

# Australia and New Zealand Regional Science Association International 45<sup>th</sup> Annual Conference

ANZRSAI welcomes participants to its 45<sup>th</sup> annual conference, hosted this year online and at Charles Sturt University, Wagga Wagga. The core theme for this year's conference focuses on:

# DATA SCIENCE IN REGIONAL POLICY: HOUSING AND WORKFORCE DYNAMICS

Thursday 1<sup>st</sup> and Friday 2<sup>nd</sup> December 2022

Charles Sturt University, Wagga Wagga

286 Pine Gully Rd, Charles Sturt University NSW 2678

ANZRSAI is pleased to acknowledge our conference sponsors:





Australian Government

Department of Infrastructure, Transport, Regional Development, Communications and the Arts



THE REGIONAL SCIENCE ASSOCIATION INTERNATIONAL

### **Conference** Venue

The conference will take place at:

### The Convention Centre Charles Sturt University, Wagga Wagga Australia 286 Pine Gully Rd, Charles Sturt University NSW 2678



### **Conference Dinner**

The first day of the confernce will conclude with Conference Dinner co-hosted by ANZRSAI and the CSU. This will take place at 7:00pm on Thursday, 1<sup>st</sup> December 2022. The Dinner venue is the **Henry's Restaurant, Wagga RSL Club, 30 Dobbs St, Wagga Wagga NSW 2650**. Please collect your dinnder tag from the conference registration desk on Thursday, 1<sup>st</sup> December 2022. The conference dinner will include presentations of ANZRSAI Awards, sponsored by the Bureau of Communications, Arts and Regional Research (BCARR) in the Department of Infrastructure, Transport, Regional Development, Communications and the Arts.

### **Conference Details**

Should you require further clarifications, please do not hesitate to contact the Conference Chair:

Associate Professor Azizur Rahman, PhD Charles Sturt University Wagga Wagga, NSW 2678, Australia Email: aspac@csu.edu.au

### Conference Schedule

Day One: Thursday	1 <sup>st</sup> December – Room A First Day
8:00am – 9:00am (60 mins)	Registration
9:00am - 9:10am (10 mins)	Greetings: The 2022 Conference Convenor Associate Professor Azizur Rahman, CSU
9:10am – 9:30am (20 mins)	Welcome, Acknowledgment of Country & Official Opening: <b>Professor Graham Brown</b> , The Deputy Vice-Chancellor & Vice-President (Academic), CSU [Session Facilitator: Azizur Rahman]
9:30am – 10:30am (60 mins)	<b>Keynote Speaker 1: Professor Delwar Akbar</b> , CQU Presentation title: <i>De-risking Australian agricultural sector through supply chain</i> <i>mapping tool: Role of regional data availability and accuracy</i> [Session Facilitator: Azizur Rahman]
10:30am – 11:00am	Morning Tea Break (30 mins)
11:00am – 12:00pm (60 mins)	<b>Keynote Speaker 2: Professor Chris Pettit</b> , UNSW Presentation title: Understanding the Data Science Toolkit for Envisioning Future Cities and Regions [Session Facilitator: Rolf Gerritsen]
12:00pm – 1:00pm	Lunch Break (60 mins)
1:00pm – 2:00pm (60 mins)	<b>Keynote Speaker 3: Professor Prem Chhetri,</b> RMIT University Presentation title: Spatially informed Covid-19 vaccine supply chain: A special approach to enhance the effectiveness of health care delivery [Session Facilitator: Vince Mangioni]
2:05pm – 3:25pm (80 mins)	Parallel Paper Presentations Session 1 (See Page 4 & 5 for schedule)
3:25pm – 3:40pm	Afternoon Tea Break (15 mins)
3:40pm – 4:30pm (50 mins)	Round Table discussions on Regional Issues <b>Panel:</b> Profs Rolf Gerritsen, Bruce Wilson, Kim Houghton, Chris Pettit, Anthony Sorensen, Prem Chhetri [Session Facilitator: Azizur Rahman]
4:30pm – 5:40pm (70 mins)	ANZRSAI AGM [Session Facilitator: Delwar Akbar, ANZRSAI President]
5:40pm – 5:45pm <sup>(5 mins)</sup>	Day one Closing [The 2022 Conference Convenor]
7:00pm – 10:00pm	Conference Dinner and Awards Presentation [Henry's Restaurant, Wagga RSL Club, 30 Dobbs St, Wagga Wagga NSW 2650]

### Guide To Presentations In the Contributed Paper Sessions

The sessions for the contributed papers allow for each speaker to have 20 minutes each for the presentation. This will include 15 minutes for the presentation and 5 minutes time for questions and answer, or other immediate feedback.

# First Contributed Paper Presentation Session – Room A Session Chair: **Delwar Akbar**

2:05pm – 3:25pm

2:05pm	Yogi Vidyattama Submission ID 2689	Changing housing taxation composition: A review of policy in the Australian Capital Territory
2:25pm	Gul Rukh Shakir Submission ID 2844	First Home buyers' affordability in post-COVID era: A microsimulation comparison of different housing programs in Queensland
2:45pm	Xin Janet Submission ID 4031	Visualising the housing market performance: Greater Sydney, Wollongong, and Central Coast
3:05pm	Vince Mangioni Submission ID 2155	Development of Wagga Wagga Special Activation Precinct
3:25pm	Zuhairan Yunmi Yunan <sup>Submission ID 8275</sup>	Perceived and observed corruption in Indonesia' Regions: A spatiotemporal analysis

#### First Contributed Paper Presentation Session – Room B Session Chair: **Michael Cameron**

Zoom Link Room B: Parallel Session Only

2:05pm – 3:25pm

2:05pm	Yuko Akune Submission ID 7453	The Impact of Sanitary and Phytosanitary Measures and Technical Barriers to Trade on the Agri-Food Trade in the Asia-Pacific Region
2:25pm	Anthony Sorensen Submission ID 8793	Agile versus Resilient Regions: Why should we focus on the former? But is it possible to measure the quality of place agility?
2:45pm	Bruce Wilson Submission ID 117	Enhancing Regional Innovation Systems in Country Australia: An Evidence-Driven Approach
3:05pm	Diwa Hopkins Submission ID 8574	Differentiating housing markets in regional Australia
3:25pm	Xin Janet Ge Submission ID 6069	Factors of regional spill over effects on housing prices: A literature review

