Number 144 April 2022

NEWSLETTER

OF THE

NEW ZEALAND MATHEMATICAL SOCIETY

Contents

PUBLISHER'S NOTICE

This newsletter is the official organ of the New Zealand Mathematical Society Inc. This issue was edited by Marie Graff and Chris Stevens. Editorial enquiries and items for submission to this journal should be submitted as plain text or LaTeX files with "NZMS newsletter" in the title of the email to nzmsnews@maths.otago.ac.nz. LaTeX templates are available upon request from the editors.

The official address of the Society is:

The New Zealand Mathematical Society,
c/- The Royal Society of New Zealand,
P.O. Box 598, Wellington, New Zealand.

However, correspondence should normally be sent to the Secretary:

Dimitrios Mitsotakis
School of Mathematics and Statistics
Victoria University of Wellington
PO Box 600
Wellington 6140
New Zealand
dimitrios.mitsotakis@vuw.ac.nz

NZMS Council and officers

Other positions of responsibility

Correspondents

Web Sites

NZMS homepage: nzmathsoc.org.nz (Webmaster: D.J.W.Simpson@massey.ac.nz)

The newsletter is available at: nzmathsoc.org.nz/?newsletter

ISSN 0110-0025

EDITORIAL

A warm hello from your new editors, Marie Graff (UoA) and Chris Stevens (UC). We would firstly like to thank the previous editors, Fabien and Melissa, for doing an amazing job with this newsletter over the last three years. Ka pai tō mahi! Hopefully, this editorial transition marks the beginning of the end for our COVID-19 restrictions and travel, details of which have dominated our lives for the last few years. Fingers crossed for undertaking international collaborations or conferences in-person this year!

There are still ongoing repercussions from COVID-19, with the NZMS colloquium being postponed last year. We will be in touch with updates on its revival for 2022. In light of this, the yearly awards were still given, and we congratulate the winners once again.

With the advent of new editors it is a good point in time to reflect on what this newsletter is all about. We would love to hear any ideas or suggestions regarding content, vision etc., so please flick us an email if you have any of these!

For the first three months of 2022, COVID has still been very present in our daily lives, namely because of the Omicron variant arriving in New Zealand just before Christmas. Once again, mathematical modelling has played a crucial role in helping to predict the various scenarios, with its successes and critics. This issue contributes toward acknowledging the huge job our colleagues did: David Bryant reminds us about the role and significance of modelling in the President's column and Mike Plank has been put in the spotlight in the portrait section as one of the key-members of the COVID-modelling team.

On the education side, the DELTA conference has been held in Auckland this year. The main challenge that arose in their report is about the decline of performance in mathematics of school students in New Zealand. An analysis is also proposed by Sarah Howell and Bronwyn Wood to illustrate this concerning trend.

We are looking forward to receiving your ideas and suggestions. Our contact details are on the previous page.

Marie Graff and Chris Stevens

PRESIDENT'S COLUMN

Like most Kiwis, I am a complete sucker for national flattery from important international institutions. I felt smugly chuffed to read the following in last month's Scientific American

> *New Zealand (Aotearoa in Māori) ... has been a standout success story in the pandemic. The government there countered COVID with nationwide stay-at-home orders, border controls, hygiene campaigns, accessible testing and contact tracing. The results were dramatic: 18 months into the pandemic, the country had seen only 27 COVID deaths. By late 2021, 90 percent of eligible citizens were fully vaccinated.*[1]

It may be COVID fatigue, and it may be the work of spin doctors, but I get the sense that our sense of national achievement in the face of COVID is being rewritten or forgotten. Yes, there were mistakes, poor predictions and examples of unfounded confidence in the face of uncertainty. But there was also ingenuity and remarkable collaboration. Epidemiologists, computer scientists, statisticians and, yes, mathematicians, worked together and with the government to help navigate through some critical and difficult decisions. The mortality rate from COVID stayed miraculously low, in part because of interventions informed by mathematical and statistical modelling.

The COVID mathematics response, here and overseas, is a wonderful example of mathematics in context. The SIR model is as perfect an example of G.H. Hardy's 'useful and dull mathematics' as one could think of. However the epidemiological realities of COVID quickly pushed the mathematics, and the mathematicians, into a dozen different disciplines. Researchers were forced to develop new technical, computational, statistical, and mathematical tools. Fundamental research challenges remain for mathematicians of all persuasions.

We often talk of the timelessness of mathematics, of hidden structure revealed. The mathematics we teach tends to be scrubbed so clean it squeaks. What COVID mathematics tells us, and what it should tell our students, is that mathematics is also very much of the present, involving real issues, and real people, right here and right now.

On a related issue, I have been working with a small team setting up an internship program for graduate students in mathematics, statistics, and eventually STEM. The scheme is based on the APR.Intern program https://aprintern.org.au/ and has only been made possible with the help and support. We also acknowledge help from colleagues in MITACs, Canada. Research internship programs are available in NZ for Engineering, Commerce, Computer Science and several other disciplines, however Callahan Innovation let me know that Mathematics and Statistics are 'out of scope'.

We are looking into running research internships for PhD students in the period between when they have submitted their theses and the oral exam, as in the APR.Intern. We will be contacting students and supervisors soon to get a sense of the number of graduate students keen to be involved. If you would like to help out with this initiative please let me know.

Cheers,

David Bryant

[1] R.G. Nelson. A microbe proved that individualism is a Myth. Scientific American March 2022 pg 28

EDUCATION

Herenga Delta Conference in New Zealand

Herenga in Te Reo Māori is a mooring place where people from afar come to share their knowledge and experiences.

The 13th Southern Hemisphere Conference on the Teaching and Learning of Undergraduate Mathematics and Statistics, organised by a New Zealand team, was successfully hosted online on 22-25 November 2021. The local organising committee brought together mathematics lecturers from different parts of New Zealand, who worked together to deliver a vibrant and engaging conference. The resilience of the Delta community was seriously tested last year. In the lead up to the conference, opinions were much divided on its viability without our joint physical presence in a delightful location with tourism options as part of the package – a traditional Delta experience. Regardless, the decision was made early in 2021 to hold the 13th Delta conference entirely online for the first time in its history. This decision had to be made well in advance because of the somewhat unusual nature of the conference – all participants have an option to submit a manuscript for a Special Issue of the International Journal of Mathematical Education in Science and Technology (IJMEST) about eight months before the start of the conference so that the special issue is published before the beginning of the conference. This meant that the local organising committee had to make a difficult decision at the start of the year in order to provide clarity for potential submitting authors. As a silver lining in the dark Covid-clouds gathered over us, many new Northern Hemisphere delegates from Canada, Ireland, Norway, the UK, and the USA chose to contribute their research for dissemination in this special issue having the certainty of their participation in the conference without the need to travel. This unexpected but pleasant surprise turned a traditionally Southern Hemisphere conference attended mostly by Australians, New Zealanders, and South Africans into a truly worldwide conference. This might have been a realised promotional opportunity that would result in the growth of the Delta community internationally. Overall, as a testimony to the quality of the Delta conference, the online conference attracted over 100 delegates who remained engaged for the duration of the four-day online experience.

As usual, the Delta conference brought together mathematics lecturers and education researchers, providing a forum for sharing their experiences, ideas and research findings on the topic of teaching and learning of mathematics at the university level. These insights were shared in 71 presentations, including five plenary talks, complemented by 12 journal articles published in the Special Issue of the IJMEST and separate conference proceedings with three full papers and presentations' abstracts (https://www.herengadelta.org/).

The challenge of teaching and engaging students in mathematics at the tertiary level has been amplified not only by the disruption caused by the COVID-19 pandemic but also by a widespread decline in student mathematics performance in New Zealand. A recent report by the Royal Society Te Apārangi ("Mathematics and Statistics in Aotearoa New Zealand: Expert Advisory Panel Report," 2021) exposed the ongoing decline of student mathematical achievement in New Zealand (29 pts) against the relative stability of the OECD average (5 pts) in PISA benchmark indicators since 2003. Similar evidence is observed in the Trends in International Mathematics and Science Study (TIMSS): out of 64 countries assessed in TIMSS in 2019, New Zealand scored significantly lower than all OECD countries taking part, except for Chile and France, and significantly lower than the centre point.

Over time, the trend is particularly concerning for high school students, with Year 9 average achievement being the lowest recorded since 1995. This is in sharp contrast with other countries, with 13 out of 33 improving their performance from 2015 to 2019, whereas New Zealand is one of the only four countries with decreased achievement. New Zealand school education appears to be grappling with major unresolved issues, which inevitably translate into additional challenges for most of us teaching at the tertiary level.

These and other challenges related to mathematics education at the university level were the focus of presentations at Herenga Delta. You can find out more about that in the articles and classroom notes published in the Special Issue of the IJMEST, available here https://www.tandfonline.com/journals/tmes20/collections/Herenga-Delta-2021. One of them is co-authored by our incoming president, Melissa Tacy, who, together with Katherine Seaton, addressed a widespread concern about the integrity of online assessment and the threat of contract cheating by synthesising advice from the literature about what might comprise "internet resistant" question design and provided practical, specific, annotated examples to demonstrate how such advice can be put into everyday practice.

If you have never attended a Delta conference, I would like to invite you warmly to join this diverse and vibrant community of mathematics educators who get together every two years. Next time, if all goes to plan, the 14th Delta conference will be in Cape Town, South Africa, in late November 2023.

I want to finish by expressing appreciation for the enormous amount of work undertaken by the local organising committee to ensure the conference's success.

