution of the Institute since 2002.

Review panel: Celia Hoyles, Gaven Martin, Ron Sandland and Arvind Gupta

AMSI's ongoing advocacy role will continue to be promoted as one of the key long-term benefits of membership. AMSI has built a strong reputation as an advocate for the mathematical sciences discipline, leading to a raised profile with government, additional funding for universities, and world-class education resources for students and educators.

The panel's recommendations are being implemented and AMSI believes that this review will lead to a brighter future for the mathematical sciences in Australia.

"AMSI has clearly established itself as the key national body for facilitating the advancement of mathematics in its multifarious aspects in Australia."

"AMSI's educational outreach activities are first class and wide ranging."

Recommendations

1 Develop a strategy with a clearly articulated mission, vision and linked performance goals. Its performance against these goals should be actively monitored by the Board.

2 Develop a strategic approach to lift the level of research activity in the mathematical sciences in universities outside the major institutions.

3 Develop strong linkages and collaborative programs with international mathematical research institutes.

4 Ensure the graduate internship program is aligned to AMSI's goals. It should introduce a formal process for ensuring that internships are high-quality research projects and align its activities to best international practice (MITACS, the Smith Institute).

5 Reinvigorate the AMSI Industry Advisory Committee. Minimally the Committee should have the resources to sponsor at least one high-quality industry-academic event each year and a brief to consider longer-term strategic initiatives such as developing a bid for a multi-disciplinary industry-focused Cooperative Research Centre.

6 Engage the leadership of MISG to understand whether a synergistic linkage can be developed, for example the MISG might be a rich source of research projects for the graduate internship program.

7 Develop a future overarching strategy for the Institute's outreach role in education following reflection on its successes and challenges. Special consideration should be taken of the introduction and roll out of the new Australian National Curriculum and the challenges this introduces for mathematics teaching and learning.

8 Continue to serve as a bridge between mathematicians and the mathematics education community in order to develop further genuine and mutually beneficial partnerships with key organisations.

9 Consider identifying key areas of concern in mathematics education and outreach on which partnership initiatives might usefully be undertaken.

10 Document and analyse the impact of AMSI's work to date on teachers and on learners and clearly communicate how AMSI adds value for mathematics teaching and learning and careers advice to its members and also to the wider mathematics education community.

11 Consider developing its linkages and collaborative programs with international groups in mathematics education, possibly, but not exclusively, through activities of the International Commission on Mathematical Instruction (ICMI).

12 Build international partnerships through the summer schools. This will allow additional international students to attend these schools while allowing AMSI to offer a broader range of schools at minimal cost.

13 Maintain the vacation scholarships program while improving the marketing of these scholarships to engage outstanding students in challenging research problems and potentially recruit them for postgraduate studies.

14 Continue, in collaboration with its members, with the development of a proposal for a co-funded research centre partnering with the ARC, DIISR and DEEWR using it as an opportunity to build stronger relations with the members and other stakeholders. This needs to be executed with a high degree of professionalism to align fully with the Government's budgetary cycle processes.

15 Clearly communicate its value proposition to its members to create an understanding of the importance of the total AMSI contribution (including its advocacy role) and not simply focus on the direct, immediate benefits (local workshops etc).

16 Develop and implement a business development strategy to identify and exploit funding opportunities consistent with AMSI's overall mission.

17 Develop a clear succession plan to ensure continuity of effective operations when a number of senior staff retire in the near future.

18 Review its communication strategy to address the effectiveness of its current vehicles and tailor these to the needs of stakeholders. This review should address its web strategy to enhance its national and international presence, as well as encouraging its members to understand that communication is a two-way process and that they have a responsibility to participate in AMSI decision making.

19 AMSI should move away from the current representational model for the Board to one comprising largely independent members, the Director of AMSI and the DVC(R) of the University of Melbourne. The independent members should be chosen to reflect the skills needed to give effect to AMSI's strategy and mission.

20 The University of Melbourne should remain as the Lead Agent for AMSI but that the management of AMSI should move to the Office of the DVC(R) to reduce potential conflicts of interest and improve relations with the Department of Mathematics and Statistics. It will also enhance the profile of AMSI within the University and create an appropriate Lead Agency relationship between the University and AMSI.

21 To give effect to the above two recommendations it will be necessary to re-negotiate the JVA between AMSI and its members. This should be done as expeditiously as possible.

22 AMSI should review the membership strategy to increase the efficiency of the fund-raising process. We believe a staggered three-year membership cycle would be appropriate.

23 AMSI should clearly articulate the differentiated benefits available to the two classes of members and consider whether the fee differential is warranted. We do not recommend increasing the fee level for full members but AMSI should consider whether the fee level for associate members should be increased or whether a third (intermediate) membership class should be introduced.

About AMSI

The Australian Mathematical Sciences Institute (AMSI) is a national, collaborative venture of 35 universities and organisations around Australia. AMSI has a high profile in the mathematical sciences both nationally and internationally.

Membership

ASSOCIATE MEMBERS

Australian Bureau of Statistics
Australian Mathematics Trust
CSIRO
Central Queensland University
Charles Sturt University
Curtin University of Technology
Deakin University
James Cook University
Macquarie University
Queensland University of Technology
Swinburne University of Technology
University of Ballarat
University of Canberra
The University of New England
The University of Newcastle
University of South Australia
University of Southern Queensland
University of Technology, Sydney
The University of Western Sydney
University of Wollongong
Victoria University

FULL MEMBERS

The Australian National University
La Trobe University
Monash University
RMIT University
The University of Adelaide
The University of Melbourne
The University of New South Wales
The University of Queensland
The University of Sydney
The University of Western Australia

SOCIETY MEMBERS

Australian Mathematical Society

AMSI's Mission

AMSI's 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

Chair's Report

2010/2011 has been an eventful year for AMSI. Most notably it has seen the first full, formal, external review of the organisation and its objectives and operations. In addition, it has seen some significant changes in government policy that have adversely impacted on our ability to secure federal government funding support. Thirdly, there have been significant personnel changes, with several longstanding senior staff retiring, or about to retire. Each of these issues has raised significant challenges for AMSI as it plans for the future.

Clearly the review of AMSI has been a major initiative. The Review was led by Dr Ron Sandland AM, and I would like to thank Dr Sandland and his team for their deep and thorough review. The outcome was a series of 23 recommendations, which are presented on page 5. Suffice to say that the Board considered the recommendations and endorsed all of them, with only relatively minor adjustment to a few recommendations. The recommendations covered governance; the need for a revisitation of the fundamental Joint Venture Agreement (JVA) arrangements; explicit articulation of more focused vision and mission statements for the organisation; changed arrangements with the University of Melbourne as Host Institution; a review of the financial support for AMSI, and a range of other matters which are presented elsewhere in this annual report.

The Review was circulated to members and discussed at a members' meeting in February 2011. At this meeting, members endorsed the decision of the Board in accepting the recommendations. The issues involved with reformulating the vision and mission for AMSI were tackled at that meeting and a new statement was established (see page 7). I would particularly like to acknowledge Board Member Dr Eileen Doyle for her significant and helpful contribution in facilitating this process.

In addition to this focus on a current vision and mission statement, the meeting also endorsed a number of actions aimed at implementing the review recommendations at large. Thus the review of the composition of the Board; the arrangements necessary to revise the JVA document; the review of the fee structure; endorsement of the intern program initiatives; and the negotiations with the University of Melbourne for changed administrative arrangements, were all agreed and endorsed at this meeting.

The second significant issue this year has been the change in federal government policy with respect to funding, in particular, the devolution of funding in school education to the states. This is an important change for AMSI because over the past eight years we have been able to secure funding from Canberra for national initiatives, like the ICE-EM and TIMES programs, which enabled AMSI to prosecute projects with a national focus. This change in policy has meant that funding for these programs has effectively ceased, as none of the states are minded to fund initiatives of this kind from their own budgets. The most immediate impact has been the ending of the TIMES project, which has forced us to reduce our staff who were funded by this program. We are seeking alternative sources of support but this is a difficult task in the current economic climate and will require a rethinking of how we might best contribute in this important area.

On a more positive note, we are actively progressing discussions around the establishment of a national research institute. Whilst we are not yet at the point where funding is likely to flow in the immediate term, the discussions are positive and encouraging for some support in a more favourable economic and political environment. In this endeavour we have pleased with the support of other interested parties such as the CSIRO and have formed a welcome partnership with them to prosecute this initiative together.

The third significant development over the year has been the departure of several longstanding AMSI staff members. Notable amongst these has been Jan Thomas, Dick Barker and Thomas Montague. Collectively this is a significant loss of capacity, skill and institute memory. Geoff Prince has been active in seeking capable replacements and we look forward to refreshing the organisation with a new cohort of capable senior staff. I want to record my appreciation of the contribution

of each of the above staff. Jan has been a motive force in our advocacy program over many years; Dick has been a tower of strength in handling the finances and in bringing commercial pragmatism to the organisation, most tellingly as reflected in our agreement with Cambridge University Press for the publication of the second edition of the ICE-EM texts; and Tom Montague has soldiered valiantly in getting the intern program up and running. To all I pass on AMSI members' appreciation and my personal thanks for a wonderful, sustained performance.

There have been other significant matters worthy of brief mention as well. I mention in particular, and with much appreciation, the continued support of the University of Melbourne. This has been reflected in many ways. The University has been receptive to a changed administrative arrangement that sees the University's roles as Lead Agency and Host Institution, versus its role as a Full Member of AMSI, separated and clarified. This will see strategic issues resting within the responsibility of the DVC Research, and administration matters moved from the Department of Mathematics and Statistics to the Faculty of Science. This allows the University's membership role to be taken by the Department to the benefit of all, and with the added benefit of the roles being transparent and separate. In addition, the University has been most generous with its tangible support during this past year. This has been reflected most obviously via the provision of new accommodation for AMSI offices within the main campus of the university. Space is at a premium in all universities and AMSI has been most favourably accommodated in a refurbished, free standing, two-story building within the main campus. I acknowledge this generosity with the Institute's genuine appreciation of this support.

In concluding, I would like to make three further points. First, to thank the staff

of AMSI, particularly Geoff Prince for his contribution as Director of AMSI. AMSI has been well served by its three Directors and Geoff is doing a fine job navigating the organisation through a difficult transition period. Geoff's enthusiasm, energy, judgment and competence in managing within this environment have been a major contributor to the Institute's success during some trying times, and he is well supported by a truly dedicated staff.

Secondly, I confirm my own retirement from the position of Chairman of AMSI from 1 September 2011. It will have been just short of ten years since I accepted the invitation to take the Chairman's role. It has been a privilege to be part of AMSI's establishment and growth into a very effective advocate for the mathematical sciences within the country. The role has been made easier by the tremendous support of the members and staff of AMSI. I have already acknowledged many who have played senior roles, but the mathematical sciences discipline is well served by the full staff of AMSI and the multitude of individuals who have served in a voluntary capacity on committees and task forces over the years. There is no other like body to AMSI in the country and the mathematics and statistics community can take considerable pride in the establishment and maintenance of AMSI for almost a decade.

Finally, I am pleased to be passing the role of Chairman of AMSI to a mathematician and business person, Dr Ron Sandland AM. Ron has had a distinguished career and has been engaged at senior levels with the CSIRO and with many government initiatives. I am confident that AMSI will benefit greatly from Ron's arrival and the different perspectives he brings. I wish him well in the new role.

With every good wish to AMSI and the mathematics and statistics community nationally for the future development of the mathematical sciences within Australia.

Dr James Lewis
CHAIR

Director's Report

This has been a year of substantial and significant change for AMSI. As Jim Lewis has said in his report much of our agenda this year has been shaped by the first review of the Institute. The response to its recommendations by AMSI's membership has been uniformly positive and we have made significant progress on many of the issues addressed in the review report. The review panel worked extremely hard and generously made both their time and their experience available to AMSI and its officers. It is a pleasure to record our thanks to Ron Sandland, Arvind Gupta, Celia Hoyles and Gaven Martin, and to the panel's executive officer, Simi Henderson. This annual report contains a section dedicated to the review and our response which I commend to you.

The Collaborative and Structural Reform (CASR) grant has wound to a close, having funded a number of AMSI's flagship programs in research and higher education. Under this grant, the AMSI Internship Program was launched, and this framework has been adapted to a new internship program under the Enterprise Connect scheme. The 2011 AMSI Summer School, held at the University of Adelaide, featured a new careers event, which will now be a fixture at subsequent summer schools. BioInfoSummer was revived, being held at the end of 2010 at the Walter and Eliza Hall Institute. This event was a tremendous success, bringing interest from corporate sponsors for the next BioInfoSummer. The Graduate Winter School at the University of Queensland was also funded by the CASR grant along with our Industry event, this year held as part of CSIRO's climate change conference, Greenhouse2011 in Cairns. You can read about all these events later in this report.

My personal thanks go to Simi Henderson, our Program Manager (Research and Higher Education) for managing our flagship events program and to Finnur Larusson (Summer School), Matt Ritchie and Terry Speed (BioInfoSummer), Darryn Bryant (Graduate Winter School) for their wonderful work.

Our intern program is undergoing both rapid growth and rapid change. In the last twelve months we have placed 13 research students in private companies and government agencies and we expect this to at least double in the next year. We have rebranded the program to improve its access into disciplines outside the mathematical sciences. We also have a dedicated website *amsiintern.org.au* and a new intern manager following the departure of Tom Montague at the end of June 2011. Awareness of the program is growing among postgraduate students. We have more than 64 prospective interns on

our books, and this number is constantly growing. We have dealt with over 28 different industry partners, many of whom have engaged multiple interns. The aim of the project is to increase the research capacity of Australian enterprise and to improve the work readiness of our PhD graduates. You can read more about this innovative program and its wide-ranging benefits on page 32–37 of this report.