## Day Two: Friday 2<sup>nd</sup> December – Room A

Zoom Link Room A: Second Day

8:30am – 8:55am (30 mins)	Registration
8:55am - 9:00am (5 mins)	Welcome and Acknowledgement of Country Associate Professor Azizur Rahman, CSU
9:00am – 10:00am (60 mins)	<b>Keynote Speaker 4: Linda Randall</b> , Nordregio Presentation title: <i>Regional implications of remote work: A Nordic perspective</i> [Session Facilitator: Azizur Rahman]
10:00am – 11:00am (60 mins)	<b>Keynote Speaker 5: Professor Ganna Pogrebna</b> , CSU Presentation title: <i>Anthropomorphic learning: Bridging behavioural science and data science to predict human behaviour</i> [Session Facilitator: Azizur Rahman]
11:00am – 11:15am	Morning Tea Break (15 mins)
11:15am – 12:15pm (60 mins)	Parallel Paper Presentations Session 2 (See Page 7 for schedule)
12:15pm – 1:00pm	Lunch Break (45 mins)
1:00pm – 1:15pm (15 mins)	Invited Talk Professor Lewis Bizo, Executive Dean of FOBJBS, CSU Presentation title: TBA [Session Facilitator: Azizur Rahman]
1:15pm – 1:45pm (30 mins)	Invited Talk Senator, the Hon Bridget McKenzie, Shadow Minister for Infrastructure, Transport and Regional Development Presentation title: Building stronger, more sustainable, and prosperous regions [Session Facilitator: Azizur Rahman]
1:45pm – 2:45pm (60 mins)	<b>Keynote Speaker 6:</b> Scott McManus, CSU Presentation title: Action for more ethical data science in regional policy when working in Indigenous Country or with Indigenous data [Session Facilitator: Azizur Rahman]
2:45pm – 4:05pm (80 mins)	Parallel Paper Presentations Session 3 (See Page 8 for schedule)
4:05pm – 4:15pm	Afternoon Tea Break (10 mins) Conference closing Thanks, ANZRSAI Organising Committee Chair The President of the ANZRSAI Council

# Second Contributed Paper Presentation Session – Room A Session Chair: **Anthony Sorensen**

#### 11:15am – 12:15pm

11:15am	Michael Cameron Submission ID 7613	An exploratory analysis of cultural distance between regions of New Zealand
11:35am	Kim Houghton Submission ID 8375	Voting with our feet: The changing regional destinations of urban Australians during COVID
11:55am	Jacques Poot Submission ID 1843	Urban Resilience and Social Security Uptake: New Zealand Evidence from the Global Financial Crisis and the COVID-19 Pandemic

# Second Contributed Paper Presentation Session – Room B Session Chair: **Vincent Mangioni**

Zoom Link Room B: Parallel Session Only

11:15am – 12:15pm

11:15am	Yong Vann Submission ID 4769	Modelling and forecasting new dwellings completed: a combination method
11:35am	MD Moyazzem Hossain Submission ID 4659	Predicting Extreme Rainfall in Regional Areas of Bangladesh: A Bayesian Approach
11:55am	Paul Dewick Submission ID 4944	Alternate View on Multilevel Modelling

# Third Contributed Paper Presentation Session – Room A Session Chair: **Diwa Hopkins**

2:45pm – 4:05pm

2:45pm	Md. Abdul Kuddus Submission ID 7863	A mathematical model for COVID-19 transmission dynamics in Bangladesh
3:05pm	Gillian Walker Submission ID 6141	Rise and fall of dairy industry in NSW, Australia- A supply- demand relationship analysis
3:25pm	Jannatul Ferdous Submission ID 1599	Developing an Analytical Framework to Depict Disruptions in Pharmaceutical Supply Chain During COVID-19
3:45pm	Md Galal Uddin Submission ID 7201	Development of an efficient water quality model using cutting-edge artificial intelligence techniques
4:05pm	Mir Talas Mahammad Diganta Submission ID 6851	Assessment of algorithms for atmospheric correction in the remote sensing technique to retrieve chlorophyll-a more precisely

# Third Contributed Paper Presentation Session – Room B Session Chair: **Yuko Akune**

Zoom Link Room B: Parallel Session Only

2:45pm – 4:05pm

2:45pm	Samsad Paeween Submission ID 5743	Assessment of groundwater quality using improved water quality index in Siliguri city, West Bengal, India
3:05pm	Abdul Majed Sajib <sup>Submission ID 5759</sup>	Improving water quality monitoring program using cutting- edge artificial intelligence-machine learning-remote sensing techniques
3:25pm	David Maré Submission ID 1158	Accounting for Social Difference When Measuring Cultural Diversity
3:45pm	John Gibson Submission ID 6331	Remotely (and wrongly) too equal: Popular night-time lights data understate spatial inequality
4:05pm	Kim Houghton Submission ID 1091	Rebalancing Australia: Setting a Regionalisation Ambition

### The Keynote Speakers

Our 45<sup>th</sup> annual conference will have a full programme of special sessions and keynote speakers. We are delighted that the following high profile regional speakers have confirmed that they will present at our conference.





Delwar Akbar is a regional economist and a research leader in agricultural supply and value chain area. He has been working with rural and regional industries and businesses to improve their productivity and sustainability. His research during the last decade has focused predominantly on rural and regional economics, value chain analysis, economic impact assessment and regional development. Along with other researchers, he has received significant levels of funding support (over 10 million dollar) have been received through the Category 1-4 grants. He has integrated economic models with supply chain, services and planning models. Recently, he has been developing and testing collaborative business models that could boaster circular rural economic systems and trade. Over his academic career, he has been involved with more than 70 research and consultancy projects, and published over 140 refereed papers and project reports. Title of the talk: De-risking Australian agricultural sector through supply chain mapping tool: Role of regional data availability and accuracy.