Kind regards | Ngā mihi

Tanya Evans (University of Auckland) – Deputy Convener and IJMEST Special Issue Editor

Other members of the local organising committee:

Phil Kane (University of Auckland) – Convener

Stephanie Budgett (University of Auckland) – Proceedings Editor

Rosie Cameron (University of Canterbury) – Proceedings Editor

Cami Sawyer (Massey University / Ministry of Education) – Whova platform, Programme

Rachel Passmore (University of Auckland) – Treasurer

Kerri Spooner (Auckland University of Technology)

THE CONCERNING STATE OF MATHEMATICS EDUCATION IN AOTEAROA NEW ZEALAND SCHOOLS

Mathematics education in New Zealand secondary schools: Are students studying less algebra?

Mathematics education in New Zealand has received considerable attention in the past year, as we seek to understand and combat declining maths achievement and a 'slippage in expectations'. A Royal Society of New Zealand Expert Advisory Panel report documented just had bad things have become. Primary principals have been vocal in calling for more support to address the decline in performance.

While the prevailing focus of these concerns has been on primary schools, what is happening in secondary school maths, particularly in Years 11-13? This blog post, based on findings from Sarah Howell's Masters of Education dissertation, reveals the concerning decline in the number of students studying algebra, the gatekeeper to progression in mathematics.

Why is algebra so important?

A key question we set out to answer was what type of maths learning set students up well for future success in maths – in other words, what maths learning should not be left to chance? A set of 'key standards' (Figure 1) were identified through analysis of the research literature in Mathematics and Statistics education, the requirements of Aotearoa New Zealand universities' for tertiary study involving Mathematics and Statistics, and the content of the NCEA Achievement Standards [AS].

For those not familiar with New Zealand's NCEA system, assessment in the final three years of secondary school is broken up into modules ('achievement standards') that are each assessed separately. These standards span three "levels' reflecting increasing sophistication in the learning being assessed. Some standards are externally assessed (e.g. through national examinations) and others are internally assessed within individual schools and monitored through national moderation processes. While the achievement standards are assessment and not curriculum specifications, schools typically structure their senior mathematics teaching around these standards, tackling one standard at a time. Schools have flexibility in which standards to offer and how to combine these standards to form courses of study, and students also have flexibility in which standards they actually want to be assessed against.

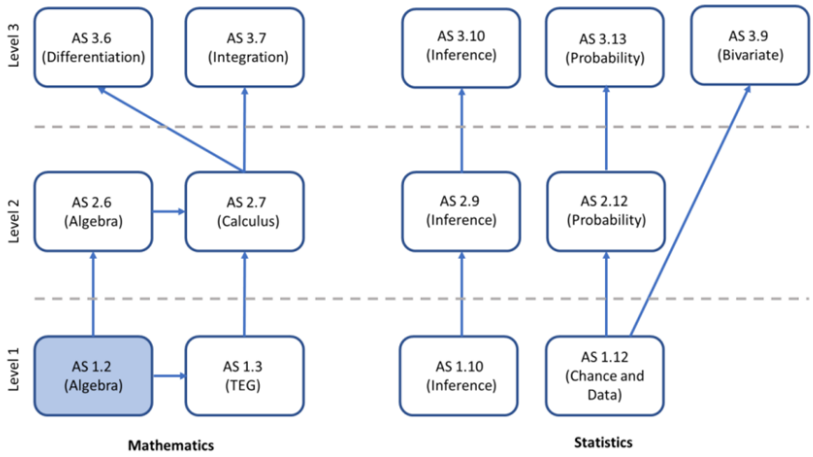


Figure 1: Our representation of the key standards for progression and pathways in Mathematics and Statistics.

A note on Figure 1: The arrows represent the contributing prior learning for each standard, not alternative pathways to reach the standard. The full names of the standards can be found here. AS1.2 (Algebra) has been shaded as our analysis suggested that it acts as 'gatekeeper' standard for progression in Mathematics.

We coined the term 'key standards' for this research to represent the Achievement Standards in each of Mathematics and Statistics, which best support progression through the levels of NCEA and onto first year university

study in these disciplines. The focus of this blog is on the maths (in particular algebra) standards but the analysis in the Masters dissertation includes both Mathematics and Statistics.

Analysis revealed that AS1.2 (Algebra) is one of these key standards but additionally acts as an important 'gatekeeper' in NCEA Mathematics progression. *If students do not participate in this standard or perform well in this assessment, they will be highly unlikely to progress through an algebra and calculus pathway.* As a result, this study paid particular attention to this Achievement Standard.

Algebra in decline

Our research examined the participation and success of NCEA maths students between 2013 and 2019 across Aotearoa New Zealand. *We identified some concerning patterns for algebra and calculus in particular.* One notable pattern was that Level 1 and 2 (Year 11 and 12) students were studying less algebra and calculus than in previous years. For example, fewer students from any school decile were sitting the Level 1 (Year 11) A.S1.2 (Algebra) in 2019 than in any previous year (see Figure 2). In addition, as Figure 2 shows, the decline in this achievement standard has been most steep in the higher decile schools (Deciles 10, and Deciles 7-9) since 2015. At its peak in 2015, Decile 10 students were almost 1.7 times more likely to be participating in AS 1.2 (Algebra) than in 2019. Decile ratings are used in New Zealand to classify schools based on the socio-economic status of the homes in their surrounding area, and so the differences in AS 1.2 (Algebra) uptake across decile ratings suggests that students attending schools in higher socio-economic areas are more likely to be accessing this important 'gatekeeper' mathematics standard.

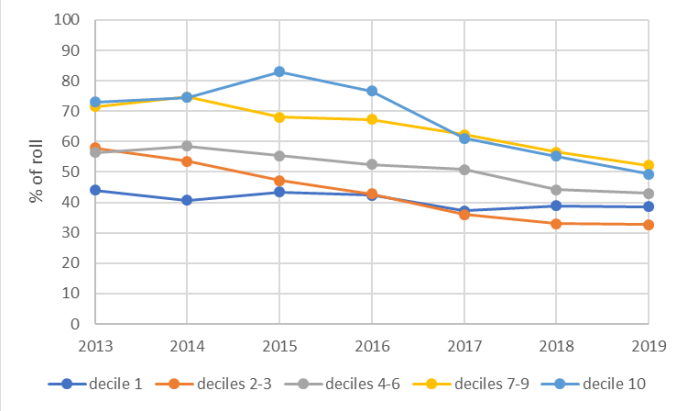


Figure 2: Rates of participation of Year 11 students in AS1.2 (Algebra), 2013-2019.

All Level 1 and 2 NCEA Mathematics algebra and calculus Achievement Standards which are externally assessed had declined during this time period. In addition, *patterns of inequity associated with school deciles persisted year after year,* with lower decile schools far less likely than higher decile schools to offer the AS1.2 (Algebra) Achievement Standard

There is also a strong pattern associated with school decile that relates to achievement. For example, in the same Algebra Achievement Standard 1.2, (see Figure 3), not only do higher decile schools have higher pass rates (red line), but students attain many more merit and excellence grades (purple line).

If we combine the percentage of those who participated in the standard and attempted the exam, with pass rates, it paints a sobering picture for those at Decile One schools compared to their counterparts at Decile 10 schools. To illustrate this picture even further: If we had 1000 Year 11 students from each of the Decile One and Decile 10 schools in 2019,

- For the Decile 10 schools, 436 students would pass AS1.2 (Algebra), with 300 of those students getting Merit or Excellence.

- For the Decile One schools, only 199 would pass the standard, with 76 of those getting Merit or Excellence.

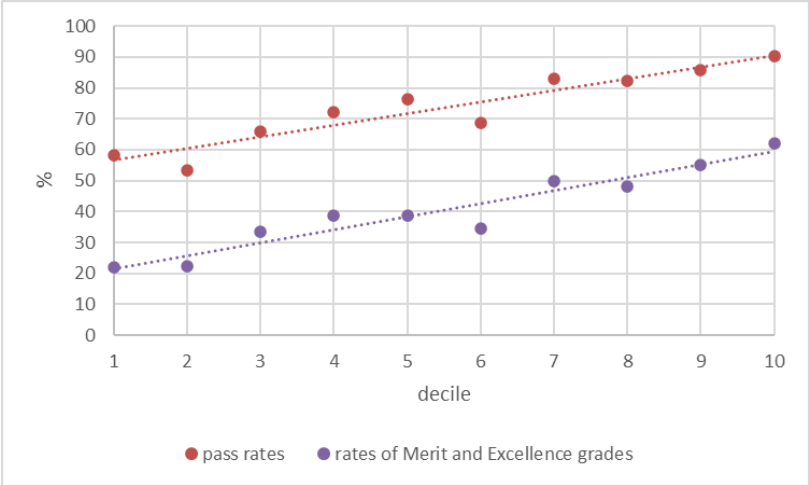


Figure 3: Pass rates and rates of Merit and Excellence grades for Year 11 students against school deciles for AS1.2 (Algebra) in 2019.

Why and how is this decline happening?

The reasons behind what we found are complex. One of the unique features of NCEA is the flexibility it allows schools and students to select the achievement standards they wish, especially in Mathematics and Statistics, where there are 43-60 credits available at each level. While some schools require students to participate in particular Achievement Standards, others are left up to the individual choice of students and/or their teachers (parents also play a role here). The potential exists for schools to not even offer the key standards, meaning students have no pathway to access the associated knowledge and skills for progression.