The Improving Mathematics Education in Schools (TIMES) project has also come to an end, running for just under two years, providing school mathematics support to teachers in six Outreach clusters comprising 54 schools, the development of 68 Teacher Content Modules, support of a collaboration with CSIRO to produce the e-newsletter *Maths by Email*, and the production of a suite of materials to promote both careers in mathematics and mathematics in careers. The TIMES project has seen AMSI develop a close working relationship with Education Services Australia to host the Teacher Content Modules on their website for digital curriculum resources, Scootle. The relationship will grow to include a joint careers initiative.

I am pleased to say that our partnership with CSIRO Education on *Maths by Email* will continue and it is a pleasure to welcome the Australian Bureau of Statistics to the project. A special acknowledgement goes to Janine McIntosh who managed the TIMES project and met the stringent reporting requirements. Michael Evans worked his magic with AMSI's writing team in producing 3,000 pages of teacher support materials! See pages 30–31.

This year has seen a new dimension added to our relations with government with the proposal for a national, distributed research centre in the mathematical sciences. There have been a number of meetings with the Australian Research Council, the Department of Education, Employment and Workplace Relations and the Department of Innovation, Industry, Science and Research and although the centre was not funded in the 2011 budget the proposal is being further developed for resubmission to government in late 2011. There are many imperatives driving this concept, an important one is the need, based on international experience, for such a centre to increase the external engagement of the mathematical sciences with Australia's industrial and research sectors. A second imperative is the projected growth in demand of 55% to 2020 for PhDs in mathematics and statistics while the projected growth in supply is zero!

A continuing theme of our advocacy with government is the funding of mathematics and statistics in our universities. 2011 is a particularly important year in this respect with a full blown review of the Higher Education Base Funding arrangements taking place. The position of our discipline improved significantly in 2007 following the National Strategic Review of the Mathematical Sciences in December 2006 when we achieved parity with Computer Science. AMSI made a significant submission to this year's Review following extensive consultation with our membership. We have recommended very specific measures related to our heavy service teaching load and the chronic shortage of mathematical sciences graduates. The AMSI submission can be found on our website.

Retirement lured away two invaluable AMSI staffers this year: Dick Barker and Jan Thomas. I relied on both of them for their wisdom and ideas. Dick was our backroom numbers person whereas Jan was always at the front of the house. On behalf of the entire organisation I wish them both well for a more relaxed future.

I hope that this, our eighth annual report, will give you a sense of the breadth and depth of our activities in pursuit of AMSI's vision:
The radical improvement of mathematical sciences capacity and capability in the Australian community.

Professor Geoff Prince
DIRECTOR

Advocacy

One of AMSI's most important functions is that of advocacy on behalf of the mathematical sciences. AMSI has built a reputation as a central voice on a number of issues, representing the views of university mathematics and statistics departments and government agencies that form its membership.

AITSL

AMSI authored a submission to the Australian Institute for Teaching and School Leadership (AITSL) proposal for a National System for the Accreditation of Pre-service Teacher Education Programs.

The AMSI submission discussed the minimum education requirements that would appropriately prepare mathematics graduates to enter the classroom. In particular, it highlighted the need for teachers of Years 11 and 12 mathematics subjects to have a bachelor's degree with a major in mathematics.

Research Workforce Strategy

AMSI has been heavily involved with the Research Workforce Strategy project undertaken by the Commonwealth Department of Innovation, Industry, Science and Research, with the mathematical sciences having been chosen as a case study for this project following Jan Thomas' serious engagement with senior staff within the Department.

AMSI made a submission in response to the Research Workforce Strategy consultation paper, which was issued on 28 June 2010. Professor Geoff Prince gave a talk at the Research Workforce Forum on 18 March 2011.

The Australian Government's Research Workforce Strategy, *Research Skills for an Innovative Future*, was launched by Senator The Hon Kim Carr on 19 April 2011.

ACHMS and response to ERA

The Excellence in Research for Australia (ERA) initiative was a hot topic for discussion at the February 2011 meeting of the Australian Council of Heads of Mathematical Sciences (ACHMS). This initiative from the Australian Research Council seeks to assess research quality within Australia's higher education institutions using a combination of indicators and review by committees of experts. A 2009 trial of ERA evaluated the Physical, Chemical and Earth Sciences and the Humanities and Creative Arts clusters, however the 2010 ERA process covered eight discipline clusters, including the Mathematical, Information and Computing Sciences cluster.

The ACHMS discussed a range of issues relating to the mathematical sciences and the ERA process. As a result of these discussions, working groups were formed to draft letters to the ARC regarding technical issues, and to the Minister for Innovation, Industry, Science and Research regarding other concerns raised at the meeting.

The Minister has since announced improvements in the methodology for ERA 2012 based on feedback received and experience from the 2010 process.

Higher Education Base Funding

AMSI's role as a representative for the mathematical sciences in Australian universities was evident with the Higher Education Base Funding review panel inviting AMSI to a consultation meeting as a key stakeholder.

AMSI coordinated a working party to prepare a submission on behalf of the mathematical sciences for the Higher Education Base Funding Review. The members of the ACHMS were invited to submit contributions to aid in the preparation of the submission in order to provide a view that was truly representative of the discipline. The final submission was warmly supported by the discipline.

CASR Project Report

National Collaboration in the Mathematical Sciences: Integrating research, industry and education

In 2007, the Department of Education, Science and Training (now DEEWR) awarded AMSI a $2 million grant through the Collaborative and Structural Reform (CASR) fund to address priority areas in the mathematical sciences. The three-year project aimed to strengthen links between higher education, industry and research through collaborative projects.

Cutting-edge developments in science, technology, medicine, commerce and management rely increasingly on sophisticated inputs from mathematical scientists. In biotechnology, mathematics is said to be the microscope of the future. Advances in medical imaging result from clever new techniques in mathematical data inversion. The means to stabilise the earth's climate over long periods will require self-consistent forward mathematical modelling.

Funding from DEEWR allowed AMSI to coordinate a program that forged stronger links between mathematics and statistics, other disciplines and industry. Further funding is required to ensure that this improved collaboration and engagement continues at an internationally competitive rate.

Industry-Higher Education Linkages

Mathematical and statistical modelling can provide valuable new insight into virtually any serious practical problem.

AMSI Intern

AMSI Intern was established with funding for 30 postgraduate internships in the mathematical sciences. In 2009, AMSI formed partnerships with Enterprise Connect, offering targeted internships in small and medium enterprises throughout Australia, and with the Victorian Life Sciences Computation Initiative.

AMSI Intern has now expanded to all disciplines and offers internship placements independent of government subsidy.

Industry workshops

Over the three-year period, AMSI ran a series of industry workshops in partnership with MITACS, MASCOS, ICE-WARM, UNESCO and CSIRO. The workshops targeted areas where collaboration between mathematical scientists and industry is key to maintaining a competitive atmosphere:

• Mathematics of Water Supply and Pricing

• Future Models for Energy and Water Management

• Climate Uncertainty and Risk

The workshops offered short courses and keynote lectures from leading experts in both industry and academia. Feedback was extremely positive with requests for more frequent meetings of this format.

BioInfoSummer

There is a clear need in biotechnology for people who are trained in both biology and data analysis. BioInfoSummer is an annual bioinformatics workshop that brings together international and Australian experts, students and industry representatives.

AMSI has a major sponsorship agreement with EMBL Australia and BioPlatforms Australia that will fund BioInfoSummer over the next three-years.

"The AMSI Summer School was a wonderful experience to learn interesting mathematics in a fun environment, whilst making great friends."

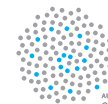- AMSI Summer School Student

"The project has given us access to real industry practices."

- AMSI Summer School Intern

"The internship has allowed my group to better use limited financial resources. At the same time the candidate has provided an alternative, and useful, perspective of the problem in question."

- Industry Partner

"The AMSI Vacation Research Scholarship gave me invaluable experience in mathematical research that I believe is highly applicable to my future academic endeavours."

- Vacation Research Scholar

Education-Research Linkages

To remain competitive internationally it is crucial for Australia to have a wide research base. By facilitating a number of stimulating educational events, AMSI helps to improve the breadth of mathematics and statistics education for aspiring research students.

Schools and Scholarships

The annual AMSI Summer School and Graduate Winter School increase the breadth of experience in mathematical sciences education. School topics are chosen in response to current national need and demand.

Both schools offer innovative new courses that are difficult to find elsewhere, as well as traditional areas in high demand, all delivered by experienced lecturers. The Winter School brings international experts to Australia, and recent lecturers include Professor Jean Lasserre (Laboratory of Analysis and Architecture of Systems, France) and Professor Charles Colbourn (Arizona State University).

To ensure that undergraduate research experience becomes part of the national culture in the mathematical sciences Vacation Research Scholarships are offered annually to students entering their honours year. Students undertake a six-week research project and at the end they come together with CSIRO Vacation Scholars to present their work at CSIRO's *Big Day In*.

An important spin-off from these programs is the development of ongoing communication networks among the nation's body of postgraduate students in the mathematical sciences.

Subjects and Courses via Access Grid

A program of shared honours courses between AMSI member institutions has been established. These courses provide students with a greater variety of subjects that they can study. Due to the AMSI program, Australia joins the UK as an international leader in the collaborative teaching of advanced mathematics.

The AMSI AGR network also facilitates access to international experts who are visiting and lecturing in Australia and provides a means of carrying out collaborative research within Australia and overseas.

Theme Programs

Theme programs over extended periods allow coordinated collaboration between disciplines and different fields of mathematics, providing an economical means of sharing the experience of international experts. Many new research collaborations are formed during these events.

2008 Concepts of Entropy and their Applications

Over 70 talks were presented during this program, covering a wide range of topics including the historical foundations of thermodynamics, statistical mechanics, dynamical systems, partial differential equations, environmental data modelling, signal processing, information theory and operations research. International participants came from the UK, Germany, Netherlands, Italy, New Zealand, USA, Israel, France, Russia and Canada.

The research outcomes of the Theme Program were published in a special issue of the journal Entropy, published by Molecular Diversity Preservation International (MDPI), based in Zurich.

2009 Group Theory, Combinatorics and Computation

This program brought together world experts, early career researchers and graduate students. Australian researchers and students had the opportunity to interact with world experts in their field and related areas. Experts came from Israel, USA, UK, New Zealand, Iran, India, Korea, China, Germany and Belgium.

A special week during the program was specifically geared towards early career researchers and graduate students, consisting of a series of workshops to open up problems to a wider audience and foster international research interaction.

"The AMSI Vacation Research Scholarship gave me a unique insight into the academic research environment and allowed me to pursue some of my own mathematical interests. In all, it was a great experience."

- 2010/2011 Vacation Research Scholar

Research and Higher Education

Simi Henderson
BSc (Hons)
Program Manager (Research and Higher Education)

Simi manages AMSI's Research and Higher Education program. The program comprises AMSI's flagship programs, workshop sponsorship, industry events and lecture tours. She also undertakes various project work within the Institute. During her time at AMSI Simi has also worked as Research Assistant on the ALTC-funded Mathematics for 21st Century Engineering Students project.

2010 Graduate Theme Program

The fifth annual Graduate Theme Program in the Mathematical Sciences was hosted by the University of Queensland in July 2010. Two advanced courses on the theme, *Graphs, Networks and Designs*, were delivered by Professor Brian Alspach, University of Newcastle, and Professor Charles Colbourn, Arizona State University.

24 students from around Australia and New Zealand attended the two-week event, and the group made the most of the opportunity to ask questions during the lectures. Each student presented a 30-minute talk on his or her own research, providing a valuable opportunity to obtain feedback from high-profile mathematical scientists. The excellent Queensland winter weather also allowed the group to enjoy some warmer days and social activities.

Many thanks to Darryn Bryant, Andree Phillips and the team at the University of Queensland for presenting an excellent program.

The theme of the 2011 Graduate Winter School is *Global Optimisation: theory and applications*. It will be held from 26 June to 8 July at the University of Queensland.

Vacation Research Scholarships

The 2010/2011 AMSI Vacation Research Scholarships were awarded to 16 undergraduate students from around Australia to complete a supervised six-week research project during the summer holidays. At the end of the summer, the students came together with CSIRO vacation scholars to present their work at the CSIRO-sponsored *Big Day In*, held at Macquarie University.

The scheme provides students with professional experience unavailable in the undergraduate degree program. Student supervisor **Dr Leonardo Lopes**, Monash University, said, *"Before the scholarship, our student was great academically. Now we feel he is also a better professional outside the classroom. He understands deadlines, feedback, and supervision in a way he would simply not be able to in the classroom."*

The Cambridge University Press book prize for best student talk was awarded to Vincent Schlegel, University of Adelaide, who eloquently explained his research on quantum structures of Yang-Mills fields.

Projects covered a wide range of areas in both pure and applied mathematics and statistics, including *Ehrenfeucht–Fraïssé games in finite algebras* and *Modelling cellular immunology of tuberculosis*.

"The AMSI Winter School was a rewarding and enriching experience. I appreciated the opportunity to work with and learn from world-class lecturers and students and had a lot of fun along the way. It was a great experience and I hope I have the opportunity to work with my fellow participants in the future."

   - Graduate Winter School student

"The AMSI Vacation Research Scholarship gave me a unique insight into the academic research environment and allowed me to pursue some of my own mathematical interests. In all, it was a great experience."

   - Vacation Research Scholar

"The AMSI Vacation Scholarship program was an excellent opportunity for me to learn about mathematics and about the research process. The Big Day In was a valuable experience, both in that it gave me many networking opportunities and it gave me practice in making my research understandable to other scientists and students."