### PROFESSOR CHRIS PETTIT (UNSW)



Chris Pettit is the Director of the City Futures Research Centre, inaugural professor of Urban Science, and Plus Alliance Fellow at UNSW Sydney. He currently Chair of the Board of Directors for CUPUM (Computational Urban Planning and Urban Management) and on the International Advisory Board for the "Geo for all" initiative. He is a member of the Planning Institute of Australia's National Plantech Wrking Group, the advisory board for the Centre for Data Leadership, the Committee for Sydney's Smart Cities Taskforce and the NSW Government Expert Advisory Group for Planning Evidence and Insights. Title of the talk: Understanding the Data Science Toolkit for Envisioning Future Cities and Regions.

### Professor Ganna Pogrebna (CSU)

Ganna Pogrebna is a pioneer in behavioural data science. She is Executive Director of the AI and Cyber Futures Institute at Charles Sturt University, Honorary Professor at the University of Sydney, and Lead for Behavioural Data Science at the Alan Turing Institute. Blending behavioural science, AI, computer science, data analytics, engineering, and business model innovation, Ganna helps businesses, cities, charities, and individuals to better understand why they make the decisions they make and how they can optimize their behaviour to achieve higher profit, better social outcomes, as well as flourish and bolster their wellbeing.



#### PROFESSOR PREM CHHETRI (RMIT UNIVERSITY)



Prem is Professor in the School of Accounting, Information System and Supply Chain, RMIT University, where the focus of his teaching and research revolve around transport planning, retail logistics, and global trade operations management. He is a spatial analyst with a strong interest in supply chain analytics, urban infrastructure, urban systems modelling, transport and logistics analysis, emergency services planning, and management of geographic information. He will talk about: Spatially Informed Covid-19 Vaccine Supply Chain: A Spatial Approach to Enhance the Effectiveness of Health Care Delivery

### Linda Randall (Nordregio)

Linda Randall is a human geographer with an interest in addressing placebased inequalities through collaboration between researchers, policy makers and practitioners. Originally from Melbourne, she is currently a Senior Research Advisor at the Nordic Institute for Regional Development and Planning (Nordregio) in Stockholm, Sweden. Linda works primarily on Nordic and European projects concerning the implications of digital technologies for cities and regions. Her presentation is titled – Regional implications of remote work: A Nordic perspective.



#### Scott McManus (CSU)



Scott has over 25 years' experience in the exploration and mining industry focusing on data quality, resource estimation, model quality and communicating quality to end users. He is currently researching uncertainty methods with spatial domains and teaching spatial analysis and statistics at Charles Sturt University. He is also involved in Mid North Coast Rugby. He will talk about: Action for more ethical data science in regional policy when working in Indigenous Country or with Indigenous data



School of Computing, Mathematics and Engineering

# Book of Abstracts of the 45<sup>th</sup> Annual Conference of Australian and New Zealand Regional Science Association International.



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The CSU Convention Centre, Wagga Wagga Thursday 1<sup>st</sup> and Friday 2<sup>nd</sup> December 2022

#### **ANZRSAI** Administrator

Data Science Research Unit (DSRU) School of Computing, Mathematics and Engineering Charles Sturt University Wagga Wagga, NSW 2678 AUSTRALIA

# Forewords



ANZRSAI2022 Organiser:

Associate Professor Azizur Rahman Leader of Statistics and Data Mining Research Group School of Computing, Mathematics and Engineering, CSU

Conference administrative assistant:	Ramin Ghorashi School of Computing, Mathematics and Engineering, CSU
Edited by:	Associate Professor Azizur Rahman School of Computing, Mathematics and Engineering, CSU
Published by:	ANZRSAI inc./Statistics and Data Mining Research Group School of Computing, Mathematics and Engineering Faculty of Business Justice and Behavioural Science Charles Sturt University, Australia
Printed by:	Data Science Research Unit, Charles Sturt University

#### WELCOME FROM THE ORGANISER

It's my great pleasure to welcome you to the 45th Australian and New Zealand Regional Science Association International Conference organised by the Statistics and Data Mining Research Group from the Faculty of Business, Justice and Behavioural Sciences (FBJBS), at the CSU Convention Centre Wagga, December 01-02, 2022.

This conference is a significant event concerning regional issues, and the conference's core theme is *Data Science in Regional Policy: Housing and workforce dynamics*.

The conference covers a wide range of contemporary topics, including regional floods, impacts of the climate changes, cybersecurity and hacking issues, such as what recently happened with Optus and Medibank, as well as regional policy debates and issues such as sustainable development.

The overall conference program comprises six keynotes – three invited talks, one roundtable discussion and three parallel sessions with other conference activities. The ANZRSAI's Annual General Meeting (AGM) will also be held at this event.

Academics, researchers, and students from national and international universities in Australia, New Zealand, Japan, UK, Ireland, Sweden, Bangladesh and elsewhere are attending in this year conference. It provides students with many opportunities, including learning about contemporary research issues related to regional development and data science, research methods and data analysis tools and techniques, and they will gain skills from experts' presentations. They will also benefit from getting feedback on their research projects, interacting with external peers, academics, professionals from industries and decision makers from governments.

Importantly, attendees would also enjoy our University's hospitality and its beautiful carbon neutral campus.

Some awards will be presented at the conference. Charles Sturt Deputy Vice-Chancellor (Academic) Professor Graham Brown will open the conference, and Senator the Hon. Bridgit McKenzie, Shadow Minister for Infrastructure, Transport and Regional Development, will attend the event and offer an invited talk.

Finally, my sincere thanks are due to every participant and the sponsors who support this event in one way or another. A big special thank you to Senator the Hon. Bridgit McKenzie and Professor Graham Brown for their dedication to finding time (from their very occupied schedule) and making valuable contribution in this year event.

### A. R<u>ahman.</u>

Associate Professor Azizur Rahman, PhD The Convenor of 2022 ANZRSAI Conference

#### WELCOME FROM THE ANZRSAI PRESIDENT



This year is the 45th Annual ANZRSAI Conference and I am delighted that we are being hosted on the Wagga wagga campus of Charles sturt University (CSU).

The core theme of our conference is Data Science in Regional Policy: Housing and workforce dynamic. The importance of this theme at the current time is obvious to everyone.

I am very grateful to Associate Professor Azizur Rahman and his colleagues at CSU for offering to host a hybrid conference in Wagga Wagga, with the options of people participating in person or on-line. I am confident this will be a conference with something for everyone with an interest in regional policy and practice.