Teachers are often under pressure to 'get students credits' and therefore, for topics that students (or teachers) view as more difficult (which frequently includes externally assessed standards, such as Algebra), schools can decide to not offer these or offer alternative (arguably easier) standards instead. National data support this, with the average pass rate for externally assessed standards across all subjects being 78.4%, while the pass rate for internally assessed achievement standards is 84.7%. In addition, *students are also less likely to participate in externally assessed standards with 2019 data showing that internal assessment now exceeds external assessment in a ratio of about 3:1.*

The decline in the study of Algebra at Level 1 has significant implications for students and for New Zealand's educational system. If students don't do Algebra in Year 11, it is very difficult to pick this subject up in Year 12 or 13. *Failing to secure a strong foundation in Mathematics also has significant impact on future tertiary education pathways,* with growing concerns expressed by universities and polytechs that New Zealand students are not sufficiently maths literate for future study or that they may be locked out of future higher paying jobs.

Implications for policy

There is currently a review of NCEA underway to address some of the concerns raised in this study. The review includes a focus on well-being, equity, coherence, pathways and credibility for students and teachers alike. These changes are expected to be finalised by 2026. The changes indicate a much greater focus on progression of learning for students which will be challenging given that many schools have reduced their focus on teaching algebra. Equitable mathematics programmes across schools in different socio-economic communities will also be required. However, we owe it to our students to provide them with coherent and equitable pathways by offering them opportunities in maths that open rather than shut doors.

Acknowledgments

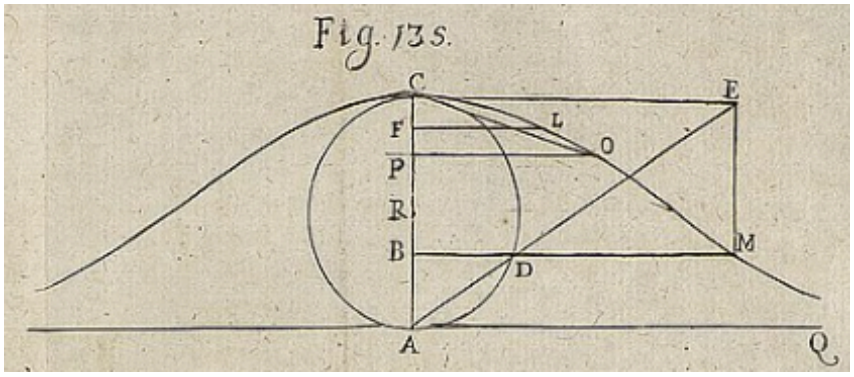
This article was recently published as an NZARE (NZ Association of Research in Education) blog post on Sarah Howell's MEd dissertation. A link to the blog post is here: https://nzareblog.wordpress.com/2022/04/05/maths-education/.

Sarah Howell and Bronwyn Wood

MATHEMATICAL MISEPONYMY

The Witch of Agnesi

Most of us who studied polar coordinates in a calculus class would have met the curve frequently referred to as the Witch of Agnesi and probably wondered at the name. In case you have forgotten how to define the curve, what better way is there to remind you than to produce Agnesi's own diagram from her book [1, Fig 135]? In the diagram AC is the diameter of a circle while AQ is a tangent. To get the curve pick any point D on the circle and extend AD to the point E where it meets the tangent at C then from E run a perpendicular to the point M that lies also on the line through D parallel to AQ: points M formed in this way constitute the curve.



The book [1] was one of the early books on calculus and was considered important enough to be translated into English, [2]. In his translation of [1], at [2, p 229] Colson translated the name Agnesi used for the curve, viz versiera (well, versiera, [1, p 381]), as witch, the result of a confusion between an Italian word which was the feminine form of a word meaning devil and the intended Latin word referring to turn. In reading what I could find about the English name I cannot help but wonder to what extent it also reflects the prevailing view at the time that women could not possibly be mathematically competent.

So who first described the curve? I found two particularly useful sources: [5, p 94] as well as Wikipedia at https://en.wikipedia.org/wiki/Witch_of_Agnesi#History, both of which discuss some of the history of the discovery and also the naming of the curve. Both refer to [3]. Well, the nearest I got to learning Latin was a cluster of high school mottos, having a bunch of third-formers chanting Latin declensions next door to my Maths classes in my last year at high school, singing *Guadeamus* and listening to Carl Orff's *Carmina Burana*, so my reading of [3, pp 279–281] is out of the question but it seems that here Fermat discusses the same curve in work dating back to 1659. However, the story may not even begin here as Fermat refers to an unnamed learned geometer (erudito geometra) as having informed him about the curve. There is speculation that this geometer might have been Antoine de Lalouvère, a frequent correspondent with Fermat. On the other hand at [6, p 28, footnote 49] "we have not been able to find a previous mention of a curve like the versiera in the literature, and this leads us to think that Fermat might be the real author of the curve or, at least of its algebraic equation."

There were others involved between Fermat and Agnesi, including Newton, Leibniz, Huygens (all late 17$^{\text{th}}$ century) and Grandi[2] (by 1703). Indeed, it seems that Grandi was the first to introduce the term versiera in the book [4, p 393][3]. Interestingly in [5, Book 2, Chapter 12], where the versiera is discussed along with two variants, the author uses just the term versiera for what is known as the witch of Agnesi but uses the term visiera ('visor') di Agnesi for the second variant, which differs from the first by using the mid-point of segment DE in the diagram above instead of M.

For further observations relating to the name, especially the persistence in its use by authors in English, one might look at the two additions sections of [7].

[2] My apologies for going off at a normal here but it's hard to resist! One thing Grandi was fascinated by was the statement

$$0 = 0+0+\cdots = (1-1)+(1-1)+\cdots = 1+(-1+1)+(-1+1)+\cdots = 1+0+0+\cdots = 1.$$

In particular it was used to claim a mathematical proof of the creation of something from nothing. It turns out to have some interesting applications in topology: as a simple example, to show that if you can tie a knot, 1, in a bit string in such a way that adding a further knot, -1, so that together they can be manipulated to the unknot, 0, without pulling the ends through then the original knot was already the unknot. There's just enough slack in the equations above to make this work: a bit of associativity, commutativity and convergence to allow the infinite addition. Google Eilenberg–Mazur swindle for more.

[3] The title page of [4] does not mention Grandi's name but at [4, p 384] one finds a new title page indicating that the following pages consist of notes by Guido Grandi.

References

[1] Maria Gaetana Agnesi, *Instituzioni analitiche ad uso della giventu Italiana*, Nella Regia-ducal Corte, Milano, 1748.

[2] Maria Gaetana Agnesi, *Analytic institutions*, English translation of [1] by John Colson, Taylor and Wilks, London, 1801.

[3] Paul Tannery and Charles Henry (eds), *Oevres de Fermat*, Gauthier-Villars et fils, Paris, 1891.

[4] *Opere di Galileo III*, Gio:Gaetano Tartini e Santi Franchi, Firenze, 1718.

[5] Gino Loria, *Curve piane speciali algebriche e trascendenti I*, Ulrico Heopli, Milano, 1930.

[6] Jaume Paradís, Josep Pla and Pelegrí Viader, *Fermat's method of quadrature*, Revue d'histoire des mathématiques **14**(2008), 5–51.

[7] C Truesdell, *Correction and Additions for "Maria Gaetana Agnesi"*, Archive for History of Exact Science **43**(1991), 385–386.

I found online versions of all these items.

David Gauld

PROFILE

Michael Plank

Mike Plank is a Professor of Mathematics at the University of Canterbury, specialising in the mathematical modelling of complex biological and social systems. He obtained a BSc(Hons) in Mathematics from the University of Bristol in 2000 and a PhD in Applied Mathematics from the University of Leeds in 2003. He came to New Zealand in 2004 to take up a postdoctoral fellowship at the University of Canterbury, and decided to stay, becoming a permanent staff member in the School of Mathematics and Statistics in 2006. Mike has remained at Canterbury to this day, being promoted to Professor in 2019. He is an internationally recognised researcher and has won many awards including ANZIAM's E O Tuck Medal for applied mathematics research and service, and was also a key member of the team that won the 2020 Prime Minister's Science Prize, New Zealand's premier award for science. In 2021, he was elected as a Fellow of the New Zealand Mathematical Society.

Mike's research is driven by a desire to make a difference, so his work is typically application-driven and relevant to government and industry needs. In particular, he has focussed on mechanistic mathematical and stochastic models that capture emergent behaviour and offer qualitative insight into underlying mechanisms. Using this approach he has studied ecological and social networks, population dynamics, epidemiological models, size-structured marine ecosystems, collective cell behaviour, and intracellular dynamics. His research draws on many branches of applied mathematics including stochastic processes, integro and partial differential equations, dynamical systems, spatial moment dynamics, statistical modelling, and parameter inference.

Mike is perhaps best known to the New Zealand public as one of the key leaders of the Te Pūnaha Matatini COVID-19 modelling team. When it became apparent in early March 2020 that the SARS-CoV-2 virus was going to spread rapidly in New Zealand, Mike, his long-time collaborator Alex James and I, decided to kick-start a Te Pūnaha Matatini modelling programme. Within a few days we were joined by early career researchers, Nick Steyn, Audrey Lustig, and Rachelle Binny. From the outset we realised that New Zealand would need a range of mathematical models to help control the virus, ranging from off-the-shelf compartment models through to more sophisticated stochastic models that captured key details of the local public health response. In an intense period of work from mid-March through to late April 2020, the team worked full-time on these models, meeting for at least an hour a day on Zoom to discuss progress and problems, as we supported the New Zealand effort to eliminate its first wave of COVID-19.