   - Vacation Research Scholar

AMSI Vacation Research Scholars

AMSI Summer School

Summer School BBQ

Dr Ian Saunders on careers at CSIRO

Summer School

The 9th annual AMSI Summer School was hosted by the University of Adelaide from 10 January to 4 February 2011. Eight honours-level courses in pure and applied mathematics and statistics were offered, in many cases courses that would not be available at the students' home universities. 91 students from across Australia attended the School.

The students benefited not only from attending lectures, but also from interacting with their peers and being part of a lively and enthusiastic group from 18 different universities. Intense academic work was complemented by enrichment lectures, social events, a careers afternoon, and other special events that were well attended.

Our thanks to the Summer School Director, Associate Professor Finnur Larusson, and the organising committee for presenting an excellent program.

"The AMSI Summer School was an excellent learning and social experience. I believe it has set me up perfectly with the knowledge and contacts to succeed in my PhD."

    - Summer School student

"The AMSI Summer School was a wonderful experience to learn interesting mathematics in a fun environment, whilst making great friends."

    - Summer School student

THE UNIVERSITY OF ADELAIDE AUSTRALIA
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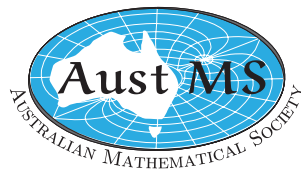
SUMMER SCHOOL COURSES	LECTURER
Geometric, combinatorial, asymptotic and statistical group theory	Dr Murray Elder (University of Queensland)
Chaotic dynamical systems	Dr Matt Finn (University of Adelaide)
Numerical analysis with applications	Dr Bishnu Lamichhane (University of Newcastle)
Lie groups and Lie algebras	Dr Thomas Leistner (University of Adelaide)
Analysis of multivariate and high-dimensional data	Assoc. Prof. Inge Koch (University of Adelaide)
Mathematical epidemiology: stochastic models and their statistical calibration	Dr Joshua Ross (University of Adelaide)
Geometric measure theory	Dr Marty Ross (ex University of Melbourne)
Monte Carlo methods	Prof. Dirk P. Kroese (University of Queensland)

AMSI Public Lecture: Shing-Tung Yau

In November 2010, AMSI hosted a free public lecture by Fields Medallist Professor Shing-Tung Yau in Melbourne as part of his tour to promote his new book, *The Shape of Inner Space: String theory and the geometry of the universe's hidden dimensions*.

Yau's talk was centred on his own story, beginning with his fascination with Euclidean geometry in high school, going through the evolution of the ideas discussed in his book and the people he encountered along the way.

This event was suited to a general audience and was very well received, with a full lecture theatre of well over 150 attendees consisting of academics, students and members of the public.

AMSI/SSAI Lecturer Denise Lievesley

Professor Denise Lievesley, Kings College London, was the 2010 AMSI Lecturer. She was the plenary speaker at the SSAI meeting in December and then undertook a lecture tour around AMSI member universities and government agencies.

Lievesley is one of the UK's leading social statisticians, and has campaigned for evidence-based development of public policy within the UK and abroad.

Lievesley has had a distinguished career, including the posts of founding Chief Executive of the English Information Centre for Health and Social Care; Director of Statistics at UNESCO, where she established its new Institute for Statistics; and Director of the UK Data Archive. Most recently she was a special advisor for the UN African Centre for Statistics, based in Addis Ababa, Ethiopia.

AMSI/ANZIAM Lecturer Darren Crowdy

In February 2011, Professor Darren Crowdy completed a lecture tour around Australia, visiting 9 universities and giving 8 lectures.

Crowdy is recognised as one of the world's leading experts in applying the theory of complex numbers to real-world problems. He is an Advanced Fellow of the Engineering and Physical Sciences Research Council (EPSRC) and holds a Chair in Applied Mathematics at Imperial College London.

On 16 February he gave an AMSI public lecture at the University of Melbourne with the ironic title, "A Complex Life". According to Crowdy, life is made easier by thinking about complex numbers, and solutions to real scientific problems can be obtained more easily by introducing imaginary concepts.

He explained, "Philip Pullman wrote in his novel, *The Golden Compass:* 'Think of Adam and Eve like an imaginary number, like the square root of minus one: you can never see any concrete proof that it exists, but if you include it in your equations, you can calculate all manner of things that couldn't be imagined without it.' Imaginary numbers have long fascinated not just mathematicians but the public at large; it is bemusing and intriguing that an 'imagined' abstraction can have real-life utility."

Shing-Tung Yau

Denise Lievesley

Darren Crowdy

BioInfoSummer

The 5th BioInfoSummer symposium was held at the Walter and Eliza Hall Institute of Medical Research (WEHI) from 29 November to 3 December 2010. BioInfoSummer brings together undergraduate, masters and PhD students and early career researchers from the mathematical and biological sciences, and introduces them to state-of-the-art bioinformatics research.

Daily sessions began with background lectures targeting students and academics moving into bioinformatics, which were followed by more specialist keynote talks.

Contributed talks and hands-on computer workshop sessions were held concurrently each afternoon.

Many thanks to Matt Ritchie (Director) and Terry Speed for organising an exceptional program.

The event was sponsored by CSIRO, VLSCI, EMBL Australia and Illumina Australia.

AMSI has entered into a three-year sponsorship agreement with EMBL Australia and BioPlatforms Australia, ensuring that this annual event continues.

BioInfoSummer Events

DATE	THEME
29 November	Introduction to Biology and Genomics
30 November	Methods in Bioinformatics
1 December	Genetic variation and disease
2 December	Transcriptomics
3 December	Phylogenetics

Access Grid Rooms

The Access Grid Room (AGR) network provides high-end videoconferencing and digital applications sharing to facilitate collaboration in both research and advanced teaching within the mathematical sciences and professional community. Through AGR, international experts who are visiting, lecturing or giving workshop keynote addresses can access a national audience that is geographically dispersed. The AGR network also provides a means of carrying out collaborative research with peers within Australia and internationally. AMSI member institutions with AGRs can present seminars, lectures, honours and masters courseware and multimedia resources, remotely and interactively, and in return participate in events presented by other AMSI institutions.

Honours courses

Honours courses in the mathematical sciences continue to be successful, with 21 courses offered in 2011. The AGR network enables these courses to be accessible to students regardless of their geographical location, and also facilitates interaction with their lecturers to receive a full learning experience. This is especially beneficial to students in regional universities who may not otherwise have access to particular subject topics.

AGR Event: Shing-Tung Yau

During Professor Yau's visit to Melbourne to promote his new book, AMSI arranged for him to present a technical talk titled *Quasi-Local Mass in General Relativity* from Monash University's Access Grid Room.

AGR (Access Grid Rooms) Seminars

SEMINARS	DATE	HOST INSTITUTION
Exploratory Experimentation and Computation in Number Theory Workshop	07/07/10–09/07/10	University of Newcastle
Haar Measure - A Short Course Via Access Grid	26/08/10–07/10/10	University of Newcastle
Functional Brain Mapping of Epilepsy	09/03/10	La Trobe University
Prediction in Measurement Error Models	09/24/10	La Trobe University
Functional and Nonlinear Analysis Workshop	02/10/10–04/10/10	University of Newcastle
Adaptive Wavelet Methods for PDEs	10/06/10	Australian National University
LP and MIP Solving in Theory and Practice	10/11/10	University of Newcastle
Non-Stationary Variance Models for Nitrous Oxide Emissions from Soil, by Spectral Tempering	10/15/10	La Trobe University
AMSI/CSIRO/SSAI Access Grid Seminar to Celebrate World Statistics Day	10/20/10	RMIT University
AMSI-SigmaOpt AGR Optimisation Seminar: Using Cutting Planes in the Feasibility Pump	10/27/10	RMIT University
MASCOS-ORSUM OR Seminar: Towards Solving MINLPs within a Constraint Integer Programming Framework: Algorithms and Applications	11/05/10	RMIT University
How can data mining help to understand what makes an optimisation problem hard, which algorithm will perform best, and why?	11/12/10	RMIT University
Option Pricing: Mean Reversion and Multi-Scale Stochastic Volatility	11/19/10	La Trobe University
Quasi-Local Mass in General Relativity	11/25/10	Monash University
Long-Range Dependence and Non-Semimartingale Models in Finance	11/26/10	La Trobe University
Getting Data Used	12/15/10	Macquarie University
Conditional Predictive Inference Post Model Selection	12/02/10	La Trobe University
A New Calculus for Ideal Fluid Dynamics	02/07/11	University of South Australia
A Complex Life	02/14/11	University of Western Sydney
Completeness in Supergravity Constructions	02/25/11	La Trobe University
CARMA-SigmaOpt Seminar: Why bankers should learn convex analysis (Parts 1 & 2)	03/03/11–04/03/11	University of Newcastle
Life of Pi: History and Computation - a talk for Pi Day	03/15/11	University of Newcastle
New Demiclosedness Principles for (Firmly) Nonexpansive Operators	04/14/11	University of Newcastle
Level-Crossings of Symmetric Random Walks	05/06/11	La Trobe University
Jonfest2011: A Workshop on Computational and Analytical Mathematics	17/05/11–20/05/11	Simon Fraser University
Visualizing and Forecasting Functional Time Series	05/27/11	La Trobe University
Special Solutions to Ultradiscrete Painlevé	06/10/11	La Trobe University
A Simple Diffusion Limit for Flows in Stable Multi-Class Queueing Networks	06/17/11	La Trobe University
Symplectic and CR-Methods in Complex Analytic Geometry	27/06/11–30/06/11	University of New England

Mathematical Scientists on Sabbatical

Dr Tom Mestdag, University of Ghent, Belgium
Dr Dejan Delic, Ryerson University, Canada

Dr Todd Niven, La Trobe University
Dr Marcel Jackson, La Trobe University

Scientific Workshops

Geometric Stochastic PDEs Workshop

World Statistics Day - Dr Melanie Bahlo

WORKSHOP	SUMMARY
Exploratory Experimentation and Computation in Number Theory University of Newcastle 7–10 July 2010 Attendees: 28 Speakers: Wadim Zudilin (University of Newcastle)	The workshop brought together mathematicians from all over the world who work in the areas of number theory and experimental mathematics highly influenced by the genius of Srinivasa Ramanujan. Four of the keynote lectures were available via AMSI access grid facilities.
Algorithms, Algebra and Analysis in Four Dimensions The University of Queensland 20–21 July 2010 Attendees: 25 Speakers: Benjamin Burton, Murray Elder, Stephan Tillmann (University of Queensland)	Four-dimensional topology is an important branch of geometry and topology. Many important problems—as well as the decidability of these problems—are still open. The workshop stimulated interaction between researchers in the three key areas of algorithms, algebra and analysis, and brought about new collaborations to work on difficult problems.
nGAME workshop - Simon Clarke to attend University of Sydney 27 August 2010 Attendees: 34 Speakers: Masahiro Takatsuka (University of Sydney)	A workshop presenting the results of the nGAME project, covering issues around presenting, teaching and learning across the Access Grid network as well as the latest developments in remote communication technology.
Geometric and Nonlinear Partial Differential Equations Mission Beach, Queensland 30 August – 3 September 2010 Attendees: 50 Speakers: Neil Trudinger, Alan Carey, Alison Irvine and Xujia Wang (Australian National University) Florica Cirstea (The University of Sydney), Min-Chun Hong (University of Queensland)	The conference brought together leading overseas and Australian researchers, together with young Australian researchers and graduate students, and enhanced the strong relationship between Australia and overseas in geometric and nonlinear analysis. The workshop consisted of a mixture of expository talks and focused discussion sessions covering highly topical research areas such as geometric flows and their applications, optimal transportation, conformal geometry, regularity issues in nonlinear PDE and reaction diffusion equations, and singular variational problems.
Second Australian Mathematical Society Early Career Workshop The University of Queensland 25 – 26 September 2010 Attendees: 58 Speakers: Bronwyn Hajek (University of South Australia), Anthony Henderson (University of Sydney), Stephan Tillmann (UQ)	The workshop consisted of 3 research presentations and 2 advice sessions with opportunity for discussion. The aim of these talks was to stimulate discussion, create new collaborations, and expose PhD students and early-career researchers to other fields of research. Advice talks were given by leading Australian researchers from academia and industry, discussing grant applications and engaging with and consulting for industry.
ALTC Workshop: Effective Learning, Effective Teaching in the Quantitative Disciplines The University of Queensland 30 September – 1 October 2010 Attendees: 100 Speakers: Diane Donovan (UQ), Birgit Loch (Swinburne)	Immediately following the annual AustMS conference, this workshop, designed specifically for lecturers and tutors teaching in the quantitative disciplines, provided a practical, hands-on approach to effective learning and teaching in these disciplines.
Functional and Nonlinear Analysis Workshop University of Newcastle 2–4 October 2010 Attendees: 19 Speakers: Brailey Sims, Jonathan Borwein, Juliane Turner, David Allingham (University of Newcastle)	The three-day workshop took advantage of Prof. Joe Diestel's CARMA-sponsored visit to enhance awareness and facilitate exploration of recent developments in the theory of both linear and nonlinear operators, the study of radical algebras and the extension of traditional nonlinear analysis into the setting of hyperbolic metric spaces.
Bayes on the Beach QUT/SSAI 4–5 October 2010 Attendees: 30 Speakers: Kerrie Mengersen, Matt Falk, Alice Currie (QUT)	The conference provided a small forum for discussion on developments and applications of Bayesian Statistics, allowing academics, early career researchers and students to interact, share ideas and learn. Topics covered included Metropolis-Hastings algorithms, ecological and environmental applications of Bayesian methods, sequential Monte Carlo and optimal experimental design, and probabilistic Forecasts of Volatility and its Risk Premia.
Workshop on Discrete Optimisation with Applications in Transport, Logistics, and Networks (DO10) University of New South Wales 12–15 October 2010 Attendees: 90 Speakers: Lyn Forsyth, Gary Froyland, and Ian Sloan	The workshop was organised by MASCOS in conjunction MITACS, CMM, and MATHEON, and was the third in the series of such collaborative meetings. The Workshop brought together academic researchers, industry researchers and industry leaders to discuss the most recent developments in discrete optimisation in these areas, and promoted regional and international mathematical exchange and collaboration. The workshop was a resounding success, attracting very high quality speakers from Australia, Germany, Chile and Canada.
Dirac Operators in Geometry, Topology, Representation Theory, and Physics University of Adelaide 18–22 October 2010 Attendees: 29 Speakers: Pedram Hekmati, Dr Snigdhayan Mahanta and Mathai Varghese (University of Adelaide), Peter Bouwknegt (ANU)	A lecture series by Dan Freed (University of Texas, Austin). Dirac introduced his eponymous operator to describe electrons in quantum theory. It was rediscovered by Atiyah and Singer in their study of the index problem on manifolds. These lectures explored new theorems and applications in this area.
World Statistics Day AMSI Access Grid Network 20 October 2010 Attendees: 70 Speakers: Peter Hall (University of Melbourne), Melanie Bahlo (WEHI), Christine O'Keefe (CSIRO)	AMSI, CSIRO and SSAI ran an afternoon session over the Access Grid network to celebrate the inaugural World Statistics Day. The event was a great success, with participation from ten Access Grid rooms. The celebration of World Statistics Day acknowledges the service provided by the global statistical system at national and international level, and strengthens the awareness and trust of the public in official statistics.