I also thank Charles Sturt University and BCARR – the Bureau of Communications, Arts and Regional Research – in the Department of Infrastructure, Transport, Regional Development, Communications, and the Arts, for their financial support as the Conference's main sponsors. This is a significant contribution to regional science in Australia. I particularly thank Karen Malam and Lucy Williams for their ongoing support for our annual conference.

Special thanks are also due to Professor Graham Brown (DVC-Academic), Professor Lewis Bizo (Executive Dean of FOBJBS), Professor Mark Morrison (Associate Dean Research, FOBJBS) and Professor Irfan Altas (Head of School, SOCME) at Charles Sturt for their all supports to this year conference. Among other publication opportunities, participants are welcome to submit their paper presented at the conference to the Australasian Journal of Regional Studies. I hope that both the conference program and its location will be an irresistible temptation to join us in December 2022.

Delwar Akbar

Professor Delwar Akbar ANZRSAI President, 2022

#### WELCOME FROM CSU



On behalf of the School of Computing, Mathematics and Engineering (SCME), it is my great pleasure to welcome you to the 45<sup>th</sup> Australian and New Zealand Regional Science Association International Conference (ANZRSAI2022) which will take place at the Charles Sturt University Convention Centre, Wagga Wagga Campus, on 1<sup>st</sup> and 2<sup>nd</sup> December 2022.

SCME, through its strong focus on and commitment to research, provides a high level of learning, mentoring and guidance in various Faculty Research Areas of Charles Sturt such as data science and policy analysis. Our academic staff are very successful researchers in terms of winning competitive research grants and research excellence awards (including prestigious Vice-Chancellor awards). Our School publication profile has also significantly improved due to a substantial increase in high ranking journal publications.

ANZRSAI2022 will provide a cross-disciplinary venue for researchers from government, industry, and academia at local national and international level together to create a forum for exchanging innovative research ideas, state-of-the-art, and highlight activities that deal with modern data modelling challenges and assisting various policy decisions, especially around regional issue and developments. The ANZRSAI2022 keynote sessions involve understanding the data science toolkits to accessing more ethical data for regional policy developments at a precision scale. ANZRSAI2022 also have a range of invited sessions and a round table discussion which are specially focusing on industry's practical problems and how to resolve them through state-of-the-arts modelling and technologies.

I am confident that ANZRSAI2022 will successfully serve the purpose of creating an environment of cooperation and collaboration through insightful presentations, discussions and sharing the technical ideas with colleagues and experts at national and global level.

Once again, I welcome you all and hope you enjoy the ANZRSAI2022.

Infan Altas

**Professor Irfan Altas** Head of School, School of Computing, Mathematics and Engineering, CSU

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# Preface

The overwhelming growth of data and its users is a reality, which has put new thoughts among the research community to devise new ideas for giving data driven evidenced-based policy decisions at local, state, national and international level. In recent years, regional statistics and data science have received renewed interest from a broad range of stakeholders ranging from Governments to corporations and end users of data and its analysis or modelling tools. As a result, regional development, and modelling, applied statistics and data science research such as housing and labour force dynamics, geospatial modelling, artificial intelligence, data mining and policy analysis have been placed high as a local, state and national priority in many countries including Australia. In this data centric world with vastly growing demand situation, there is a need to ensure that reliable regional priority-based analysis and data science-based modelling solutions that address important and emerging policy issues at both public and private institutions are disseminated timely and widely amongst the research and industry community.

The 45<sup>th</sup> Australia and New Zealand Regional Science Association International conference (ANZRSAI2022) aims to promote research collaborations and exchange ideas between regional research scientists and professionals, data modellers, applied statisticians and social scientists who will detail the latest innovations in research to gather and disseminate information from small to big data settings, and from policy analysts who will describe how they use existing information from increasing big data environments and indicate areas in which there need to be methodological and technological developments. Another aim is to establish connections between researchers at tertiary institutions and working in industry in Australia and overseas. The theme of ANZRSAI2022 is "Data Science in Regional Policy: Housing and Workforce Dynamics".

This year, the main feature of the ANZRSAI2022 is that it has received a more than 25 good quality submissions (covering a wide range of topics including housing taxation, predicting extreme rainfall, social agile versus resilient regional communities, cultural distance analysis, COVID-19, AI techniques, spatiotemporal analysis, data science, public policy and agricultural modelling and policy) from 9 different countries across the globe. A truly international mix of HDR students to expert researchers in academia and industry are attending the 2022 conference. The keynote sessions involve in *De-risking Australian agricultural sector through supply chain mapping tool* to action for more ethical data science in regional policy targeting for precision level local policy. ANZRSAI2022 also has a range of invited sessions and panel discussion which are specially focusing on industry's research issues and modelling opportunities using contemporary data science methodologies tools and techniques.

In addition to the refereed abstracts book, ANZRSAI2022 will publish selected full papers as a Special Issue in the "Australian Journal of Regional Studies (AJRS)" a high-quality journal and flagship publication by the ANZRSAI. Authors are encouraged to write an expression of interest by email to the Conference Organising Committee Chair on aspac@csu.edu.au for contributing to journal publications.

Finally, thanks to all authors and participants who have contributed to the ANZRSAI2022 initiative. We are looking forward to welcome you in the next conference as well.

### A. R<u>ahman.</u>

Associate Professor Azizur Rahman Leader, Statistics and Data Mining Research group ANZRSAI2022 Organising Committee Chair

# Acknowledgements

We would like to thank all the members of the Organising Committee, Program Committee, Publicity Team, Awards Committee and Referees for the peer reviews who have provided excellent supports to the ANZRSAI2022. Thanks are also due to all of our valuable sponsors and partners for their significant contributions. Special thanks to Professor Graham Brown, the Deputy Vice-Chancellor and Vice-President (Academic) for his valuable time and speech to open ANZRSAI2022.