In order to execute its COVID-19 elimination strategy, New Zealand had to resolve a unique set of public health challenges, each of which generated a similarly unique set of mathematical modelling problems. Mike and the team drew on a wide range of mathematical tools to address these problems. Although New Zealand was lucky to be able to follow events in other countries where COVID-19 was less controlled, the resulting observations and corresponding data had to be translated into a New Zealand setting, where they were applied in ways not seen overseas. This included developing models for elimination, border incursion, and outbreak surveillance, as well as investigation of the impacts of COVID-19 on New Zealand communities. Indeed, Mike led the work that became particularly important for understanding the potential impact of COVID-19 on Māori communities.

This work was rewarding, but with very real and immediate consequences for the lives of New Zealanders, it could also be very stressful. I particularly remember Dr Ian Town, the Ministry of Health's Chief Science Advisor, telling us we could take a day off on Easter Saturday during that first Level 4 lockdown. That day represented a rare break for Mike and the team in what was an incredibly demanding period. Mike worked almost full-time on these models for over two years, only broken for several stints of parental leave. Unlike most academic research, the turn-around time for COVID-19 modelling is typically measured in days, sometimes hours, and once complete, the results need to be communicated clearly and concisely to public officials and politicians, not to mention the general public. Mike always brought his calm and considered presence to this work, and led many of the key mathematical developments. Indeed, Mike's work was regularly cited at the Government's daily 1 pm briefings, at times forming key talking points in the government's public health communication strategy.

During the pandemic, Mike also became one of New Zealand's most prominent expert commentators, contributing to well over a thousand media interviews and stories. Communication of the early elimination strategy against COVID-19 was relatively straightforward. However, as the virus became established here in 2021 and the possibility of achieving population immunity diminished, the public health messaging had to become more nuanced. Mike, in particular, stepped up into a higher profile role as a communicator during what was arguably the most difficult point in the pandemic. More than ever, this required well-judged communication of uncertainty and the accompanying risk around government decisions. Mike was able to do this while maintaining his independence and without undermining the government response. This included the need to explain what mathematical modelling can - and cannot - do and dealing with criticism that stemmed from overly simplistic reporting of modelling results. His strength as a communicator made him a trusted and respected house-hold name, and in 2021 he was named a Kiwibank New Zealand Local Hero Medallist as a "known voice and go-to media expert on the virus".

Within the mathematics community, Mike is probably better known for his broader work in biomathematics. His review paper on random walks in the Journal of the Royal Society Interface is the go-to paper for researchers using random walks to model biological processes and has almost 1,200 citations on Google Scholar. He has another paper in Nature with Alex James that combines a nonlinear differential equation model with random matrix theory to provide a new explanation for why complex ecosystems exist in reality, despite a long-standing theory that high-dimensional ecosystem models cannot be stable.

Mike's wider research programme has also had significant impact in industry and government. He is a member of the NZ Prime Minister's Chief Science Advisor expert panel "Towards a vision for fisheries in New Zealand in 2040". His ongoing research on balanced fishing has been cited in reports by the Food and Agriculture Organisation of the United Nations and the International Union for the Conservation of Nature, and discussed in a forum at the European Union Parliament. His research on social networks of at-risk children - again work with Alex James, amongst others - has been influential in Oranga Tamariki and led to several invitations to present at international conferences.

Over the years Mike has served in various governance and editorial roles. He is an Editorial Board member for Applied Mathematical Modelling and the ANZIAM Journal. He has also served as a panellist for the Marsden Fund and Performance-Based Research Fund. Mike has long been a leading member of the New Zealand branch of ANZIAM, serving as current branch President, as well as representing ANZIAM on the Board of the International Council of Industrial and Applied Mathematics since 2016. He has been an Associate Editor for the ANZIAM Journal since 2010 and has sat on ANZIAM's Executive Committee since 2014. As co-convenor of the 2019 ANZIAM Conference in Nelson, Mike led the development and implementation of a Code of Conduct that has since been adopted for subsequent ANZIAM conferences and events. Mike was also involved in development of the Code of Conduct for ANZIAM and the Terms of Reference for the ANZIAM Nominations Committee that aims to ensure a diverse pool of high-quality nominations for ANZIAM awards and their evaluation in a transparent and unbiased manner.

Mike is valued by his colleagues as a collaborative and a highly productive researcher and teacher. He has supervised more than a dozen PhD students in mathematics, and several more Masters students, and published more than 120 journal articles. In 2021, he was jointly awarded the University of Canterbury Research Medal with Alex James for "ground-breaking work that has informed the Government's response to the Covid-19 pandemic in New Zealand." Mike is also a good mathematician to share some beers with, and to be fair, most of us now owe him one for his important contributions to one of the world's most effective COVID-19 responses. So if you do see him at the next Maths Colloquium or ANZIAM Conference, can I suggest that the first round is on you?

Shaun Hendy

LOCAL NEWS

AUCKLAND UNIVERSITY OF TECHNOLOGY

SCHOOL OF ENGINEERING, COMPUTER AND MATHEMATICAL SCIENCES

Staff News

Dr Michael Lockyer and Mr Shaun Wason have resigned from their lecturer positions.

Dr Catherine Sweatman is appointed to the role of Programme Director for BSc. Dr Alna van der Merwe has taken care of this role since Michael Lockyer's departure at the beginning of the year.

A group of academic staff members from the Department of Mathematical Sciences is building up a centre for research in "Mathematical Modelling and Analytics".

Conference Participation

Dr Nuttanan Wichitaksorn is attending the online CFE-CSDA Conference and will present a talk "A0843: Forecasting Half-Hourly Electricity Prices using a Mixed-Frequency VAR Framework: The Case of New Zealand Market". The online conference provides opportunities for people to build up collaborative network.

Wenjun Zhang

UNIVERSITY OF AUCKLAND

DEPARTMENT OF MATHEMATICS

Staff News

Teaching has been fully online for the first half of semester, but we will return to in-person teaching after the Easter break. Many staff are excited about the prospect of international travel and are making plans.

Florian Lehner has started work (remotely) as a lecturer in Pure Mathematics.

The mathematics department had a 100% success rate in promotions in 2021. Vivien Kirk and Warren Moors were promoted to Professor. Padraic Bartlett was promoted to Professional Teaching Fellow grade PTF4. Tanya Evans was promoted to Senior Lecturer grade 6, and Marie Graff to Senior Lecturer grade 1.

Julia Novak is leaving the University of Auckland to work for the Ministry of Education.

Padraic Bartlett is also leaving the university.

Other News

Robyn Gandell was awarded an ERME (European Society for Research in Mathematics Education) Emerging Researcher award for her paper at the CERME12 conference.

Ofer Marmur's paper "Fraction images: the case of six and a half" with co-authors Xiaoheng Yan and Rina Zazkis was awarded "highly commended" for the 2020 Janet Duffin Award.

Professor Eamonn O'Brien was awarded a 2021 Te Taumata Rangahau — Research Excellence Award from the University of Auckland. Eamonn was also featured in an episode of "The Neumann Talk" podcast (interviews with past winners of the Australian Mathematical Society's B.H. Neumann Prize). You can listen to it in several major podcast apps.

Claire Postlethwaite has been appointed Program Director for the Activity Group on Dynamical Systems for the Society of Industrial and Applied Mathematics (SIAM), for the term 2022–23. The biggest part of this role is to organise the biannual Dynamical Systems conference, which will take place in Portland, Oregon, USA, in May 2023.

Gabriel Verret and Jeroen Schillewaert were elected to the Council of the Combinatorial Maths Society of Australasia.

Jeroen has been invited to visit the IHES in Paris for one month starting mid-August. He will collaborate with other visitors and local researchers at IHES and Paris-Saclay (Orsay) on a project entitled "Fixed points for group actions on spaces of non-positive curvature". He will spend two weeks in September on a Research in Pairs project with Jacques Verstraete (UCSD) at the Banff International Research Station (BIRS). He recently gave invited talks at the ACC Conference (Melbourne, AUS), Symmetry Newcastle (AUS), Algebraic graph theory international webinar (organised jointly by universities in Slovenia, USA and Mexico), and Istanbul.

Steven Galbraith

DEPARTMENT OF ENGINEERING SCIENCE

Dr. Maedeh Amirpour joined the department from August 2021 as a Lecturer in Computational Modelling research. She completed her PhD at The University of Auckland with focus on computational mechanics of functionally graded composites. Maedeh received the prestigious Rutherford fellowship from Royal society Te Aparangi in 2019 to work on her own research entitled: 'Toward tailored 3D printed bio-based human interfaces - rational design by predictive modelling'.

Modelling Housing Feature Impacts on Sale Price in Newly Developed Suburbs

Christina Yin-Chieh Lin (UOA), Andreas W. Kempa-Liehr (UOA), Andrew Mason (UOA)
Department of Engineering Science
University of Auckland

BACKGROUND

Shortage of affordable housing is a growing crisis all around the world. Surveys conducted by Gallup's World Poll from 2015 to 2017 across 140 different countries indicate that on average 27% of a country's population cannot afford adequate housing. Countries are looking for new housing solutions to create sustainable and affordable housing conditions for middle-class families. One new solution is the mass development of entirely new suburbs that support a local community. Auckland Council has presented a plan to develop outer suburbs such as Fairview Heights and Hobsonville and expand the current city into `Greater Auckland'. These new suburbs have not been adequately studied because this is a relatively new approach to property development. Modelling housing feature impacts in the new suburbs will be increasingly relevant to future developers.