Scientific Workshops continued

Geometric Stochastic PDEs Workshop

Optimisation and Control Day 2011

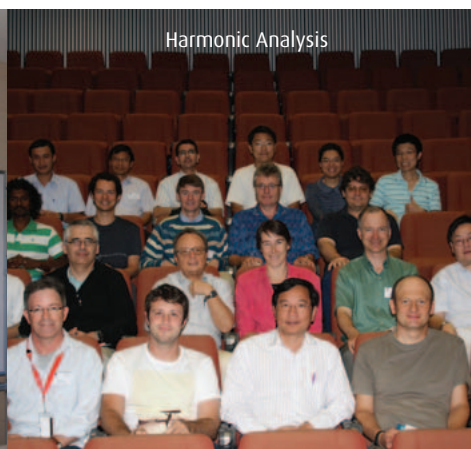| WORKSHOP	SUMMARY
The AMSI Workshop on Network Measurement, Management and Modelling University of Adelaide 3 November 2010 Attendees: 45 Speakers: Matthew Roughan (University of Adelaide)	The workshop investigated the interplay between real measurements of networks and the mathematical models for those measurements needed to solve practical network management problems.
Techniques and Applications in Digital Security Deakin University 10 November 2010 Attendees: 41 Speakers: Jemal Abawajy, Lynn Batten, Gleb Beliakov, Morshed Choudhury, Bernard Colbert, Dr. Honghua, Robin Doss, Rafiq Islam and Gang Li (Deakin University), Leijla Batina (Radboud University), Graham Farr (Monash University), Andrei Kelarev (Ballarat University)	As academic research in digital security has advanced over the last twenty years, techniques and applications are being developed for specific use in this area. These include wavelets and their applications in digital forensics, classification algorithms for use in malicious software detection, and genetic algorithms custom-made for the cryptographic community. ATIS assembled a number of people working across a spectrum of techniques and applications relevant to the digital security community in order to understand the methods currently available, determine gaps needing to be filled and develop five and ten year plans for the development of the area.
Prof. Shing-Tung Yau Tour AMSI 25 November Attendees: 500 Speakers: Prof. Shing-Tung Yau (Harvard University)	In a series of lectures around Australia, Professor Shing-Tung Yau described in general terms how geometry enables the understanding of space time, and traced its historical development from the ancient Greeks through Einstein to modern string theory, analysing the contributions of many great geometers and physicists along the way.
Riemannian and Differential Geometry La Trobe University 30 November – 2 December 2010 Attendees: 25 Speakers: Yury Nikolayevsky, Grant Cairns, Gerd Schmalz	The workshop disseminated knowledge and the exchange of ideas in Riemannian geometry, homogeneous spaces, loop groups, parabolic geometry and CR geometry. Two prominent international speakers presented keynote addresses; Prof. Alekseevsky on modern Riemannian geometry and Professor Lauret on homogeneous geometry.
Optimisation and Control Day University of South Australia 29 January 2011 Attendees: 33 Speakers: Yalcin Kaya, Regina Burachik (University of South Australia)	The one-day workshop on new advances and trends in optimisation and control, theory, numerical methods and applications featured nine prominent speakers. Optimisation is a fundamental and strategic discipline; its many facets are used by practically all the applied mathematics community. Applications of optimisation are found in many disciplines including engineering, biology, medical sciences, economics and environmental sciences.
AMSI International Conference in Harmonic Analysis and Applications Macquarie University 7–11 February 2011 Attendees: 36 Speakers: Xuan Duong, Jeff Hogan, Chris Meaney, Adam Sikora (Macquarie University)	The conference covered a very broad selection of topics in harmonic analysis and its interaction with partial differential equations. The conference brought together leading international and Australian researchers as well as young Australian researchers and PhD students in the field of Harmonic Analysis and related topics for the dissemination of the most recent developments in the field, and for discussions on future directions.
MathWest Workshop 2011, a celebration of the first International Mathematical Union (IMU) Executive Committee Australian visit University of Western Australia 1–2 March 2011 Attendees: 70 Speakers: Cheryl Praeger (University of Western Australia)	The two-day workshop contained a dazzling line-up of lecturers from the IMU Executive Committee. Taking advantage of the IMU Executive meeting, the workshop gave Australian researchers the opportunity to hear from some of the world's most renowned and respected mathematicians.
Geometric Stocastic PDEs University of New South Wales 5–6 May 2011 Attendees: 28 Speakers: Ben Goldys (UNSW)	The theory of geometric stochastic PDEs is an emerging area of research at the centre of many modern developments in pure mathematics, mathematical physics and engineering. The workshop consisted of a series of expository talks by leading specialists in both deterministic and stochastic geometric PDEs and their applications.
Modern Spatial Statistics: In honour of Julian Besag Queensland University of Technology 11–12 May 2011 Attendees: 80 Speakers: Kerrie Mengersen, Claire Alston, Dow Jaemjaret (QUT)	Spatial statistics deals with the analysis of spatial data. The conference was held in honour of Julian Besag, a noted spatial statistician who is credited with some of the initial work and theories in this area of statistics. The conference gave local statisticians from diverse backgrounds an opportunity to hear high profile speakers from the field of spatial statistics in an intensive two-day session.
Jonfest: A Workshop on Computational and Analytical Mathematics The IRMACS Centre, Simon Fraser University 16–20 May 2011 Attendees: 200 Speakers: The IRMACS Centre, Simon Fraser University	Professor Borwein's 60th birthday provided the opportunity to celebrate the profound impact his research has had on optimisation, functional analysis, operations research, mathematical programming, number theory and experimental mathematics. The workshop discussed promising research directions and approaches in these areas.
Australian Mathematical Sciences Students' Conference Monash University 9–10 June 2011 Attendees: 46 Speakers: Stephen McCormick, David Hartley, Mark Bentley, Marsha Minchenko, David Fear, Luke Hande and Sangeeta Jhanjee	The second in this annual series, the conference stimulates communications between mathematical science graduate students by providing a forum in which students gain an understanding of the mathematics research being conducted across different universities and share experiences of graduate study.
Symplectic and CR-Methods in Complex Analytic Geometry University of New England 27–31 June 2011 Attendees: 25 Speakers: Gerd Schmal, Adam Harris (University of New England)	The workshop provided an opportunity for mathematicians working in complex analytic and CR-geometry within Australia to meet and discuss the latest developments in their own research and to bring to the workshop two leading experts from the international research community.

Hosted Visitors

AMSI has sponsored the following distinguished academics to visit Australia to present their research.

Australian Mathematical Sciences Students' Conference

Harmonic Analysis

Optimisation and Control Day

WORKSHOP	SPEAKER	UNIVERSITY	COUNTRY	RESEARCH INTERESTS
Harmonic Analysis	Thierry Coulhon	University of Cergy-Pontoise	France	Analysis and operator theory
Harmonic Analysis	El Maati Ouhabaz	University of Bordeaux	France	Harmonic analysis and operator theory
Symplectic and CR-Methods in Complex Analytic Geometry	Serguei Ivashkovitch	Université de Lille	France	Pseudoholomorphic curves in complex geometry
Optimisation and Control Day 2011	Helmut Maurer	University of Münster	Germany	Sensitivity analysis theory for optimal control
Optimisation and Control Day 2011	Hans Josef Pesch	University of Bayreuth	Germany	Optimal control theory and its applications to spacecraft re-entry problems, fuel cells and other industrial problems
Harmonic Analysis	Fulvio Ricci	Scuola Normale Superiore	Italy	Harmonic analysis, Lie groups and singular integrals
STATPHYS24 Exactly Solvable Models in Statistical Physics	John Cardy	Oxford University	UK	Theoretical condensed matter physics, statistical mechanics, critical phenomena and conformal field theory
Bayes on the Beach	David Elston	Biomathematics & Statistics Scotland	UK	Statistical modelling techniques, spatio-temporal modelling of population distribution and abundance, and applications of random effect models using REML and MCMC methods
AMSI Lecturer 2010	Denise Lievesley	University College London	UK	Social research methods and research ethics
AMSI Lecturer 2011	Darren Crowdy	Imperial College London	UK	Application of complex analysis in the physical sciences and mathematical physics, including applications of algebraic geometry, conformal mapping and slow viscous flow
Geometric Stochastic PDEs	David Elworthy	University of Warwick	UK	Stochastic analysis on Riemannian manifolds
Modern Spatial Statistics	Chris Glasbey	Biomathematics & Statistics Scotland	UK	Spatial and temporal models, including image analysis and bioinformatic applications
Geometric Stochastic PDEs	Roger Moser	University of Bath	UK	Applications of partial differential equations and calculus of variations in differential topology and materials science
Geometric Stochastic PDEs	Hendrick Weber	University of Warwick	UK	Stochastic motion by mean curvature
Harmonic Analysis	Lixin Yan	Zhongshan University	China	Harmonic analysis, singular integrals and function spaces
Techniques and Applications in Digital Security	Bimal Roy	Indian Statistical Institute	India	Statistics and its applications
Exploratory Experimentation and Computation in Number Theory	Heng Huat Chan	National University of Singapore	Singapore	Areas of mathematics influenced by Srinivasa Ramanujan

Hosted Visitors continued

Symplectic and CR-methods in Complex Analytic Geometry Workshop

Darren Crowdy

Shing-Tung Yau

WORKSHOP	SPEAKER	UNIVERSITY	COUNTRY	RESEARCH INTERESTS
ALTC workshop	Bill Barton	University of Auckland	NZ	Mathematics and language
Riemannian and Differential Geometry	Rod Gover	University of Auckland	NZ	Application of differential geometry and Lie representation theory to problems in analysis, complex analysis and mathematical physics
Harmonic Analysis	Qui Bui	University of Canterbury	NZ	Function spaces
Symplectic and CR-Methods in Complex Analytic Geometry	John Bland	University of Toronto	Canada	Functions of complex variables and differential geometry
Exploratory Experimentation and Computation in Number Theory	Frank Garvan	University of Florida	USA	Applications of q-series to number theory and combinatorics
Functional and Nonlinear Analysis	Joseph Deistel	Kent State University	USA	Geometric theory of Banach spaces, Grothendieck's theory and operator ideals
Functional and Nonlinear Analysis	Anthony Lau	University of Alberta	USA	Banach algebras, in particular group algebras
Grad School	Charles Colbourn	Arizona State University	USA	Network algorithms and network design
STATPHYS24 Exactly Solvable Models in Statistical Physics	Barry McCoy	Stony Brook	USA	Classical statistical mechanics, integrable models and conformal field theories
STATPHYS Monte Carlo Algorithms in Statistical Physics	David Landau	The University of Georgia	USA	Condensed matter physics
STATPHYS Monte Carlo Algorithms in Statistical Physics	Alan Sokal	New York University	USA	Statistical mechanics, quantum field theory, mathematical physics and computational physics
Dirac Operators in Geometry, Topology, Representation Theory, and Physics	Dan Freed	University of Texas	USA	Global issues in geometry and global analysis
Shing-Tung Yau Lecture Tour	Shing-Tung Yau	Harvard University	USA	Differential geometry, differential equations and mathematical physics
AMSI-ISSNIP ECR Workshop on Information Processing in Sensor Networks	Gene Tsudik	University of California, Irvine	USA	Computer and network security, privacy and applied cryptography
Harmonic Analysis	Song-Ying Li	University of California	USA	Partial differential equations and harmonic analysis
Harmonic Analysis	Richard Laugesen	University of Illinois	USA	Wavelets and singular integrals
Riemannian and Differential Geometry	Jorge Lauret	University of Cordoba	Argentina	Einstein homogeneous manifolds, Lie algebras and geometric invariant theory over the real numbers
Optimisation and Control Day 2011	Roberto Cominetti	Universidad de Chile	Chile	Optimisation, convex analysis, path following and penalty methods, transportation and game theory
Modern Spatial Statistics	Dani Gamerman	Instituto de Matemática	Rio de Janeiro	Dynamic models, spatial statistics, survival analysis, stochastic simulation, econometrics and Bayesian inference

"AMSI has welcomed the idea of a national curriculum in mathematics and we have already contributed to its implementation."

Ms Janine McIntosh

DipT

Schools Project Officer

Janine McIntosh is the Schools Project Officer. Her role is to develop school mathematics material and to work with teachers to enhance the mathematics experiences of the children they teach. Janine is an experienced primary teacher who has also worked as curriculum writer for the VCAA and the Australian Curriculum, Assessment and Reporting Authority (ACARA), in mathematics education at The University of Melbourne and serves on the Maths Challenge committee of the Australian Mathematics Trust.