# **Organising Committee**

#### **Program Chairs:**

Associate Professor Azizur Rahman, Charles Sturt University

#### **Organising Committee:**

Associate Professor Azizur Rahman (Chair), Charles Sturt University Professor Rolf Gerritsen, Charles Darwin University Associate Professor Yogi Vidyattama, University of Canberra Scott McManus, Charles Sturt University Dr Gregory Jones, University of Southern Queensland Associate Professor Vince Mangioni, University of Technology Sydney Associate Professor Md Rafiqul Islam, Charles Sturt University Associate Professor Michael Cameron, University of Waikato

### **Program Committee**

Associate Professor Azizur Rahman (Chair), Charles Sturt University Professor Rolf Gerritsen, Charles Darwin University Associate Professor Delwar Akbar, CQUniversity Associate Professor Yogi Vidyattama, University of Canberra Associate Professor Vince Mangioni, University of Technology Sydney Professor Mike Hefferan, Queensland University of Technology Professor Bruce Wilson, RMIT University Dr Paul McPhee, Federation University Professor Tony Sorensen, University of New England Associate Professor Michael Cameron, University of Waikato Dr Omoniyi (Niyi) Alimi, University of Waikato

### **Awards Committee**

Associate Professor Azizur Rahman (Chair), Charles Sturt University, Australia Associate Professor Michael Cameron, University of Waikato, New Zealand Associate Professor Vince Mangioni, University of Technology Sydney, Australia

### **Publicity Team**

Associate Professor Azizur Rahman (Chair), Charles Sturt University Associate Professor Yogi Vidyattama, University of Canberra Professor Delwar Akbar, CQUniversity

### **Keynote Speakers**

Professor Chris Pettit, UNSW Professor Ganna Pogrebna, Charles Sturt University Professor Prem Chhetri, RMIT University Linda Randall, Nordic Institute for Regional Development and Planning (Nordregio), Sweden Dr Scott McManus, Charles Sturt University Professor Delwar Akbar, CQU

### Sponsors





Australian Government

Department of Infrastructure, Transport, Regional Development, Communications and the Arts



### **Publication**

The 2022 ANZRSAI Conference book of abstract proceedings is published in the ANZRSAI Publications by The Australia and New Zealand Regional Science Association Inc (ANZRSAI).

### Citation of this document:

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Finally, we would like to thank everyone who has contributed to the 2022 ANZRSAI Conference.

### **Book of Abstracts**

### Keynote / Invited Speakers

First Invited Speaker: Professor Graham Brown, DVC & Vice-President, CSU Welcome, Acknowledgment of Country & Official Opening

# **First Keynote Speaker: Professor Delwar Akbar**, Central Queensland University **De-risking Australian agricultural sector through supply chain mapping tool: Role of regional data availability and accuracy**

**Abstract:** Australian agricultural sector accounts 55% of Australian land use and 12% of goods and services exports in 2020-21. About 72% of agricultural output is exported. Agricultural output, rural industries and communities are interrelated to each other. However, the agricultural sector's output is often affected by upstream and downstream supply chain uncertainties in both domestic and export markets. A commodity specific supply chain mapping tool can forecast risks and suggests how to deal with uncertainties in the agricultural supply chain. A proposed mapping tool consists of four components: product, infrastructure, process and factors. Availability of accurate data and information for these components is essential to complete the supply chain mapping tool at regional scale such as for central Queensland region in Australia. This study will provide insights about the availability and accuracy of data and how these data are affecting the mapping tool; and therefore, affecting business and supply chain plans at regional scale in Australia.

#### Second Keynote Speaker: Professor Chris Pettit. University of New South Wales

#### Understanding the data science toolkit for envisioning future cities and regions

**Abstract:** The emergence of AI, ML and other data-driven approaches offer the promise of new insights into the form and function of our cities and regions. In this presentation I will critically reflect on various novel data analytical approaches and the strength and weakness of such approaches. I will take a case study approach in the context of a recently completed National scale research project "Value Australia - Sharpening our land and property decisions with Artificial Intelligence". This project was funded through the CRC-P scheme with partners: FrontierSI Commonwealth Bank of Australia, Value General NSW, Liverpool City Council, Omnilink and UNSW. The project developed a number of data science outputs including: an automated property valuation model using ML, a property market dashboard and a scenario planning tool.

#### Third Keynote Speaker: Professor Prem Chhetri, RMIT University

# Spatially informed Covid-19 vaccine supply chain: A spatial approach to enhance the effectiveness of health care delivery

**Abstract:** A time-sensitive mass vaccination under supply uncertainty is a major challenge during the Covid-19 pandemic. Area-specific susceptibility to Covid-19 in large and complex cities necessitates health authorities to achieve the optimal balance between spatial justice and operational efficacy. In this presentation, I will present a decision support system (DSS) that integrates spatial analytics and data science techniques to optimise a priority-based distribution of COVID-19 vaccines in Melbourne. Novel hierarchical heuristic-simulation procedures are applied to create a holistic algorithm for prioritising demand allocation and optimising vaccine distribution. Three vaccine supply scenarios, namely limited, excessive, and disrupted supply, were formulated to operationalise a two-dose vaccination program. Local area plans anchored on health centres were generated to ensure the vaccination of the most needed and vulnerable populace is prioritised whilst achieving spatial optimality in service delivery. I will conclude with key findings that highlight the value of spatially informed vaccine supply chain to enhance the effectiveness of health care service delivery.

#### Fourth Keynote Speaker: Linda Randall, Nordregio

#### Regional implications of remote work: A Nordic perspective

**Abstract:** The dramatic increase in remote work since the onset of the COVID-19 pandemic has fueled much speculation about the future of the geography of work. This research seeks to contribute to the discussion, providing insight into the state of play regarding remote work in the Nordic countries based on Nordic literature, statistical data, policy review, online surveys, and stakeholder interviews. Findings suggest that, although higher levels of remote work are expected to be maintained post-pandemic, there is little evidence to support a large-scale shift towards a "remote-first" mindset. At the same time however, changing patterns of migration, mobility and multilocality, along with accounts from local and regional stakeholders, do suggest some potential for remote work to influence longer-term urban and regional development trends. Despite some challenges, this potential is largely viewed in a positive light, an opportunity to revitalise struggling communities outside of the larger cities.