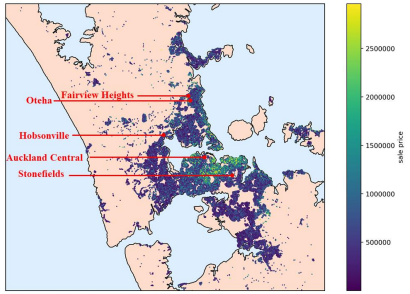


Figure 1 Map of Greater Auckland

OBJECTIVES

This study focuses on analyzing newly developed suburbs in Auckland to understand housing feature impacts on sale price in these new suburbs and provide interpretable. Defining a reliable point of reference for our model is critical for conveying the results to non-experts in machine learning, such as housing developers. Our chosen point of reference is the price of a standard house in the new suburbs over time. Modelling housing feature impacts relative to a standard house will create a unique solution to our regression problem that is easy to interpret. The main objectives of this study are to:

- Understand the impact of individual housing features on sale price in a new suburb.
- Validate the robustness of our proposed model by making predictions for a new suburb.

METHODS

This study proposes separating the effects of price change over time from the effects of individual housing features by decomposing the problem into two components:

- Price of a standard house over time
- Impacts of individual housing features on sale price relative to the standard house

The chosen formula for our model is:

$$Log(P_i) = w_0 + w_A(A_i - \bar{A}) + w_L(L_i - \bar{L}) + \sum_{b \in \mathcal{B}\setminus\bar{B}} w_b^{\mathrm{B}} \mathbb{1}_{B_i=b} + \sum_{c \in \mathcal{C}\setminus\bar{C}} w_c^{\mathrm{C}} \mathbb{1}_{C_i=c} + \sum_{g \in \mathcal{G}\setminus\bar{G}} w_g^{\mathrm{G}} \mathbb{1}_{G_i=g} + \sum_{f \in \{0,1\}\setminus\bar{F}} w^{\mathrm{F}} \mathbb{1}_{F_i} + \sum_{s \in \mathcal{S}} w_s^{\mathrm{S}} \mathbb{1}_{S_i=s} + \frac{1}{N(M_i)} \sum_{m \in \mathcal{M}} w_m^{\mathrm{M}} \mathbb{1}_{M_i-5 \le m \le M_i+6} + \varepsilon_i$$

RESULTS

We conduct a case study on modelling house sales in three new Auckland suburbs-Fairview Heights, Oteha, and Stonefields. The estimated percentage change in price for individual housing features compared to a standard house are calculated from the fitted coefficients of housing features. A house with only one bedroom is estimated to have a price approximately 37.25% lower than the price of a standard house with three bedrooms. A house with four bedrooms is estimated to be 10.43% higher in price than the standard house, but the increase in price for each added bedroom plateaus above four bedrooms. This indicates that most buyers are not satisfied with single-bedroom houses, but five bedrooms or above can become excessive. Additionally, houses with at least one free-standing garage are estimated to have prices 5.01% higher than those who do not.

Area	Floor Area in excess of 184m^2	Land Area in excess of 256m^2
Price Change	2.43% per 10m^2	0.56% per 100m^2

Bedrooms	1	2	3	4	5	6+
Price Change	-37.25%	-10.53%	0.00%	10.43%	12.82%	10.89%

Bathrooms	1	2	3	4	5+
Price Change	-3.63%	0.00%	0.63%	1.82%	0.37%

Garages	0	1	2	3+
Price Change	-0.73%	0.00%	6.41%	6.22%

Garage Type	No Free-Standng Garage	At Least 1 Free-Standing Garage
Price Change	0.00%	5.01%

Figure 2 Percentage price change from housing features

RESULTS

We use our ridge regression model fitted on Fairview Heights, Oteha, and Stonefields to make house price predictions for sales in the Hobsonville suburb. Root mean square error (RMSE) is $129,779 after back transformation. The box plot of residuals against sale years does not show any clear trend of residual changes across time (see Fig. 3). Residuals are relatively uniform across sale years. This implies that the non-linear house price trend over time is effectively captured by our model. There is one clear outlier with a residual just above one million in magnitude. This outlier property is a townhouse sold in 2018 and with a floor area of 400m^2. This is more than twice the median floor area of other townhouses, but the actual sale price is unexpectedly low for unknown reasons. Overall, approximately 91% of our predictions are within $200,000 of the true sale price.

Figure 3 Scatter plot of predicted price against actual price

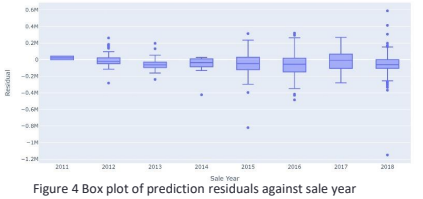


Figure 4 Box plot of prediction residuals against sale year

CONCLUSIONS

- The proposed method of modelling sale prices relative to a 'standard' house effectively captures the non-linear effects of individual housing features and price change over time.
- Our model is able to predict house prices in the new suburb of Hobsonville with reasonable accuracy.
- The insights from our model has the potential to be applied to other new suburbs to assist with the planning phase of suburb development.

Christina's contribution to Forum "Math–for–Industry" 2021 won the Best Poster Award.

She is also involving MBIE Endeavour Research Programme ("NZ IPT Roadway") and a SfTI's National Science Challenge spearhead project (3D/4D printing of bio-based composites). Maedeh was awarded Amelia Earhart Fellowship from the USA in 2016, which is awarded annually to only 30 female researchers worldwide for the novel simulation and modelling methodology that she developed during her PhD research.

Christina Yin-Chieh Lin won the Best Poster Award at the Forum "Math-for-Industry" 2021 of the Vietnam Institute for Advanced Study in Mathematics (see previous page) for her research *Modelling Housing Feature Impacts on Sale Price in Newly Developed Suburbs*.

Associate Professor Richard Clarke has accepted the Dean's invitation to take up the role of Deputy Dean, effective from 10th December. Richard was Associate Dean Postgraduate (Research) from 2018 to 2022, and more recently led the establishment of the community of learning for the Faculty Part IV project coordinators, which has helped significantly in coordinating activities such as the cross-Departmental projects and combined Part IV Project Exhibition Day.

Andreas Kempa-Liehr and Piaras Kelly

UNIVERSITY OF WAIKATO

DEPARTMENT OF MATHEMATICS AND STATISTICS

Passing of John Turner

Message from the Vice-Chancellor: It is with sadness that I advise of the passing of the University's first Dean of the School of Computing and Mathematical Sciences, John Turner. John was 93.

John joined the University of Waikato in 1970 as a Reader in Mathematics, having moved from the United Kingdom where he was Principal Lecturer in Statistics Operations Research at Leeds Polytechnic. Between 1971 and 1973 John was the Acting Director of Computing Services at the University which preceded his appointment as the Foundation Dean of the School of Computing and Mathematical Sciences in 1986. John's contribution as the Foundation Dean was significant, establishing the Bachelor of Computing and Mathematical Sciences along with programmes for Diploma, Masters, and Doctorate awards.

John set the direction of teaching and research among the department's 19 staff and introduced methods and systems adopted by other institutions around New Zealand at the time. He was also the Chief Examiner for the Bursary and Scholarship Examinations in Applied Mathematics, which saw him set papers and organise marking teams to deal with more than 5,000 scripts per year from secondary schools throughout New Zealand.

John was widely published and was a member of many mathematical and computing societies, including being the founding member of the Waikato and Bay of Plenty Computer Society, and a Fellow of the Royal Statistical Society London.

Outside of the University, John was responsible for the establishment of the Waikato Art Group, which built up a collection of New Zealand artworks exhibited in various locations throughout the University campus. He was also the founding member of the New Zealand Federation of Classical Guitar Societies and the Hamilton Hang Gliding Society.

John was elected an Honorary Life Member of the NZ Mathematical Society in 1993 and was made an Honorary Fellow of the University of Waikato in 1994.

Our flag is being flown at half mast to mark John's passing, and our thoughts are with his family, friends and former colleagues at this time.

John Turner, 1939–2022.

Passing of Alfred Sneyd

Message from the Vice-Chancellor: It is with sadness that I advise of the passing of Honorary Fellow, Professor Alfred Sneyd, aged 79. Known by many colleagues and friends as 'Franklin', Alfred was a long-serving member of the Department of Mathematics, serving 38 years at the University before retiring in 2008.

After obtaining Bachelors and Masters degrees from the University of Auckland, Alfred completed a doctorate at the University of Cambridge. Following this he took up a lectureship at the University of Waikato in 1970.

Alfred arrived at Waikato in the early days of the University, and was instrumental in setting up and teaching

the early programmes in mathematical physics, which became a strength of the University in the years to follow.

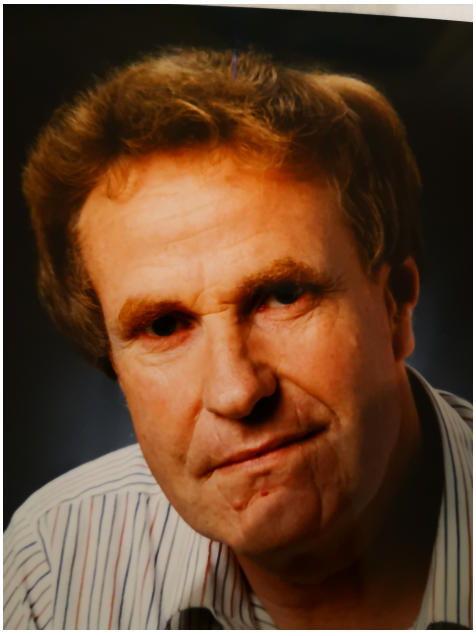
He supervised many PhD, Masters and honours students in his time at Waikato, where he was a popular lecturer and supervisor.