Grade 1 Teacher and her students

School Education

Dr Michael Evans
BSc (Hons), PhD, DipEd
Schools Project Manager

Before coming to ICE-EM, Michael was Head of Mathematics at Scotch College, Melbourne. He has worked with the VCAA in various capacities for many years. He been involved with the development on the Australian Curriculum and is presently working on the senior curriculum and F–10 curriculum. In 1999 he was awarded an honorary Doctor of Laws by Monash University for his contribution to mathematics education. In 2001 he received the Bernhard Neumann award for contributions to mathematics enrichment in Australia.
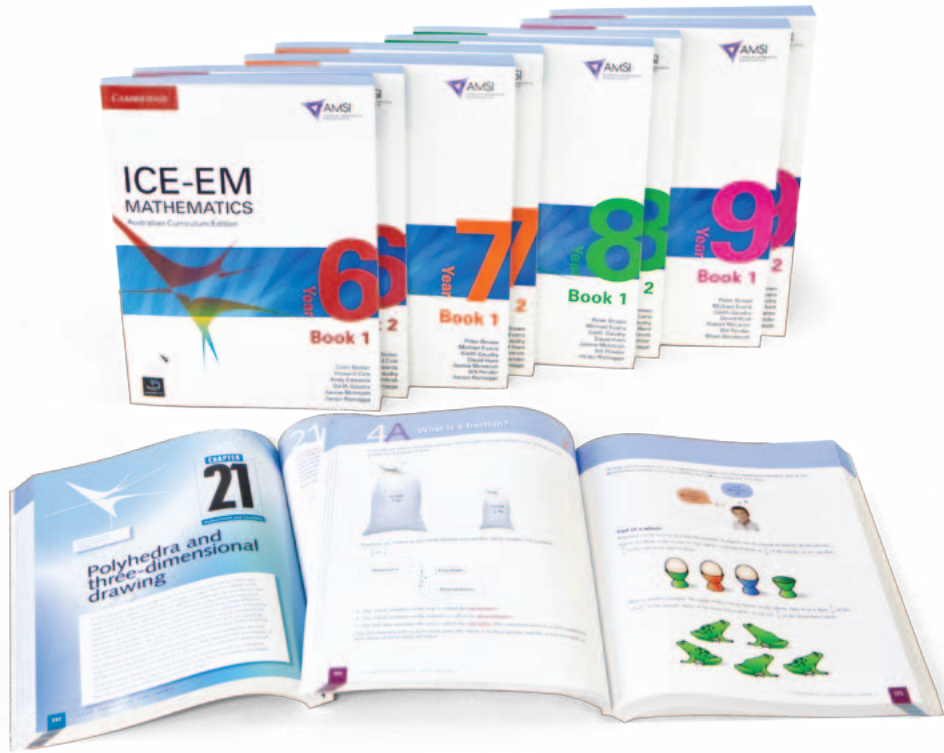
ICE-EM Mathematics textbooks

In early 2011, AMSI finalised an agreement with Cambridge University Press (CUP) to publish the ICE-EM Mathematics textbooks. The twelve full-colour textbooks have been rewritten to meet the detailed requirements of the Australian Curriculum. A considerable amount of additional content has been added and all of the existing material has been thoroughly reviewed. The first of the books was published in July 2011 and all of the books, including teacher support material, will be available by December 2011. Promotional professional development sessions are planned for three states for the second half of 2011.

Sales of the previous edition of the ICE-EM books have been good over the past year, approaching 20,000 in the last selling season. These books have already made a valuable contribution to Australian school mathematics education and we believe that they will continue to do so for many years.

Australian Curriculum

AMSI's involvement in the development of the Australian Curriculum: Mathematics, continued throughout the year. AMSI has welcomed the idea of a national curriculum in mathematics and it has already contributed to its implementation.

The rationale, aims, content descriptions and the achievement standards for the F-10 curriculum were published on the Australian Curriculum website in December 2010. Members of AMSI staff were asked to comment on the curriculum document as it was developed, and they were also involved with additions and corrections to the Glossary for the subject in early 2011.

Work on the curriculum for Years 11 and 12 recommenced in May 2011 and is scheduled for completion by 2012. The writing committee and the advisory committee for the senior curriculum includes university mathematicians and statisticians and a member of staff from AMSI.
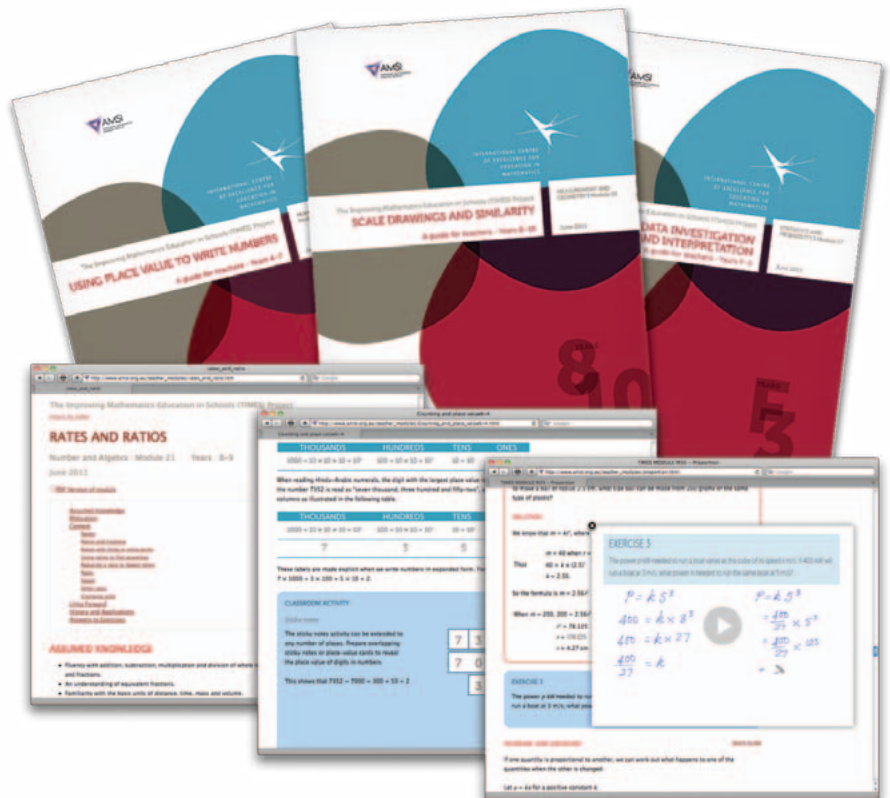
Geelong College Visit to AMSI

23 August 2010
Students: 23, Year 9 students
Teacher: Sara Peace
Background: Year 9 City Program
(provided to the students by the College)

Geoff Prince talking to Year 9 students from Geelong College

Melbourne is an amazing place to uncover the many aspects of mathematics that have shaped the city—feats of engineering, contemporary and historical architecture, the exciting finance sector, population change since Melbourne was founded, and how a city like Melbourne manages the flow of traffic and people. There were many opportunities to explore and uncover parts of the city that students had not previously considered. Students took themselves on their own voyage of discovery by focusing on a subject that they had an interest in. That included working with an engineering company to create a working model, interviewing a stock broker then following stocks and shares throughout the week by visiting the Australian Stock Exchange, investigating architecture, and interviewing a town planner to find out why Melbourne has the structures and layout it does. The students were expected to produce a video diary of their week's work, together with a visual representation of their discoveries and the mathematics they studied, ready to present the following week. This was a real opportunity for students to play with mathematical ideas that have real world applications.

Year 9 students from Geelong College

TIMES PROJECT

This year marks the conclusion of The Improving Mathematics Education in Schools (TIMES) Project. TIMES was a national collaborative project targeting school mathematics education, and has facilitated the development of world-class resources that will support teachers and students well beyond the conclusion of the project. The project provided an integrated approach to increasing mathematics achievement, developing innovative resources to support the new Australian Curriculum, and raising awareness of career opportunities that require mathematics skills.

Funding was provided by the Department of Education, Employment and Workplace Relations (DEEWR). The project ran for just under two years and closed in May 2011 when the final report was prepared for DEEWR. An evaluation of the project was conducted to identify its successes and possible areas for improvement.

The TIMES project was managed by Janine McIntosh, and Michael Evans was the Project Director. In 2010 they were joined by three project officers who worked directly with teachers in outreach schools. Antje Leigh-Lancaster worked with schools in Wollongong and Gippsland, Mark Mudge worked with schools in Townsville, Sunshine Coast and Geelong, and Rob Moore's work was focused on developing the careers component of the project.

The TIMES project had four components:

Outreach

AMSI has been actively supporting schools since its foundation, and working with teachers face-to-face has proven to be very successful in helping them to develop high-quality, engaging mathematics programs for their students. The focus of the outreach program was to help teachers understand the big ideas in mathematics and how they are connected.

The outreach program delivered 216 days of professional development for teachers in 54 schools across the country. The project aimed to strengthen the connections between primary and secondary schools by fostering partnerships between teachers at participating schools.

The project officers worked closely with the teachers to help them target the specific mathematical needs of their students. Teachers were given guidance for building an appropriate scope and sequence for the teaching of mathematics, and on sourcing appropriate information about mathematics teaching.

Clusters of schools were selected to participate based on demonstrated educational need. The outreach areas chosen for the TIMES project were:

- Gippsland, Victoria
- Townsville, Queensland
- Mandurah, Western Australia
- Geelong, Victoria
- Sunshine Coast, Queensland
- Illawarra, New South Wales

Overall, teachers found the professional development sessions useful, noting that they were appropriately tailored to their needs in the classroom. The most popular suggestion was to provide more frequent, regular and longer sessions accessible to all mathematics teachers.

Teachers responded positively to the ability of the project officers to broaden their thinking about how to teach mathematics. Most teachers noted that the mentoring provided by the project officers increased their enthusiasm for mathematics teaching.

Teacher Support

The modules are designed to support teachers by providing a resource to enhance their mathematics content knowledge. AMSI believes that a teacher with a sound understanding of the curriculum has a greater capacity to engage students with mathematics. The modules were developed in consultation with mathematicians and mathematics educators, and were trialled with schools participating in the Outreach component of the project. The modules help teachers improve their understanding of specific topics, develop lesson plans and facilitate discussion about teaching strategies amongst teachers.

The modules were written by David Hunt (University of NSW), Peter Brown (University of NSW), Jacqui Ramagge (University of Wollongong), Helen MacGillivray (Queensland University of Technology), Bill Pender (formerly of Sydney Grammar School), and Janine McIntosh and Michael Evans from AMSI.

Each module covers topics within the national curriculum, and all 66 modules are available free of charge to every primary and secondary school in Australia. They are written for teachers of K to Year 10 and consist of over 3000 pages of material.

The material is linked from the SCOOTLE website of Educational Services Australia and this in turn will be linked to the Australian Curriculum: Mathematics.
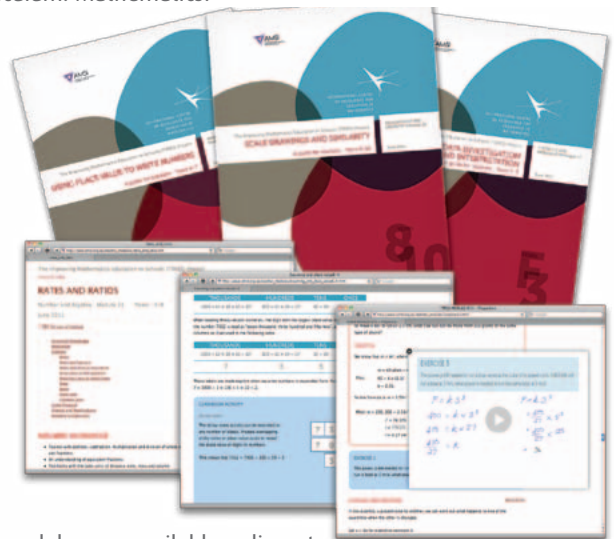
The modules are available online at
www.amsi.org.au/teachermodules

Posters

Careers Education

AMSI recognises that many young people and their parents are unaware of the importance of mathematics and do not understand that a lack of mathematical skills will limit their career options considerably.

The *Maths: Make Your Career Count* campaign was launched in December 2010 with the aim of increasing students' awareness of the breadth of careers available to them if they pursue mathematics.

A broad range of careers requiring mathematics skills were selected to be the focus of the campaign, and a diverse group of people using mathematics in their careers became the faces of the campaign. Profiles include a meteorologist, zookeeper, chef, travel agent and a football statistician, who all recognise the important role that mathematics plays in their profession.

The AMSI materials include:

- A set of 12 A2 posters
- A booklet with 20 profiles of people in different careers explaining the importance of mathematics in their work
- A DVD featuring 10 people using mathematics in their careers

The materials showcase the range of careers that involve the practical use of mathematics, presented in an attractive, accessible format appropriate for the age group.

Every school in the country was provided with a set of these brand new careers materials completely free of charge in December 2010, and AMSI has received very positive feedback from teachers about the exceptional quality of the materials created for the TIMES project.

The materials are available from
www.mathscareers.org.au
or email **times@amsi.org.au**.

Booklet and DVD

CSIRO Collaboration

CSIRO Education and AMSI jointly produce a free fortnightly newsletter called *Maths and Stats by Email*, which is sent to student, teacher and parent subscribers.

Each newsletter features stories from the cutting-edge of mathematics, brainteasers, facts, links to interesting websites, and lively discussions about mathematics in the news.

There are over 10,000 subscribers to *Maths and Stats by Email*, and AMSI has secured funding to continue producing the newsletter beyond the conclusion of the TIMES project.