### Fifth Keynote Speaker: Professor Ganna Pogrebna, Charles Sturt University

# Anthropomorphic learning: Bridging behavioural science and data science to predict human behaviour

Abstract: Understanding and modelling human behaviour is one of the major tasks facing the industry and academia of the future. This task is especially important when we consider interactions between humans and technology. Decision support systems, suggestion systems, automation, etc. all these technologically intense aspects of human life require accurate predictions of what people like, what people prefer, and where people need the help of algorithms and automated agents. Under these circumstances, recent advances in computer science, statistics, and mathematics offer several methods which try to model human behaviour. Specifically, the methodology of machine learning and, more recently, deep learning allows us to generate predictions useful for many different facets of human life. By combining behavioural science models with AI algorithms, we are able to significantly improve and simplify predictions of human behaviour in a wide variety of contexts. The resulting methodology which we label anthropomorphic learning allows us to develop more functional systems which better understand humans. This methodology is explainable, traceable, requires smaller training sets and, generally, outperforms existing algorithms by generating more accurate predictions. Anthropomorphic learning is one of the methods of behavioural data science, a new interdisciplinary field, which emerges as a direct response to the need for studying behaviour "in the wild", outside the "sterile" laboratory setting and controlled environments. This keynote address will discuss the methodology of anthropomorphic learning and its various applications.

Second Invited Speaker: Professor Lewis Bizo, Executive Dean of FOBJBS, CSU TBA

### Third Invited Speaker: Senator, the Hon Bridget McKenzie

Shadow Minister for Infrastructure, Transport and Regional Development

#### Building stronger, more sustainable, and prosperous regions

**Abstract:** Building strong, sustainable, and prosperous regions is a key outcome for governments in a nation like Australia. A siloed approach to regional development by state, local and federal governments has led to inefficient and often ineffective funding and policy decisions. Using data effectively to inform policy decisions requires 1) sharing 2) agreed definitions, and 3) consideration to localism and place-based decision making. This paper will highlight the challenges and relevant policy initiatives to address the need to back the regions own vision for their future.

#### Sixth Keynote Speaker: Dr Scott McManus, Charles Sturt University

# Action for more ethical data science in regional policy when working in Indigenous Country or with Indigenous data

**Abstract:** Dominant current practices are at risk of being tokenistic and "tick a box", reproducing systemic barriers. Prioritizing Indigenous aspirations and rights for self-determination (UNDRIP) requires focused action by all individuals and organizations to inform themselves in more ethical practice, especially in the collection and interpretation of data. This presentation is a reflection on our personal experiences of ethical and unethical research approaches. Our work is informed by scholarship associated with Indigenous data sovereignty, where lack of consultation and deficit statistics are framed as issues to be addressed. Informed by theory and our own research experiences we offer insight into more ethical data science in regional policy. This presentation is significant because all regional policy is on Indigenous Country and impacts Indigenous people or is focused directly on Indigenous people. The impact of this presentation is improved cultural responsivity in Data science to inform regional policy.

### **Contributed Abstracts**

#### Submission ID #2689:

#### Changing housing taxation composition: A review of policy in the Australian Capital Territory

Yogi Vidyattama, University of Canberra, Australia [Co-authors: Robert Tanton and Jinjing Li]

**Abstract:** After growing slowly since being stated as national capital in 1913, the Australian Capital Territory (ACT) has been growing rapidly in the past five decades and facing the issues of growing urban area, housing. A tax modernisation program introduced by Government began in 2012 and aimed to ease the barrier of owning home by replacing inefficient taxes, such as stamp duty, with a broad-based land tax through the general rates system. This article focuses on the impact of tax reform on the ability of low income families to buy a house. A microsimulation model was used to assess the tax reform. The results show that tax reform has increased property turnover and reduced the amounts paid for stamp duty and rates for most groups of vulnerable families in the ACT. Increases in house prices may eliminate this opportunity for the vulnerable families but only if the increase is extreme.

Keywords: tax reform, housing, general rates, land tax

#### Submission ID #2844:

# First Home buyers' affordability in post-COVID era: A microsimulation comparison of different housing programs in Queensland

#### Gul Rukh Shakir, University of Canberra, Australia

**Abstract:** The recent surge in house prices, post COVID, presents a tremendous challenge to the Government in Australia. Affordable housing, specially for the new entrants of housing market, is the top priority for the current government. A number of housing programs have been proposed which aim to target and help the low- and moderate-income families into homeownership. This paper analyses two of these programs, namely "First home guarantee scheme" and "Help to buy scheme". For this, Queensland has been taken as a case study due to the recent housing crisis in the state. A housing microsimulation model is used to conduct a comparative analysis of these two programs. The impact of these two programs has been evaluated on the basis of the number of potential first-time buyers who can achieve home ownership. Results suggest that the "First home guarantee scheme" can achieve the desired outcome faster than "Help to buy scheme".

Keywords: First home buyers, microsimulation, housing affordability, Post-COVID

#### Submission ID #4031:

#### Visualising the housing market performance: Greater Sydney, Wollongong and Central Coast

#### Xin Janet Ge, University of Technology Sydney, Australia [Co-authors: Jinson Zhang]

**Abstract:** The regional housing prices have increased rapidly in the last few years. This research applies visual presentation to understand the housing market performance for Greater Sydney, Wollongong and Central Coast over the last 2 decades. The analysis compares demographics, supply and demand, housing affordability, ownership structure, housing finance status, dwelling types, and workforce for the three studied areas. The results show that the unemployment rates in the regional areas are higher than the Greater Sydney. The demand for housing had increased dramatically, in which the demand for Wollongong housing has increased more than the Central Coast in the last five years. There are also increasing the gap between house price and unit price and households are getting more difficulties to own their home. The research helps to understand the drivers of housing market and provides value information for urban planning to address affordability issues.

Keywords: Regional study, housing price, rent, affordability, supply and demand

#### Submission ID #2155:

#### **Development of Wagga Wagga Special Activation Precinct**

#### Vince Mangioni, University of Technology Sydney, Australia

**Abstract:** Special Activation Precincts (SAP) are a new initiative in planning and delivering industrial and commercial infrastructure projects in defined locations across regional New South Wales. Their objective is to bring together planning, investment and support services in the delivery of key infrastructure that support innovation, employment and connectivity between industry, community and the broader regional economy. This paper examines the Wagga Wagga Special Activation Precinct as a case study and applies action research through a stakeholder lens in defining the opportunities, strengths, challenges and limitations in the development of this project. The paper finds that in the initial planning and development stage of the project, local community concerns over the location and land uses present NSW Planning with factors to be address in bringing the benefits of the project to fruition at both a local level, in achieving the broader regional beneficiaries of the project.