Alfred held a number of administrative and leadership roles at the University including Acting Chairperson of the Department of Mathematics and Statistics in 1993 and again in 2005, joint Chairperson of the newly formed Department of Mathematics from 1996-1999, as well as school representative on the Higher Degrees Committee. He was promoted to Professor in 2004.

Alfred's extensive research efforts were mostly in the area of magnetohydrodynamics (MHD), which is concerned with the dynamics of electrically conducting fluids, such as the material that makes up much of the sun, but he also had interests in topics such as aeroplane wings and Antarctic sea ice.

Alfred had many publications in top journals, was a principal investigator on a Foundation for Research, Science and Technology grant and a principal investigator on two Marsden Fund grants.

Our flag will remain at half mast to mark Alfred's passing, and our thoughts are with his wife Fiona, his children Oliver and Rose, as well as friends and former colleagues.



Alfred Sneyd, 1943–2022.

David Chan

David joined the University of Auckland's Department of Statistics as a PhD student in November 2018, under the supervision of Dr Ben Stevenson and Professor Rachel Fewster. His thesis focuses on spatial capture-recapture methods for passive acoustic survey data. He is now currently based at the University of Waikato as a Tutor for Statistics courses as he wraps up his PhD studies.

New tutor in Statistics David Chan.

Covid modelling for the Waikato DHB

Jacob Heerikhuisen and Han Gan are continuing to develop their Covid-19 model as part of a project with the Waikato, Bay of Plenty, Hawkes Bay, Tairawhiti, and Taranaki DHBs. This covers a very wide area and large proportion of the NZ population.

The model divides the population in terms of age, ethnicity, and locality, thereby providing key projections for case numbers that allow the DHBs to plan for case numbers, and to address healthcare equity. Currently the projections for hospitalisation by age are the most valuable, but there is also growing interest in projections for the longer term tail of the epidemic, including a second wave which is expected over the winter.

Kevin Broughan

MASSEY UNIVERSITY

SCHOOL OF MATHEMATICAL AND COMPUTATIONAL SCIENCES

For the first time in many years the mathematics groups at Albany and Manawatū are in the same school: the newly-created School of Mathematical and Computational Sciences, encompassing computer science, information technology, mathematics and statistics. As part of this rearrangement all mathematics courses are now offered simultaneously on both campuses as well as by distance, rather than some being offered on different campuses in different semesters. This has required a significant amount of coordination between staff on different campuses. All mathematics courses have been online only for the first semester but we are all looking forward to teaching in person in semester two.

Various staff attended online conferences including ANZIAM's EMAC (Winston Sweatman) the Manawatū-Wellington Applied Mathematics Conference

(Carlo Laing, Robert McLachlan, Winston Sweatman), ANZIAM and MISG (Winston Sweatman).

Mick Roberts moved to the New Zealand Institute for Advanced Study at the new year, and retired from his full time position becoming emeritus at the end of March. He will return to NZIAS part time in June to work on projects supported by the Marsden Fund.

Carlo Laing

VICTORIA UNIVERSITY OF WELLINGTON

SCHOOL OF MATHEMATICS AND STATISTICS

We have some good news from our students and Professors even with university life at red.

The Women in Data Science NZ event was held online on the 10th and 17th of March, with over 100 participants each day. Profs Bing Xue and Ivy Liu gave presentations about the Data Science and AI programs at VUW. Three small scholarships were awarded to students taking Data Science related majors: Serenade Akaata, Katrina Watkins and Abbey Taylor. The winners were announced by Kate Kolich and Ivy Liu. In addition to the WiDS co-ambassadors, the scholarship selection committee members were Jasmine Hall, Kirita-Rose Escott and Teneya Nicol.

Our school has a new PostDoc, Dr Jiayi Liu, who works in mathematical logic with focus on computability theory. Jiayi is interested also in combinatorics such as Ramsey theory.

Although we have continued to experience the ongoing effects of the pandemic in 2021, this has also been a year in which staff have achieved incredible successes, both collectively and individually. There are too many accolades to mention here, but the outstanding achievements of the Staff Excellence Award recipients announced last 2nd week of December, and the 12 academics recognised in the 2021 New Zealand Research Honours earlier this year, are two notable examples of staff success. Congratulations to our very own David Cox for achieving the remarkable Teaching Excellence Award. We know he has worked hard for this accomplishment and we truly appreciate his dedication.

Julius Juodakis has successfully defended his PhD thesis entitled 'Improving automatic processing of wildlife sound recordings' which was supervised by Stephen Marsland. Julius is now a post-doctoral researcher in the School of Medicine at the University of Gothenburg in Sweden.

Dimitrios Mitsotakis

UNIVERSITY OF CANTERBURY

SCHOOL OF MATHEMATICS AND STATISTICS

Congratulations to *Charles Semple*, *Alex James* and *Thomas Li* on their promotions to the ranks of Distinguished Professor, Professor and Senior Lecturer, respectively. Charles is an internationally recognised, leading researcher in mathematical phylogenetics and matroid theory. He has been awarded seven Marsden Fund grants as a Principal Investigator and is co-author of the first book to describe the mathematical foundations of modern phylogenetics (Oxford University Press), which has become the standard reference in the field. He has held Visiting Fellowships at the University of Oxford, University of Montpellier II, and the Isaac Newton Institute for Mathematical Sciences. Charles was President of the NZMS from 2009 to 2011, and in 2013, was elected a Fellow of the Royal Society Te Apārangi.

Congratulations to *Clemency Montelle* who was awarded the 2021 NZMS Research award. This award is based on mathematical research published in the last five calendar years (2016-2020). Clemency's citation reads "Professor Montelle pursues outstanding research in the field of the history of mathematics, employing the rare combination of fluency in ancient languages and an extensive background in mathematics to uncover hitherto unknown profound and diverse mathematical achievements of our predecessors."

Two esteemed colleagues in our School were made Fellows of the NZMS. Congratulations to *Liz Ackerley* (now retired) and *Mike Plank*.

Congratulations to *Mike Plank* who at the end of last year was named one of four "Canterbury local heros" for his contributions to shaping New Zealand's Covid-19 response, as part of the 100 Kiwibank Local Hero Medallists, which honours New Zealanders who take extraordinary action to help their communities and the country.

In late January the School welcomed *Speedy Jiang* and *Luke Longworth* as Senior Tutors focusing on Digital Learning Development, new positions for our School. Both had been in the School on fixed-term contracts.

In addition to his data science support, Speedy is our School's emerging resident ornithologist. Recently married, he spent his honeymoon on Stewart Island finding out more about endemic wildlife, conservation efforts, and photographing birds.

Luke completed his Masters' in Mechanical Engineering in 2020. The recent emergence of COVID-19 opened some research and teaching opportunities and he joined a team investigating various aspects of public health, including face-mask efficacy and droplet-spread modelling. At the same time, he started working with Te Kura Pāngarau, updating several online


Speedy Jiang and Luke Longworth.

teaching resources to assist with the increased volume of students learning from home. At present, his work revolves around managing many of the School's international students and maintaining and updating the database of STACK questions used for formative and summative assessment. Outside of his academic work, Luke is most often found on or behind the stage of various theatrical productions. With a background in brass bands and improvised theatre, he has frequently found himself under the spotlight, behind the baton, or in the band. His most recent performances include MUSOC's last two cabaret performances, both as a performer and conductor, as well as starring in Riccarton Players' The Boys in the Band in 2021.

At the end of February the School farewelled *Helen Rowley* who had been with our School since 2013. She had been Senior School Administrator. Helen took up a position as Examinations Senior Coordinator in the University. Her dedication, diligence, reliability and good cheer will serve her well in her demanding new role.

Rua Murray took up a 0.5 FTE role as Associate Dean (Academic) in the Faculty of Engineering Office at the beginning of 2022. His appointment is initially for one year as the University continues the process of transitioning from College to Faculty.

Brendan Creutz and *Felipe Voloch* organized the NZMRI summer workshop on "Number Theory and Related Topics" in Akaroa, January 8 to 13, 2022, see their website.

Group photo of participants at the NZMRI workshop.

Felipe says that they were lucky to have five excellent speakers and 40 participants (of whom about half were postgraduate students) from throughout New Zealand.

Congratulations to *Mike Plank* and Jenny on the safe arrival of their daughter Iris, their second child.

Mike Plank with Jenny, Iris and Luke.

Günter Steinke

UNIVERSITY OF OTAGO

DEPARTMENT OF MATHEMATICS AND STATISTICS

Congratulations to our PhD student *Pedro Barboza Rossetto* and Master's student *Josh Bardwell* for receiving several awards at the 2021 New Zealand Mathematics and Statistics Postgraduate Conference in Wellington, (or rather online).
Pedro — for the second year in a row — was awarded the "Reserve Bank of NZ's People's Choice Award", which is presented to the most outstanding overall presentation. In addition, he also received the award for the "Top talk in applied mathematics". His presentation was entitled "Magnetically confined mountains on neutron stars".
Josh was awarded the "Runner-up people's choice award" for the second most outstanding overall presentation, and the award for the "Top talk in pure mathematics" for his talk "0-Hecke Modules for Young row-strict quasisymmetric Schur functions".