AMSI is also actively promoting the CSIRO Mathematics in Schools program to its members. Professionals and postgraduate students with a degree in mathematics are encouraged to consider taking part in this rewarding program.

For more information visit:
www.mathematiciansinschools.edu.au

To subscribe:
www.csiro.edu.au/resources/Maths-by-Email.html

L to R, Mentor - Dr Sergei Schreider (RMIT), Intern - Jon Plummer (RMIT), Industry Partners - Richard King, Phil Sheppard, Leanne Poole and Peter Postmus (Creative Analytics)

Dr Kathy Haskard
BSc, MSc, PhD

Statistician

Kathy joined AMSI in August 2010 to provide advice on statistical aspects of AMSI projects. A large proportion of her work at AMSI has been a major collaboration with Parks Victoria, where she has been involved with a range of conservation projects.

Business, Industry and Government

Dr Thomas Montague
BSc, MSc, DipEd, DPhil (Oxon)

Industry/Marketing Manager, AMSI and MASCOS

Thomas coordinates the AMSI Industry Program. This includes the Industry internship program, and identifying and coordinating partnerships between end-users and member staff participating in AMSI-sponsored projects. His prior experience includes Science Advisor to the Victorian Government, research scientist and academic, private consultant on environment and resource management, and company director.

Simi Henderson, Program Manager (Research and Higher Education) (third from left), with AMSI sponsored students at Greenhouse2011

Industry Internships

Launched in 2008, the AMSI industry internship program is designed to promote collaboration between academia and industry. AMSI offers industry partners the opportunity to use an intern's mathematical and statistical skills, guided by an academic mentor, to facilitate research relevant to the industry partner.

Benefits to industry partners include: creating links with AMSI members, gaining access to new skills and problem solving strategies, and recruitment opportunities. The program is designed to circumvent problems with intellectual property rights, allowing industry partners to enjoy the full benefits of internship successes. Benefits to AMSI members include: $5000 to staff members who act as academic mentors, a stipend of up to $15,000 over five months per intern, and the opportunity to build a track record with the Australian Research Council (ARC).

Interest in the program continues to grow and AMSI is exploring further possibilities for expanding the program, including fostering links with the MISG and ANZIAM. Additionally, an agreement with ANU, RMIT, La Trobe University and the University of Adelaide to place 5 interns per year will generate a $100,000 financial benefit to each of these full member universities.

Victorian Life Science Computation Initiative

An agreement with the Victorian Life Sciences Computation Initiative (VLSCI) also funded an additional five internship placements to encourage the use of the supercomputing facility based at the University of Melbourne. Four projects have been completed at National ICT Australia Ltd (NICTA) by students from two member universities. Another project at the Royal Melbourne Hospital is developing predictive models to provide important clinical information about epilepsy drugs using data from a large number of patients. VLSCI placements are open to interns from all AMSI member institutions and are intended to advance developments in areas such as medical image analysis, bioinformatics, modelling of structures such as the heart and brain, fisheries management and research into medical conditions such as epilepsy, arthritis, cancer and diabetes.

Collaborative and Structural Reform

AMSI's funding through a Collaborative and Structural Reform (CASR) grant concluded this year. The Department of Education, Science and Training awarded the three-year grant to AMSI to address priority areas in the mathematical sciences through collaborative projects. The project strengthened links between higher education, industry and research through a variety of programs including industry internships, linked theme programs and summer schools.

The grant allowed 28 interns from 11 universities to be placed in industry, business and government over the three-year period. It also facilitated the revival of BioInfoSummer, a week long bioinformatics symposium for postgraduate students and early-career researches in the mathematical and biological sciences.

Enterprise Connect

AMSI's partnership with Enterprise Connect continued this year, and has allowed AMSI to expand its internships program significantly by funding 90 internships over a three-year period. Enterprise Connect is an Australian Government initiative in the Department of Innovation, Industry, Science and Research (DIISR). AMSI Interns are bringing new analytical techniques to problems in areas ranging from supply chain logistics to gene sequencing. The program gives small to medium enterprises access to the analytical skills that support innovation and productivity, and provides valuable industry experience to interns.

Internship Project Profiles
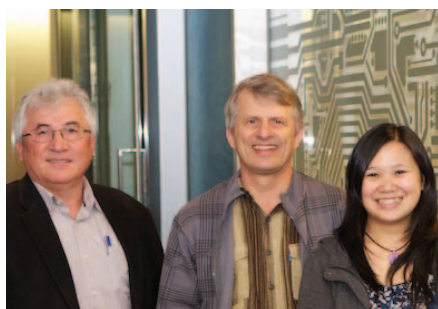
Making sense of DNA sequences

Mentor: Professor Pietro Cerone, Victoria University
Intern: Dr Eder Kikianty, Victoria University
Industry Partner: Dr Adam Kowalczyk, National ICT Australia
Project Duration: June 2010 – August 2010

This project investigated the development of statistical filters that can be used to detect biomarkers, reliably differentiating between various phenotypes of biomedical interest, in particular a disease variant or predisposition to develop a disease. The method focuses on analysis of data obtained by the high throughput DNA sequencing technologies (often referred to as Next Generation Sequencing). The results were applied directly to a number of diseases studied at laboratories of NICTA partners, including breast cancer, leukaemia and diabetes.

New models for valuing gas market contracts

Mentor: Dr Sergei Schreider, RMIT University
Intern: Jon Plummer, RMIT University
Industry Partner: Phil Sheppard, Creative Analytics
Project Duration: November 2010 – February 2011

Creative analytics creates software used by those participating in the Australian energy markets. This project reviewed the operations, market data and typical contracts associated with the Victorian and New South Wales gas markets in the context of developing a suitable model for valuing gas contracts.

Optimal parameter design for improved performance of ceramic fuel cells

Mentor: Prof. Kate Smith-Miles, Monash University
Intern: Dr Laura Villanova, Monash University
Industry Partner: Dr Michael Kah, Ceramic Fuel Cells Limited
Project Duration: January 2011 – April 2011

Ceramic Fuel Cells Limited design and manufacture a fuel cell product that generates electricity from electrochemical reactions based on a supply of air and natural gas. This project examined the relationships between system performance and manufacturing data, allowing the development new ways to analyse data to further enhance the reliability and life of fuel cells.

Edwena Dixon
BBus(Mktg), AdvDip Bus(Mktg)

Edwena coordinates the collaboration between industry and universities for the AMSI Intern program. She has worked at AMSI for the last seven years and has a background in Business (Marketing).

Consulting Projects

In 2010, AMSI entered into a three-year collaboration with Parks Victoria to assist with the analysis and management of large data sets and experimental design. Parks Victoria manages national parks and reserves on behalf of the Victorian Government, and has collected large amounts of data relating to pest control in national parks around Victoria. AMSI statistician Dr Kathy Haskard provided advice on statistical aspects of a range of conservation projects within several Victorian national parks.

Koalas at Mt Eccles

Koalas are dear to the hearts of many Australians, but they also pose a threat to the eucalyptus forests they call home. National parks therefore require careful management in order to maintain a sustainable habitat for wild koalas, and this ultimately rests on controlling the density of koalas in regions of concern. The study was conducted by Parks Victoria and the Arthur Rylah Institute for Environmental Research, and monitored koala populations in several regions including the Mt Eccles National Park. Contraceptive hormonal implants were used to reduce population growth, and the animals were tagged to allow treated koalas to be identified. A key finding of the study was that the treated koalas were retreating into the areas surrounding the national park, and that fresh, untreated koalas were taking their place. This presents many challenges for future population management and demonstrates a need to manage wider areas that are outside the jurisdiction of Parks Victoria.

Weeds in the Dandenong Ranges

Plant species such as blackberry, English ivy, sweet pittosporum, sycamore and holly are particularly persistent in the Dandenong Ranges National Park. Four areas within the national park were surveyed in 2002 and 2009 to identify changes in weed abundance and distribution. Kathy reported the findings of the study to Parks Victoria to help facilitate future management of plant pests in the national park.

Rabbits, Deer and Macropods

The Grampians National Park has extensive regions of native vegetation, including many threatened plant species. In order to preserve these pristine areas, it is important to understand the impacts that both indigenous and introduced fauna have on the vegetation. In a Parks Victoria study, plots were constructed with different types of fencing designed to prevent specific animals from entering a region of interest. There were plots that excluded rabbits; other plots excluding deer and macropods (kangaroos, wallabies etc.); plots excluding rabbits, deer and macropods; and control plots with no exclusions. This setup allowed the impact on vegetation to be traced back to specific animals.

"Parks Victoria was very enthusiastic to have a statistician on tap and it does make a difference having someone actually sitting there on a regular basis. People feel more free to ask questions that they might not otherwise ask."

Dr Andrew Robinson (Unimelb), Dr John Wright (Parks Victoria), Glen Jameson (Parks Victoria), Mark Antos (Parks Victoria), Kean Weng Wong (Unimelb), Dr Tom Montague

Balconies - Grampians National Park

Industry Events

Greenhouse2011

Greenhouse2011, held in Cairns in April, was host to AMSI's Industry Event this year. AMSI's one-day session, Climate Uncertainty and Risk, was very popular. The session examined current methods and challenges in quantifying, communicating and dealing with uncertainty in climate change projections. Peter Hayman (SARDI) and Kevin Hennessy (CSIRO) gave keynote talks at the session.

Scott Power, Research Manager and a research scientist in the Bureau of Meteorology, was the AMSI plenary lecturer.

AMSI used Greenhouse2011 as an opportunity to promote its Industry Internships Program, and sponsored the attendance of several prospective interns on the lookout for challenges in the environmental sector.

Plenary lecturer Scott Power

Integrating mathematics into the real world
Five minutes with Dr Kathy Haskard, AMSI Statistician

*Dr Kathy Haskard
AMSI Statistician*

Why is AMSI's association with Parks Victoria important?

Our association with Parks Victoria came out of a very successful internship in the summer of 2009-2010. Parks Victoria was very enthusiastic to have a statistician on tap and it does make a difference having someone actually sitting there on a regular basis, because people feel more free to ask questions that they might not otherwise ask.

Do you spend time in the field yourself?

No, but I'd love to! It's really great fun. In some of my previous jobs I occasionally had the chance to spend time out in the field and I loved it. When I was in England for my post-doctoral work I was given the task of designing and coordinating a soil survey to measure nitrous oxide levels. That was great, because I just love being outdoors and using navigational skills.

How reliable is the data you work with?

There's always an issue with using observed data rather than experimental data. In many cases we can control what's going on, such as the study that was done in the Grampians (see main article). Even with experiments like this it's still hard to get enough data to work with, but when we're relying on people's observations it's very difficult to draw meaningful conclusions. There was a study I worked on that was looking at the habitat of a bird called the *plains wanderer*. It is believed that these birds prefer open areas rather than more densely vegetated areas. I had a problem with that conclusion, because it's likely to be easier to see the birds in open areas. My statistical analysis showed that there was an association between where people saw the plains wanderer and the characteristics of the vegetation, but that doesn't necessarily mean the birds actually prefer that sort of habitat. Additional arguments are needed.

What's something you love about statistics?

Statistics applies to everything, and that's what I love about all the consulting work I have done. You get to talk to such a wide variety of people and get involved with some really interesting projects.

Geoff Prince opening the MISG 2011

Mathematics and Statistics-in-Industry Study Group

The 2011 Mathematics and Statistics-in-Industry Study Group (MISG) ran from 6-11 February and was attended by 80 mathematicians and statisticians from Australia and overseas. Founded by the CSIRO in 1993, MISG brings together eminent mathematicians from all over the world to tackle a range of problems posed by industries in Australia and New Zealand. AMSI Director Geoff Prince opened the workshop, which this year had 5 industry partners including the Environmental Protection Agency and New Zealand Steel.
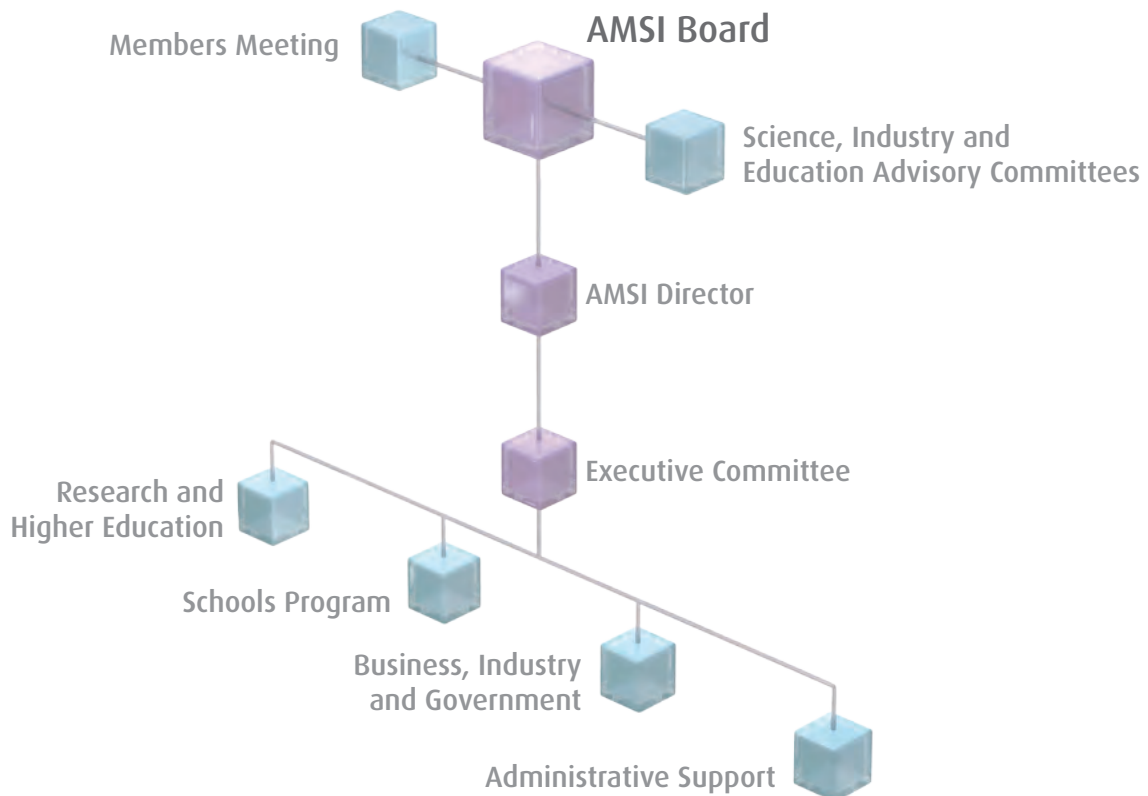
AMSI statistician Kathy Haskard was a moderator for a project with Fonterra Dairy, which looked at the equivalence of new and old technologies used to test compliance with product specifications.