Keywords: Special, Activation, Precincts

#### Submission ID #4659:

#### Predicting Extreme Rainfall in Regional Areas of Bangladesh: A Bayesian Approach

# *MD Moyazzem Hossain, Newcastle University, United Kingdom* [Co-authors: Lee Fawcett and Andrew Golightly]

**Abstract:** Given the changing nature of the world's climate, and the disproportionate effect this might have on developing countries such as Bangladesh, the prediction of extreme rainfall levels is vitally important. Extreme weather events are anticipated to become more common around the world and they impact yield volatility i.e., reduce food production. Agriculture is the major employment generation and significant economic contributing sector in Bangladesh. Recently, extreme rainfall has had a significant effect on agricultural production, which negatively affects the nation's food security and may make it more difficult to end hunger (and achieve UN Sustainable Development Goal-2). Therefore, understanding and modelling the extremes of rainfall in Bangladesh is crucial. This study considers extreme rainfall in different regional domains of Bangladesh and estimates predictive return levels using data science tools, including the Generalized Extreme Value (GEV) and Generalized Pareto Distribution (GPD) in the Bayesian setting. Finally, a comparative study is carried out among return levels at finer regional scale determined by the distributions considered here.

Keywords: Climate change, Extremes, Data science techniques, Predictive return levels, Bangladesh

#### Submission ID #7453:

# The Impact of Sanitary and Phytosanitary Measures and Technical Barriers to Trade on the Agri-Food Trade in the Asia-Pacific Region

Yuko Akune, Nihon University, Japan

**Abstract:** Many free-trade agreements have contributed to abolishing and reducing tariffs across countries; however, concerns regarding trade promotion have shifted from tariff to non-tariff measures (NTMs). This study focuses on sanitary and phytosanitary measures (SPS) and technical barriers to trade (TBT) as NTMs. They have contradictory effects on the agri-food trade; previous studies empirically show these NTMs' different effects. This empirical study examines the impact of SPS and TBT on agri-food trade in the Asia-Pacific region. The estimation results indicate that SPS and TBT become non-tariff barriers in several agri-food trades in the Asia-Pacific region. For instance, the bilateral divergence of SPS and TBT negatively affected ten SITC-based trades. Moreover, the divergence of SPS negatively affected the dairy and eggs trade, but that of TBT did not. For vegetables and fruits, the opposite effects were observed. In addition, the results for some commodities showed that more transparency encourages trade, despite increased rules and expanded divergence.

**Keywords:** non-tariff measures, agri-food trade, gravity model, sanitary and phytosanitary measures, technical barriers to trade

#### Submission ID #8793:

# Agile versus Resilient Regions: Why should we focus on the former? But is it possible to measure the quality of place agility?

#### Anthony Sorensen, University of New England, Australia

**Abstract:** In the past we have applauded the capacity of regional communities to adapt resiliently to their changing economic, social, cultural and physical environments. However, we are now in what has been termed the second machine age or 4th industrial revolution. This contributes to the invention of an accelerating and complex range of new technologies, many of which could rapidly remake our living environments and inter-regional competitiveness. I therefore believe that we need to turn our focus increasingly towards the creation of agile communities which are able to accelerate and enhance their adaptive capacity internally and creatively to accelerate the pace of regional change – often in unexpected or unimagined ways. This is unlikely to be simple task, but rather depend on the beneficial interaction of numerous participant individuals and organisations with high qualities of fluid imagination, leadership, entrepreneurship, and ability inspire their host communities. Whilst exploring these key components of agile regions the presentation will also focus on how we might statistically measure (a) place agilities and (b) the cost-benefit success of their operations. These tasks might also be difficult in the context of dramatically evolving technologies with complexly shifting mutual interdependencies.

**Keywords:** Agile and Resilient Communities, 4th Industrial Revolution, Increasingly turbulent economy and society, Need for more adaptive management of regional economies

#### Submission ID #117:

#### Enhancing Regional Innovation Systems in Country Australia: An Evidence-Driven Approach

#### Bruce Wilson, RMIT University, Australia

**Abstract:** In 2014-20, the European Union adopted Smart Specialisation with its emphasis on regional innovation as a cornerstone of its Regional Policy, making the development of a Smart Specialisation Strategy an ex ante conditionality for access to a significant proportion of the Cohesion Funds. The emphasis on innovation was reinforced by research published by Bristow and Healy in 2018, demonstrating that innovation leading regions were quicker to recover from the global financial crisis than modest innovating regions. In 2017, in the wake of the closure of the Hazelwood coal-fired electricity generator, the Latrobe Valley Authority adopted the Smart Specialisation approach as the basis of its work on the longer-term reconstruction of the Gippsland regional economy. The approach emphasized the importance of undertaking a detailed regional context analysis which could support the identification of key assets which could form the foundation of innovation opportunities. However, unlike the European Union, data on innovation activities proved to be rather limited. As the approach has been implemented and extended over the past 5 years, the LVA and its partners have maintained a strong focus on an evidence-driven approach but have had to rely on qualitative data gathering. This paper will review this experience and explore the refinement of the methodology which has occurred.

**Keywords:** Regional Innovation Systems, diverse data sources, key assets, Collaboration, missionoriented innovation

#### Submission ID #8574:

#### **Development of Wagga Wagga Special Activation Precinct**

Diwa Hopkins, Regional Australia Institute, Australia [Co-authors: Kim Houghton]

**Abstract:** The Regional Australia Institute report Building the Good Life: Foundations of Regional Housing summarises a multi-stage project undertaken by a team at the University of South Australia with the Institute in 2021-2. Taking a 20-year historical view quantitative analysis found six distinct clusters of housing markets, five in regional Australia. While geography (location) was not one of the inputs to the analysis, mapping the locations of the Local Government Areas (LGAs) in each cluster in fact shows common spatial characteristics – notably degree of proximity to large cities and distance from the coast. The divergent characteristics of each group emphasises how important it is in Australia to ensure that responses to regional housing challenges are place-based. With the drivers of markets quite different in respective clusters, responses need to be calibrated accordingly to ensure they improve the situation rather than make it worse.