Sarah Wakes has become a Fellow of Engineering NZ Te Ao Rangahau. This fellowship is "recognising the most highly experienced professionals who have made a huge impact on engineering in Aotearoa". Sarah is interested in engineering design, fluid dynamics, sustainability and coastal management. In particular, she is an expert in computational fluid dynamics with a focus on applications to engineering design and wind flow over complex coastal geomorphology. Warmest congratulations, Sarah!

The Marsden project " Gravitational waves from rotating black holes " of *Joerg Frauendiener* and collaborators recently featured in a research update from the Marsden Fund. In order to better understand nonlinear perturbations of rotating black holes, they use numerical methods to study the interaction of black holes with strong gravitational waves.

Once again, some Otago students recently featured in the news due to their excessive partying on St. Patrick's Day — not quite in alignment with Covid regulations or common sense. On such occasions, one might feel rather embarrassed to work for an institution that attracts this type of people. However, nowadays one always needs to keep in mind that many groups of strange people are actually quite small and just appear large due to their loud media presence — very much like the Covid deniers at the recent infamous Wellington "Covid camp". Hence it is important to stress that the majority of our students are very nice and intelligent people. (It would be wonderful to hear about them more often in the media!)

Jörg Hennig

PhD SUCCESS

Giorgia Vattiato (University of Canterbury. 2021)

Title: Modelling individual heterogeneity in behaviour for wildlife management and conservation.
Supervisors: Mike Plank, Alex James, Rachelle Binny (Manaaki Whenua), Isabel Castro (Massey)

Abstract: When modelling the population dynamics of wild animals we traditionally assume individual variation in behaviour is of only minor relevance to population dynamics. However, just like humans, animals exhibit consistent variation in behaviour among individuals ("personality") and most wild populations are behaviourally heterogeneous. In this thesis, we defend the argument that individual heterogeneity in animal behaviour should not be treated only as a source of "noise" in models. Instead, significant behavioural differences between members of the same species can have important consequences for population-level processes and ecological interactions. We ask to what extent individual heterogeneity affects pest eradication, what modelling strategies can be used and what kind of empirical data allow us to quantify these effects. Using the example of invasive mammal pest species in New Zealand, we first perform a meta-analysis to summarise some key characteristics of these species' trappability and space use, across a range of population densities, habitats and types of surveillance device. We then used numerical simulations to show that individual heterogeneity and the possible transmission of personalities from parent to offspring can have significant effects on the eradication of these species. Finally, we analyse empirical data from field trials to explore the different behavioural profiles observable in North Island brown kiwi, a bird species at the core of New Zealand's wildlife conservation efforts. The significance of this study is that it adds to our theoretical understanding of animal personalities by introducing a focus on their implications on wildlife management, and informs on what factors to consider when designing field experiments aimed at quantifying animal personalities

Julius Juodakis (Victoria University of Wellington)

Title: Improving automatic processing of wildlife sound recordings.
Supervisor: Stephen Marsland

Abstract: Acoustic monitoring of wildlife is emerging as a promising tool for animal conservation and research. Large amounts of natural sound recordings are routinely produced, but current use of this data is limited by lack of automatic analysis tools to process it efficiently. This thesis presents new methods for better detection of sound events, noise removal or robustness, and a framework for evaluating such improvements. Statistical and computational theory is used to support the generality of these tools, and also extended with results applicable outside of bioacoustics.

GENERAL NOTICES

KOZWavinar – 7 June 2022

A new virtual seminar series, called KOZWavinar, will be launched in 2022 for the Waves community from Australia, New Zealand and Japan. The scope of this webinar is to present recent developments of all aspects of waves, from the most theoretical mathematics to numerous applications. More information is available on the website of the webinar https://kozwaves.github.io/KOZWavinar/.

The first KOZWavinar will take place online on Tuesday 7 June 2022 at 3pm-5pm (NZ Time) with three inaugural guest speakers: Ross McPhedran (University of Sydney, Australia), Ludmila Adam (University of Auckland, New Zealand) and Hidetaka Houtani (University of Tokyo, Japan).

We look forward to seeing many of you join us!

Luke Bennetts, Amin Chabchoub and Marie Graff

Two-year postdoctoral fellowship in applied mathematics/mathematical physics

Applications are invited from outstanding early-career researchers in Applied Mathematics or Mathematical Physics to work on the research project Understanding self-organisation in multi-scale systems. The Postdoctoral Fellowship is a two-year appointment and funded via the Science Core Self-Organisation of the Dodd-Walls Centre for Photonic and Quantum Technologies.

Please, spread the word and refer potential candidates to www.math.auckland.ac.nz/~hinke/jobs.html for further details.

Informal enquiries and expressions of interest are welcome by email addressed to h.m.osinga@auckland.ac.nz, b.krauskopf@auckland.ac.nz and/or n.broderick@auckland.ac.nz.

Applications received by 15 May 2022 will be given full consideration.

Hinke Osinga

NZMS NOTICES

Calls for nominations for NZMS Awards and Fellowships

The NZMS recognises excellence in mathematical research and service to the NZ mathematical community through awards and an accreditation (fellowship) scheme. The Council asks that you all actively encourage eligible colleagues to apply for these awards and/or offer to nominate them, especially women, those of Māori ethnicity, or other members of the NZ mathematical community who are under-represented among past awardees and fellows.

Below are calls for nominations for the specific awards and for NZMS fellowships, along with their deadlines. Further details on all the awards, including past recipients, eligibility, and how to nominate someone (or self-nominate), can be found at: http://nzmathsoc.org.nz/?awards. Fellowship information and application forms can be found at: http://nzmathsoc.org.nz/?accreditation.

2022 Gillian Thornley Award for outstanding contribution to the cause or profession of mathematics

This annual award was established in 2020 to recognize outstanding contributions to the cause or profession of mathematics in New Zealand. For the purposes of this award, "contribution to the cause or profession or mathematics" could include (but is not limited to) contributions to teaching and education, research leadership, outreach, engagement with government bodies, diversity, service to professional societies, mentoring, and communication of mathematics to a general audience.

Eligibility. Nominees need not be members of the NZMS but the award would normally be given for work that took place in New Zealand and contributed to NZ mathematics.

Nominations should be sent by email to the NZMS President, Prof David Bryant (david.bryant@otago.ac.nz) by 31 August 2022. Submissions should state clearly that they are for the Gillian Thornley Award.

2022 NZMS Early Career Research Award

This award was instituted in 2006 to foster mathematical research in New Zealand and to recognise excellent research carried out by early-career New Zealand mathematicians. Candidates will be judged on their best three published research outputs and a brief CV. Research outputs could include publications in books, journals, other peer-reviewed venues, or other types of high quality mathematical research.

Eligibility. Candidates may contact the NZMS President in confidence for clarification of how the following eligibility criteria apply to their particular circumstances: candidates should be within ten years of confirmation of PhD, but an appropriate adjustment to this time period can be made to take into account career breaks or periods of reduced workload; and, candidates must have worked or studied in NZ for at least 30 months in the three calendar years immediately prior to the award year, with an appropriate adjustment for career breaks (candidates who leave New Zealand during, or prior to, the award year but satisfy all other conditions remain eligible); and, candidates must be current members of the NZMS; and no person can receive the award more than once.

All nominations and applications should be sent by email to the NZMS President, Prof David Bryant (david.bryant@otago.ac.nz) by 31 August 2022. Submissions should state clearly that they are for the NZMS Early Career Award, and should follow the guidelines at http://nzmathsoc.org.nz/?awards.

2022 NZMS Research Award

This annual Award was instituted in 1990 to foster mathematical research in New Zealand and to recognise excellence in research carried out by mathematicians in New Zealand. This Award is based on mathematical research published in the last five calendar years (2017–2021). This could include research published in books, journals, other peer-reviewed venues, or other types of high quality mathematical research. This assessment period may be adjusted to take into account an interrupted career pattern. Candidates may contact the NZMS President in confidence for clarification of how the adjustment of time period applies to the their particular circumstances.

Eligibility. To be eligible for the Award, a candidate must be a current member of the NZMS and must have been a resident of New Zealand for the last three years.

Nominations and applications should be sent by email to the NZMS President, Prof David Bryant (david.bryant@otago.ac.nz) by 31 August 2022. Submissions should state clearly that they are for the NZMS Research Award, and should follow the guidelines at http://nzmathsoc.org.nz/?awards.

2022 Kalman Prize for Best Paper

The Kalman Prize for Best Paper was instituted in 2016 to recognise excellence in research carried out by New Zealand mathematicians. The Prize will normally be awarded annually for an outstanding and innovative piece of research in the mathematical sciences published by a member or members of the NZMS. The Prize is for a single publication of original research, which may be an article, monograph or book, having appeared within the last 5 calendar years: 2017–2021. The value of the Prize is $5000. The Prize is generously funded by the Margaret and John Kalman Charitable Trust, and recognises the significant contributions to mathematics in New Zealand made by Professor John Kalman.

Eligibility. A publication may be nominated for the Prize by any member of the NZMS who is not an author of that publication. To be eligible, the nominated publication must have at least one author who: (i) is a current member of the NZMS, and was a member in the calendar year of publication of the nominated work; and (ii) is a resident of New Zealand, and was a resident of New Zealand at the time when the research was carried out.

Nominations should be sent by email to the NZMS President, Prof David Bryant (david.bryant@otago.ac.nz) by 31 August 2022. Submissions should state clearly that they are for the Kalman Prize for Best Paper, and should follow the guidelines at http://nzmathsoc.org.nz/?awards.