Following recommendations from the AMSI review, AMSI is exploring the possibility of creating a link between its internships program and the MISG. Such a link would give industry partners the opportunity to follow up on projects after the conclusion of the MISG.

The RMIT University School of Mathematical and Geospatial Sciences is hosting the workshop over a three-year period from 2010–2012.

Organisational Structure

Members Meeting

AMSI Board

Science, Industry and
Education Advisory Committees

AMSI Director

Executive Committee

Research and
Higher Education

Schools Program

Business, Industry
and Government

Administrative Support

Geoff Prince and AMSI Members

Governance

Structure of AMSI

AMSI is a collaborative unincorporated joint venture involving universities and other bodies related to the mathematical sciences. Six full member universities signed a Joint Venture Agreement (JVA) in 2002. Since then four additional universities have become full members. All Group of Eight universities are full members. A complete list of AMSI members appears on page 6 of this report.

Management of AMSI

The JVA empowers the AMSI Board to be responsible for the overall direction of the Institute, formulation of policies, and management of activities in the areas of:

• Research and Higher Education

• Business, government and industry

• Education

External advice is provided by three high profile advisory committees.

Activities are detailed in the Business Plan and Budget document, as authorised annually by the Members and the Board. Management of the Institute and its activities, as detailed in the Business Plan and Budget document, is the responsibility of the Executive Committee authorised to perform such functions by the Board.
(Members of the Executive Committee are listed on page 42).

The AMSI Board

Composition

The Board comprises up to nine persons being:

• An independent Chair appointed by the full members

• The Institute Director

• The Deputy Director appointed by the full members

• One person representing The University of Melbourne

• One person representing the full members appointed by mutual agreement of the full members

• One person representing the associate members appointed by mutual agreement of the associate members

• Two or three independent members representing business and industry appointed by mutual agreement of the full members

No non-executive members of the Board are remunerated.

Term of Board members

The persons comprising the Board are appointed for terms of one year but are eligible to serve for one or more further terms if re-appointed in accordance with clause 18.2 of the JVA.

Board Members 2010-2011

Dr James E. Lewis BE, BA, PhD, FIChemE
Independent member and Chairman

Jim is President of the Parkview Group Pty Ltd and Director of several other companies. He has had a long career in industry and for a significant period was responsible for the research effort of one of Australia's major corporations.

Prof. Geoff Prince
BSc (Hons), DipEd, PhD, FAustMS

Director of AMSI

Prior to joining AMSI 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 and, in particular, the use of jet bundle techniques and exterior differential systems in the study of differential equations arising in mathematics and mathematical physics.

Prof. Robert Staudte AB, ScB, MSc, PhD
Deputy Director to 18 February 2011

Robert is a Professor and former Head of Department of Mathematics and Statistics at La Trobe University. He is Associate Editor for *Statistics and Probability Letters* and a member of the American Mathematical Society, the Statistical Society of Australia and the Sigma Xi Honorary Scientific Society. His research interests are robust statistics, foundations of statistics, in particular evidentiary statistics; and meta analysis.

Prof. Andrew Eberhard BSc, PhD
Deputy Director from 18 February 2011

Andrew Eberhard is a Professor of Mathematics at RMIT University in Melbourne (Victoria). He is the head of the university research grouping 'System Modelling and Optimization'. He has been leader of the Optimisation and Control Scholarship Group within the school of Mathematical and Geospatial Sciences for several years. He has worked and published extensively in many areas of variational analysis and his interests include the theory of variational limits, nonsmooth optimisation, in particular optimality conditions and second order theory, the theory of viscosity solution of Hessian and curvature equations, robust control and systems theory. More recently he has work on utility function approximation and the theory of revealed preferences in relation to generalised equilibrium models in economic theory and has a growing interest in integer programming and algorithms.

Dr Eileen Doyle BMath, MMath, PhD, FAICD
Independent member

Eileen has more than three decades of diverse business experience at both the executive and board level. She has held executive roles in the steel industry, the water and wastewater industry and the timber industry. She has significant line and profit centre management experience as well as broad functional appreciation. Her non-executive director roles have covered a wide range of industries including research, financial services, business services, building and construction, steel, mining, logistics and export. Eileen is currently Chair of the Hunter Valley Research Foundation and Director of OneSteel, CSIRO, Boral, GPT, Hunter Founders Forum and Ross Human Directions.

Prof. Peter G. Taylor BSc (Hons), PhD
Nominee of the University of Melbourne to 18 February 2011

AustMS Observer from 18 February 2011

Peter is President of the Australian Mathematical Society and was previously Head of the Department of Mathematics and Statistics at the University of Melbourne, host department of AMSI. He is internationally known for his research in applied probability and stochastic modelling. He is Editor-in-Chief of *Stochastic Models* and an associate editor of *Queueing Systems* and a member of the editorial board of the *Journal of Applied Probability/ Advances in Applied Probability.* In 2008, Peter became one of the five trustees of the Applied Probability Trust. From February 2006 to February 2008, Peter was Chair of the Australia and New Zealand Division of Industrial and Applied Mathematics (ANZIAM).

Prof. Aleks Owczarek BSc (Hons), PhD
Nominee of the University of Melbourne from 18 February 2011

Aleks is Head of the Department of Mathematics and Statistics at The University of Melbourne. His research interests lie in the general field of statistical mechanics, in particular the area of phase transitions and critical phenomena especially pertaining to model polymer systems. He is part of a Statistical Mechanics and Combinatorics Group working on these topics and is also a Chief Investigator of the ARC Centre of Excellence in the Mathematics and Statistics of Complex Systems.

Prof. Tony Dooley BSc, PhD, FAICD
Representative of the Full Members

Tony is Head of the School of Mathematics and Statistics at the University of New South Wales. His research interests are in harmonic analysis on Lie groups: ergodic theory. He is a Member of the College of Experts EPSRC (United Kingdom), the MIST panel PBRF (New Zealand), sits on the board of the National Institute of Dramatic Art and sat on the ARC MICS Expert advisory panel (2001-2004).

Prof. Louis Caccettá

BSc, PhD, FTICA, FAustMS, MASOR

Representative of the Associate Members from 23 September 2010

Louis has been Head of the Department of Mathematics and Statistics at Curtin University since December 2010, and was Head from 1994 to 2004. In October 1999, he formed the Western Australian Centre of Excellence in Industrial Optimisation (WACEIO) and has been its Director ever since. His research interests include combinatorics, graph factorisations, graph theory and its applications in network design and analysis, vehicle routing problems, open pit mining and network reliability.
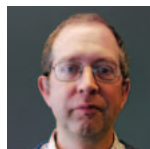
Prof. Andrew Bassom BA, PhD

Representative of the Associate Members to 23 September 2010

Andrew is Head of School and Winthrop Professor of the School of Mathematics and Statistics at the University of Western Australia. His research interests are boundary-layer theory, fluid and solid mechanics, and differential equations. He is a member of the executive committee of Australian and New Zealand Industrial and Applied Mathematics (ANZIAM), Chief Examiner TEE Calculus for the Curriculum Council, Joint Chief Editor of the ANZIAM Journal, Associate Editor of the *Quarterly Journal of Mechanics* and Applied Mathematics, the *Journal of Engineering Mathematics* and the IMA *Journal of Applied Mathematics*.

Board Observers

The Chairs of the Advisory Committees, the President of the Australian Mathematical Society and Director of MASCOS are also invited on to the Board as observers.

Prof. Jon Borwein

BA (Hons), MSc, PhD, FRSC, FAAAS, FAA

Chair of the Scientific Advisory Committee

Jon is Laureate Professor of Mathematics at the University of Newcastle and Director of the Centre for Computer Assisted Research Mathematics and its Applications (CARMA). His research interests span pure mathematics (analysis), applied mathematics (optimisation), computational mathematics (numerical and computational analysis), and high performance computing. He has also worked at Carnegie-Melon, Dalhousie, Simon Fraser, and Waterloo Universities and has held two Canada Research Chairs. He is a past winner of the Chauvenet Prize (1993) and received an honorary degree from Limoges (1999). Jon is a Fellow of the Royal Society of Canada (1994), of the American Association for the Advancement of Science (2002), and the Bulgarian Academy of Sciences (2003). In 2010 he was elected as a Fellow of the Australian Academy of Science.

Prof. Tony Guttmann

MSc, PhD, FAustMS, FAA, FTSE, FSIAM

Director of MASCOS

Tony was Interim Director of AMSI upon its foundation and an organiser of the BHP Billiton/The University of Melbourne School Mathematics Competition. His research interests lie in mathematical models of phase transitions, enumerative combinatorics and critical phenomena in general.

Prof. Peter J. Taylor

BSc, PhD, FACE, CMath, FIMA, FTICA

Chair of the Education Advisory Committee

Peter is Executive Director of the Australian Mathematics Trust and is a Professor of Mathematics and Adjunct Professor of Education at the University of Canberra. He co-chaired the International Commission on Mathematical Instruction (ICMI) Study 16 *Challenging Mathematics in and beyond the Classroom* and is a former President of the World Federation of National Mathematics Competitions, an affiliated study group of ICMI.

Prof. Nalini Joshi

BSc (Hons), MA, PhD, FAA

Chair of the National Committee for Mathematical Sciences

Nalini is Chair of Applied Mathematics and Director of the Centre for Mathematical Biology at the University of Sydney. Her research interests lie in integrable differential equations, difference equations, and extended versions of cellular automata. She was elected fellow of the Australian Academy of Science in 2008, President of the Australian Mathematical Society to September 2011 and has held visiting positions around the world.

Board Meetings

Board meetings were held in 2010 on the 23rd of September and 10th of December,
and in 2011 on the 18th of February, and 18th of April.

Dr James E. Lewis 4 of 4
Dr Eileen Doyle 1 of 4
Prof. Geoff Prince 4 of 4
Prof. Peter G. Taylor 3 of 4
Prof. Tony Dooley (from 18 February 2010) 2 of 4

Prof. Robert Staudte (to 18 February 2011) 1 of 2
Prof. Andrew Eberhard (from 18 February 2011) 2 of 2
Prof. Aleks Owczarek (from 18 February 2011) 1 of 2
Prof. Louis Caccettá (from 23 September 2010) 2 of 4
Prof. Andrew Bassom (to 23 September 2010) 0 of 1

Committee Membership

Scientific Advisory Committee

Prof. Jon Borwein (University of Newcastle) (Chair)
Prof. Phil Broadbridge (La Trobe University)
Prof. Darren Crowdy (Imperial College London)
Prof. Ezra Getzler (Northwestern University, Chicago)
Prof. Nalini Joshi (University of Sydney)
Prof. Frances Kirwan (University of Oxford)
Prof. Geoff Prince (Director, ex officio)
Prof. Terry Speed (Walter and Eliza Hall Institute)
Prof. Terence Tao (University of California, Los Angeles)
Prof. Neil Trudinger (Australian National University)

Education Advisory Committee

Prof. Peter Taylor (Australian Mathematics Trust) (Chair)
Mr Abdulmoeed Arayne (Brunswick Secondary College)
Dr Frank Barrington (University of Melbourne)
Mr Peter Brown (University of New South Wales)
Dr Steve Barry (Australian National University)
Prof. Jim Denier (University of Adelaide)
Dr Michael Evans (AMSI)
Ms Janine McIntosh (AMSI)
Assoc. Prof. Jacqui Ramagge (University of Wollongong)
Ms Jan Thomas (AMSI)
Mr David Treeby (Ivanhoe Girls' Grammar School)
Dr Leigh Wood (Macquarie University)

Industry Advisory Committee

Prof. Bill Appelbe (Victorian Partnership for Advanced Computing)
Dr James E. Lewis (Parkview Group)
Dr Thomas Montague (AMSI and MASCOS)
Dr Elliot Tonkes (Energy Edge)

Executive Committee

Prof. Geoff Prince (AMSI Director)
Prof. Andrew Eberhard (Deputy Director from 18 February 2011)
Prof. Robert Staudte (Deputy Director to 18 February 2011)
Ms Jan Thomas (Executive Officer to 31 March 2011)
Mr Richard Barker (Business Development/Marketing Manager)
Dr Thomas Montague (Industry/Marketing Manager)
Dr Michael Evans (AMSI)

Stakeholders

Members

Full Members and Associate Members are listed on page 6.
They meet as a group twice a year, normally in February
and June or July.

In the 2010–11 year, the meetings were:

• 18 February 2011 at The University of Melbourne

• 5 July 2011 at The University of Melbourne

Other stakeholders

AMSI was established through a grant from the Victorian
Government and with in-kind input by The University of
Melbourne. Funding through this grant ceased on 30 June 2005.
The following additional funding has been received
since inception:

2004: AMSI won a tender from the Department of Education,
Science and Training (DEST) for an International Centre of
Excellence for Education in Mathematics (ICE-EM), the project was
funded for four years until July 2008.