Fellowships of the NZMS

The New Zealand Mathematical Society, like many other societies, has an accreditation scheme. In particular, members may be recognised with the award of Fellowship of the NZMS. The NZMS encourages members to consider applying, and additionally, encourages members to nominate colleagues who meet the criteria. The complete criteria follow, all three of which are to be satisfied.

- Shall normally have been a Member of the NZMS for a period in excess of three years.
- Shall have had the qualifications of an Accredited Member for a period in excess of three years (i.e. have completed a postgraduate degree in mathematics at a recognised university or other tertiary institution, or shall have equivalent qualifications, and shall have been employed for the preceding three years in a position requiring the development, application or teaching of mathematics.)
- Shall have satisfied criteria (3.1 or 3.2 or 3.3 or 3.4) and 3.5:
  - 3.1. have made a substantial and sustained contribution to the mathematical sciences;
  - 3.2. have made a substantial and sustained contribution to the profession of mathematical scientist;
  - 3.3. have made a substantial and sustained contribution to the teaching and learning of the mathematical sciences;
  - 3.4. have made a substantial and sustained contribution to the application of the mathematical sciences;
  - 3.5. have made a substantial and sustained contribution to the New Zealand mathematics community.

Members' applications are encouraged before 1 June 2022.

Next deadline for applications for Financial Assistance — 15 May

The NZ Mathematical Society has quarterly deadlines for financial assistance applications. Applications must be made well in advance (at least one month before the funded activity, but the earlier the better) and retrospective applications will not be considered. The remaining deadlines for applications for 2022 are: 15 May, 15 August, and 15 November. You should hear back from the Council within a month of the deadline. The types of grants are as follows.

NZMS Student Travel Grants

The NZMS invites applications from students for financial support for the presentation of research at conferences, attending workshops, and developing new collaborations. Typical grants for travel within NZ and Australia are in the range $200–$600. For travel further overseas, larger grants may be considered. To be eligible, a student must be based at an institution in New Zealand and be active within the New Zealand mathematical community. NZMS Student Travel Grants can contribute to costs including: flights, conference registration, accommodation, and travel-related costs associated with family responsibilities.

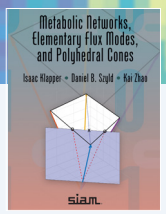
NZMS Student Travel Grants are generously supported by an annual grant from the Margaret and John Kalman Charitable Trust .

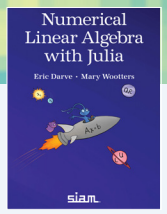
NZMS Financial Assistance

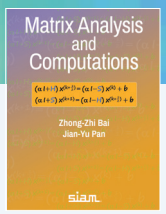
The NZMS invites applications for financial assistance with the costs of mathematical research-related activity. Any research-related activity will be considered. For example: hosting mathematical visitors; organising conferences, workshops, or outreach activities; and conference attendance, including costs associated with family responsibilities.

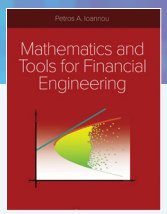
Further information and application details can be found on the NZMS website: http://nzmathsoc.org.nz/?assistance.

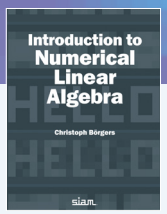
New SIAM Titles

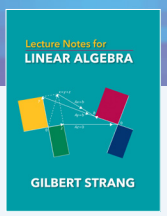


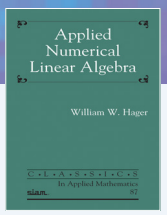


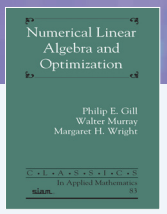












Metabolic Networks, Elementary Flux Modes, and Polyhedral Cones

Isaac Klapper, Daniel B. Szyld, and Kai Zhao

This book presents a mathematical analysis of the relationship between the cell biology idea of metabolic networks and the mathematical idea of polyhedral cones, which have become important constructs in the field of microbiology. Fundamental objects called elementary flux modes (EFMs) can be described mathematically via convex cone concepts; the fundamental algorithm of this relationship is the Double Description method. While this method has an extended history in the field of computational geometry, this monograph addresses its relatively recent use in the context of cellular metabolism, providing an easy-to-read introduction to a central topic of mathematical systems biology.

2021 • viii + 122 pages • Softcover • 978-1-611976-52-6
List $60.00 • SIAM Member $42.00 • OT171

Numerical Linear Algebra with Julia

Eric Darve and Mary Wootters

Numerical Linear Algebra with Julia provides in-depth coverage of fundamental topics in numerical linear algebra, including how to solve dense and sparse linear systems, compute QR factorizations, compute the eigendecomposition of a matrix, and solve linear systems using iterative methods such as conjugate gradient. Julia code is provided to illustrate concepts and allow readers to explore methods on their own. Written in a friendly and approachable style, the book contains detailed descriptions of algorithms along with illustrations and graphics that emphasize core concepts and demonstrate the algorithms.

2021 • xiv + 406 pages • Softcover • 978-1-611976-54-0
List $89.00 • SIAM Member $62.30 • OT172

Matrix Analysis and Computations

Zhong-Zhi Bai and Jian-Yu Pan

This comprehensive book is presented in two parts; the first part introduces the basics of matrix analysis necessary for matrix computations, and the second part presents representative methods and the corresponding theories in matrix computations. Among the key features of the book are the extensive exercises at the end of each chapter. The book provides readers with the matrix theory necessary for matrix computations, especially for direct and iterative methods for solving systems of linear equations. It includes systematic methods and rigorous theory on matrix splitting iteration methods and Krylov subspace iteration methods, as well as current results on preconditioning and iterative methods for solving standard and generalized saddle-point linear systems.

2021 • x + 486 pages • Softcover • 978-1-611976-62-5
List $99.00 • SIAM Member $69.30 • OT173

Mathematics and Tools for Financial Engineering

Petros A. Ioannou

This book presents an overview of fundamental concepts in mathematics and how they are applied to basic financial engineering problems, with the goal of teaching students to use mathematics and engineering tools to understand and solve financial problems. Part I covers mathematical preliminaries and Part II addresses financial topics ranging from low- to high-risk investments. Based on lectures for a master's program in financial engineering given by the author over 12 years at the University of Southern California, it contains numerous examples and problems, establishes a strong general mathematics background and engineering modeling techniques in a pedagogical fashion, and covers numerical techniques with applications to solving financial problems using different software tools.

2021 • xvi + 266 pages • Softcover • 978-1-611976-75-5
List $79.00 • SIAM Member $55.30 • OT176

Introduction to Numerical Linear Algebra

Christoph Börgers

This textbook on numerical methods for linear algebra problems presents detailed explanations that beginning students can read on their own, allowing instructors to go beyond lecturing and making it suitable for a "flipped" classroom. The author covers several topics not commonly addressed in related introductory books, including diffusion, a toy model of computed tomography, global positioning systems, the use of eigenvalues in analyzing stability of equilibria, and multigrid methods. A detailed derivation and careful motivation of the QR method for eigenvalues starting from power iteration is also included, as is a discussion of the use of the SVD for grading.

2022 • x + 348 pages • Softcover • 978-1-611976-91-5
List $79.00 • SIAM Member $55.30 • OT178

Lecture Notes for Linear Algebra

Gilbert Strang

Lecture Notes for Linear Algebra provides instructors with a detailed lecture-by-lecture outline for a basic linear algebra course. The ideas and examples presented in this e-book are based on Strang's video lectures for Mathematics 18.06 and 18.065, available on MIT's OpenCourseWare (*ocw.mit.edu*) and YouTube (*youtube.com/mitocw*). Readers will quickly gain a picture of the whole course—the structure of the subject, the key topics in a natural order, and the connecting ideas that make linear algebra so beautiful.

The book is available in digital form on Google Play.

2021 • iii + 183 pages • Digital 978-1-7331466-4-7
List $34.00 • WC18

Applied Numerical Linear Algebra

William W. Hager

This introduction to numerical issues that arise in linear algebra and its applications touches on a wide range of techniques, including direct and iterative methods, orthogonal factorizations, least squares, eigenproblems, and nonlinear equations. It provides clear and detailed explanations on a wide range of topics from condition numbers to singular value decomposition, as well as material on nonlinear and linear systems. It includes numerical examples, often based on discretizations of boundary-value problems, to illustrate concepts; exercises with detailed solutions at the end of the book; and supplementary material and updates online.

2022 • xiv + 424 pages • Softcover • 978-1-611976-85-4
List $89.00 • SIAM Member $62.30 • CL87

Numerical Linear Algebra and Optimization

Philip E. Gill, Walter Murray, and Margaret H. Wright

This classic volume covers the fundamentals of two closely related topics: linear systems (linear equations and least-squares) and linear programming (optimizing a linear function subject to linear constraints). For each problem class, stable and efficient numerical algorithms intended for a finite-precision environment are derived and analyzed. While linear algebra and optimization have made huge advances since this book first appeared in 1991, the fundamental principles have not changed. These topics were rarely taught with a unified perspective, and, somewhat surprisingly, this remains true 30 years later. As a result, some of the material in this book can be difficult to find elsewhere.

2021 • xvii + 426 pages • Softcover • 978-1-611976-56-4
List $89.00 • SIAM Member $62.30 • CL83

siam Society for Industrial and Applied Mathematics
BOOKSTORE

Visit the SIAM bookstore (*bookstore.siam.org*) to order these titles and more.

Outside North and South America order from Eurospan (*eurospanbookstore.com/siam*) and save on shipping.