2007: AMSI received funding from the Department of Education
Employment and Workplace Relations (DEEWR) under the
Collaboration and Structural Reform Fund (CASR). The three-year
National Collaboration in the Mathematical Sciences: integrating
research, industry and education grant funded many of AMSI's
flagship programs.

2009: AMSI received further funding from DEEWR for The
Improving Mathematics Education in Schools (TIMES) project. The
project was funded for one year and extended AMSI's education
program.

2010: AMSI entered into a three-year partnership with Enterprise
Connect, an initiative of the Department of Innovation, Industry,
Science and Research (DIISR). The three-year partnership expands
the AMSI Internship Program.

Comprehensive progress reports and updated business plans are
presented in accordance with the Funding Agreements.

Communication with stakeholders

All Full and Associate Members of AMSI have nominated a person
to be their representative to communicate with AMSI. In the case
of member universities, this is usually the Head of the Department
or School or Discipline of Mathematics and Statistics. These
'member representatives' or their proxies are invited to meet as
a group every six months to hear reports of progress on current
matters and to raise matters of common interest and concern.

The AMSI Director's monthly reports on activities are emailed
to Board members, committee members and AMSI
member representatives.

The Joint Venture Agreement members meet bimonthly to provide
input on AMSI activities.

Employees

Policies and procedures

Staff members are employed on fixed term contracts through the University of Melbourne and its policies and procedures are followed.

Senior staff

Professor Geoff Prince
BSc (Hons), DipEd, PhD, FAustMS

Director of AMSI

is profiled on page 40

Ms Jan Thomas
BSc (Hons), DipEd, BEd (TESOL)

Executive Officer

As Executive Officer for AMSI, Jan's principal responsibilities were policy analysis and response, promoting careers in the mathematical sciences and supporting the Director of AMSI. She is a former teacher, curriculum advisor and teacher educator and retired from AMSI on 31 March 2011. She is now a Senior Fellow.

Ms Simi Henderson
BSc (Hons)

Program Manager (Research and Higher Ed)

Simi manages AMSI's Research and Higher Education program. The program comprises AMSI's flagship programs, workshop sponsorship, industry events and lecture tours. She also undertakes various project work within the Institute. During her time at AMSI Simi has also worked as Research Assistant on the ALTC funded Mathematics for 21st Century Engineering Students project.

Dr Thomas Montague
BSc, MSc, DipEd, DPhil (Oxon)

Industry/Marketing Manager, AMSI and MASCOS

Thomas coordinates the AMSI Industry Program. This includes the Industry internship program, identifying and coordinating partnerships between end-users and member staff participating in AMSI sponsored projects. His prior experience includes Science Advisor to the Victorian Government, research scientist and academic, private consultant on environment and resource management, and company director.

Dr Kathy Haskard
BSc, MSc, PhD

Statistician

Kathy joined AMSI in August 2010 to provide advice on statistical aspects of AMSI projects. A large proportion of her work at AMSI has been a major collaboration with Parks Victoria, where she has been involved with a range of conservation projects.

Dr Michael Evans
BSc (Hons), PhD, DipEd

Schools Project Manager

Before coming to ICE-EM, Michael was Head of Mathematics at Scotch College, Melbourne. He has worked with the Victorian Curriculum Assessment Authority (VCAA) in various capacities and over many years. He also has a continuing involvement with the Australian Curriculum. In 1999 he was awarded an honorary Doctor of Laws by Monash University for his contribution to mathematics education. In 2001 he received the Bernhard Neumann award for contributions to mathematics enrichment in Australia.

Ms Janine McIntosh
DipT

Schools Project Officer

Janine McIntosh is the Schools Project Manager. Her role is to develop school mathematics material and to work with teachers to enhance the mathematics experiences of the children they teach. Janine is an experienced primary teacher who has also worked as curriculum writer for the VCAA and the Australian Curriculum, Assessment and Reporting Authority (ACARA), in mathematics education at The University of Melbourne and serves on the Maths Challenge committee of the Australian Mathematics Trust.

Richard Barker
Dip Acc

Business and Marketing Manager

As AMSI's Business and Marketing Manager, Richard oversees the administration of AMSI's external grants. He plays a key role in the promotion of the ICE-EM materials and was a central figure in negotiating the deal with Cambridge University Press to publish the textbooks. Richard has extensive experience in marketing and business development in the commercial sector.

Associate Professor Bill Blyth
BSc (Hons), DIC, PhD

Access Grid Coordinator

Bill was previously Head of the Department of Mathematics at RMIT University. He is Chair of the Engineering Mathematics Group of Australia, a Centre Affiliate at the International Centre for Classroom Research at The University of Melbourne, and led the design and construction of the RMIT University AGR. His research interests are mathematics education in technology-rich classrooms and numerical solutions to differential and integral equations.

Members Meeting

Eileen Doyle

Bob Anderson

Stan Miklavcic

Ron Sandland

Farewell

Jim Lewis being presented with a photo memoir by Geoff Prince on behalf of AMSI at his farewell dinner.

Dr James Lewis

James Lewis was the inaugural Chair of the AMSI Board; his time at the helm spanning nine years. He has overseen the execution of all of AMSI's major programs to date, and temporarily stepped into the Director role when AMSI was without one. Jim stepped down as Chair in September 2011.

Jan Thomas   Richard Barker   Thomas Montague   Bill Blyth   Kathy Haskard

Jan Thomas

Jan Thomas retired as Executive Officer at AMSI at the end of March and now holds an honorary position at the University of Melbourne and has an office at AMSI. One of the founding staff members at AMSI, Jan has made a significant contribution as an advocate for mathematics education in Australia.

Richard Barker

Richard Barker retired from his position at AMSI at the end of July. Dick has been a talented and dedicated member of the AMSI team for seven years, not only looking after AMSI's financial affairs, but also having a hand in the generation of contracts and preparation of grant submissions. His departure will certainly leave a gap that will be difficult to fill.

Dr Thomas Montague

Thomas Montague concluded his employment at AMSI at the end of June. Tom had run a number of industry events and consultancy projects, and established the Industry Internship program under the CASR grant during his seven years at AMSI.

Assoc. Prof. Bill Blyth

Bill Blyth finished his term at AMSI towards the end of February as coordinator of the Access Grid program. Under his stewardship, Bill grew the Honours courses, seminars and events delivered over the Access Grid network.

Dr Kathy Haskard

Kathy Haskard resigned from her role as the AMSI Statistician towards the end of May to take up a new position at a firm interstate.

$$\int_M \nabla \cdot A\, dV = \int_{\partial M} A \cdot n\, d$$

Financial Statements

Financial records are administered by AMSI staff in conjunction with, and using the facilities of, The University of Melbourne. All financial statements are reconciled to the university's integrated system *Themis* to ensure compliance and to verify the unspent AMSI funds held by the university.

Three externally funded projects were completed during the period with full acquittal of the funds provided. This leaves the DIISR/Enterprise Connect project for the funding of intern placements in Small and Medium Enterprises as the remaining externally funded activity. The AMSI core operation, with financial support from Member subscriptions, commercial revenues and contributions from intern placements has recorded an increase in carry forward funds and is in a position to support key programs over the coming year.

AMSI has, during the year, completed its involvement in the publishing and marketing of schools textbooks after several years of significant profit. During the period, the transition to a commercial publishing agreement with Cambridge University Press commenced with high expectations of continued profitability.

Certification

The University of Melbourne undertakes to provide audited financial statements for all contractually funded activities but not for the overall AMSI Group. In the absence of such an overall audit statement, the following certification is provided.

We hereby certify that the funds received by the AMSI Group during 2010/11 and the expenditure incurred during that period were in accordance with the relevant funding agreements, with the AMSI Joint Venture Agreement, and with the approved Business Plan. The balance of the unspent funds as at 30th June 2011 is in agreement with the records of The University of Melbourne.
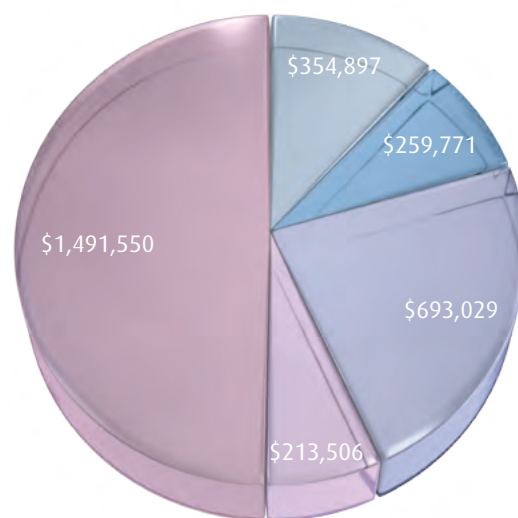
Geoff Prince
Director

Richard Barker
Business Manager
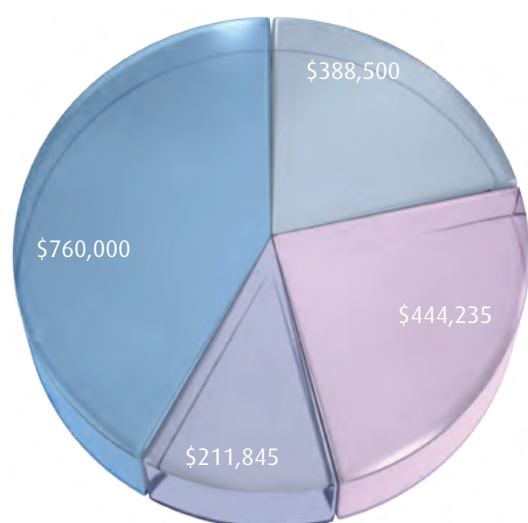
Group Income 2010–11	$
Government Funding	388,500
Commercial Incomes	444,235
Internship Program	211,845
AMSI Membership Subscriptions	760,000
	1,804,580

Group Expenditure 2010–11	$
Research and higher Education	354,897
Business Industry and Government	259,771
Schools Education	693,029
Administration	213,506
Staff Costs	1,491,550
	3,012,753

Financial Performance

	July 2010 to June 2011 $	July 2009 to June 2010 $
INCOME		
Funding:		
AMSI Member Subscriptions	760,000	639,924
DIISR - Enterprise Connect, Internships	292,700	195,300
DEEWR - Improving Mathematics Education in Schools	0	2,000,000
DEEWR - Equity and Structural Reform Branch	95,800	490,200
Sponsorship:		
Australian Char Pty Ltd	0	6,000
Farrell Family Foundation	0	50,000
AustMS - AMSI Summer School in Mathematics	15,000	0
EMBL Australia - BioInfoSummer	25,000	0
Course Fees and Charges	0	5,041
Sale of publications	364,845	489,311
Copyright income	32,303	0
Contributions from CUP Agreement	36,000	0
Internships - industry contribution	122,000	83,800
VLSCI Internship Program	89,845	0
Consulting services	10,000	128,899
Contribution - Federation Fellowship Fund	-40,000	0
Other income	1,087	3,503
Total Income	1,804,580	4,091,978
EXPENDITURE - Personnel		
Salaries, permanent and casual	1,600,156	1,550,471
External salary support	-108,606	-176,812
	1,491,550	1,373,659
EXPENDITURE by Program		
Research and Higher Education		
Research	104,125	298,492
Sponsorship:		
workshops, conferences, seminars		
researchers - guest lecturers and visiting fellows		
Higher Education - summer school, graduate		
theme program, AGRs, vacation scholars	250,772	295,362
Business, Industry and Government		
Intern program, focused workshops, costs reconsulting projects	259,771	184,845
Schools Education		
Schools - teacher PD, promotion of careers,		
schools materials for students and teachers	693,029	661,593
	1,307,697	1,440,292
Administration	183,841	151,648
Independent Review cost	29,665	0
	213,506	151,648
Total Expenditure	3,012,753	2,965,599
Net of Actual Income less Expenditure	**-1,208,173**	**1,126,379**

Financial Position

	30 June 2011	30 June 2010
	$	$
ASSETS		
Funds on Hand:		

AMSI
    Core Executive, commercial operations and administration of
    member contributions.
	875,812	654,779

Project 80005
    National Collaboration in the Mathematical Sciences: integrating
    research, industry and education. Funded by DEEWR through the
    Equity and Structural Reform Branch.
	0	400,650

Project 80019 Improving Maths Education in Schools. Funded by DEEWR.	0	1,049,781

Project 80027
    Scenario models of Population Dietary Intake.
    Funded by Dairy Australia.
	0	3,385

Projects 80028/30 Internship program. Funded by DIISR/Enterprise Connect.	313,372	195,300
	1,189,184	2,303,895
Stock on Hand:	0	93,462
ICE-EM Mathematics textbooks.	0	93,462
Net Assets	**1,189,184**	**2,397,357**
EQUITY		
Retained income brought forward	2,397,357	1,270,978
Net of income over expenditure:		
AMSI	221,034	89,007
Books taken from stock	-93,463	
Project 80005	-400,650	-211,094
Project 80018	-1,049,781	1,049,781
Project 80027	-3,385	3,385
Projects 80028/30	118,072	195,300
	-1,208,173	1,126,379
Net Equity	**1,189,184**	**2,397,357**

Summer school lecture
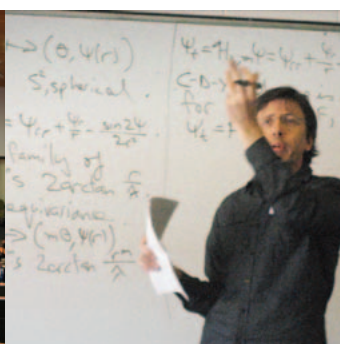
Joe Growtowski - SAC event

Internship program

World Statistics Day

"One of the most challenging and rewarding experiences of my life."

- Summer School Student

www.amsi.org.au