Keywords: Housing, Regional housing markets, Place-based policies

#### Submission ID #6069:

#### Factors of regional spillover effects on housing prices: A literature review

Xin Janet Ge, University of Technology Sydney, Australia [Co-authors: Dongkai Li]

**Abstract:** With the development of the metropolitan real estate market in recent years, there has been a trend of residents spilling out of the metropolis, especially in the wake of COVID-19. Housing prices in the regional areas have increased. The factors that cause the spillover are unclear. This paper aims to excavate the potential factors that make households move away from metropolitan areas to regional areas through a literature review. The review will develop the keywords and then search literature from Google Scholar. The analysis will analyse the spillover effect by considering the economic, geographic, demographic and social characteristics. Understanding the factors of spillover effect is conducive to real estate valuation, provides informed information for governments formulating regional planning and land policies, advises developers to compose commercial strategy, and helps buyers to make choices.

Keywords: Spillover effect, regional market, housing prices, literature review

#### Submission ID #7613:

#### An exploratory analysis of cultural distance between regions of New Zealand

Michael Cameron, University of Waikato, New Zealand [Co-authors: Mikaela Paradizo Medina]

**Abstract:** The importance of cultural distance (the similarity or dissimilarity between cultures, societies, or countries) and homophily (the tendency for people to seek out or be attracted to those similar to themselves) remain under-recognised in economics. Where cultural distance measures have been employed, this has typically been limited to cultural distance between countries, or between regions of large countries. To some extent, that reflects a paucity of appropriate data at the subnational level for developing measures or cultural distance within countries. In this paper, we develop new measures of cultural distance between regions of New Zealand, using the inter-country cultural distance between the birthplaces of residents of each region. Our results demonstrate that cultural distance is greatest between the most populous regions (Auckland, Canterbury, Wellington, Waikato) and smaller regions, and between the four most populous regions themselves. We interpret this as demonstrating that the most populous regions exhibit the greatest birthplace diversity, and that the sources of migrant populations differ meaningfully between these populous regions. Our results also demonstrate that geographical distance may not be the most meaningful measure of distance between regions in all contexts, with cultural distance having only a relatively small correlation with geographical distance.

Keywords: Cultural distance, homophily, diversity, New Zealand

#### Submission ID #8375:

#### Voting with our feet: The changing regional destinations of urban Australians during COVID

Kim Houghton, Regional Australia Institute, Australia [Co-authors: Diwa Hopkins]

**Abstract:** The Regional Movers Index tracks the outflows of city-dwellers to regional places from 2019 to 2022 using confidentialised change of address data from the Commonwealth Bank. The quarterly reports show significant changes in the regional locations favoured by departing city-dwellers. Once the initial lockdowns ended the first round of popular destinations were high amenity coastal places, but over two years the emerging popular destinations have moved increasingly inland as young people in particular look for a combination of job and housing availability in regional Australia.

Keywords: Internal migration, Population change, Millennials

#### Submission ID #1843:

# Urban Resilience and Social Security Uptake: New Zealand Evidence from the Global Financial Crisis and the COVID-19 Pandemic

Jacques Poot, University of Waikato, New Zealand [Co-authors: William Cochrane and Matthew Roskruge]

Abstract: This paper focuses on the spatial variation in the uptake of social security benefits following a large and detrimental exogenous shock. Specifically, we focus on the Global Financial Crisis (GFC) and the onset of the COVID-19 pandemic. We construct a two-period panel of 66 Territorial Authorities (TAs) of New Zealand (NZ) observed in 2008-09 and 2020-21. We find that, despite the totally different nature of the two shocks, the initial increase in benefit uptake due to the COVID-19 pandemic was of a similar magnitude as that of the GFC, and the spatial pattern was also quite similar. We link the social security data with 146 indicator variables across 15 domains that were obtained from population censuses that were held two years before each of the two periods. To identify urban characteristics that point to economic resilience, we formulate spatial panel regression models. Additionally, we use machine learning techniques. We find that the most resilient TAs had two years previously: (1) a low unemployment rate; and (2) a large public sector. Additionally, but with less predictive power, we find that TAs had a smaller increase in social security uptake after the shock when they had previously: (3) a high employment rate (or high female labour force participation rate); (4) a smaller proportion of the population stating ethnicities other than NZ European; (5) a smaller proportion of the population living in more deprived area units. We also find that interregional spillovers matter and that resilient regions cluster.

**Keywords:** urban economic resilience, social security, Global Financial Crisis, COVID-19, panel data, model selection, spatial econometrics, machine learning

#### Submission ID #4769:

#### Modelling and forecasting new dwellings completed: a combination method

Yong Vann, Hamilton City Council, New Zealand [Co-authors: Andy Zhao, Greg Carstens and Nathan Dalgety]

Abstract: Construction has played an increasingly important role in New Zealand's economic development, so forecasting construction demand is vital for both policy formulation and implementation, and for designing effective regional infrastructure development plans. However, research on forecasting construction demand in New Zealand at a regional level is sparse. Using local data and knowledge of Hamilton City, this study proposes a comprehensive forecasting method that can predict the number of new dwellings consented and completed in the short- and medium-term. The proposed method combines two consecutive models which have different forecasting methodologies: sub-model 1 implements multivariant forecasting frameworks using econometric methods to predict the number of new dwellings consented; the output from sub-model 1 is fed into sub-model 2 to predict the number of new dwellings completed by applying a machine learning method to council's rich building inspection dataset. This study finds that the use of economic variables and a combination method can enhance forecast accuracy in terms of low mean absolute percentage errors (MAPE) and acceptable root mean square standard error (RMSE). The output produced serves as valuable input for developing local urban and infrastructure planning and growth strategies. Furthermore, the robust method proposed in this study not only contributes to the literature but also provides practical direction to local authorities and researchers in developing new dwelling forecasting methodology at a regional level.

**Keywords:** modelling, forecasting, dwellings consented, dwellings completed, econometrics, machine learning

#### Submission ID #1158:

#### Accounting for Social Difference When Measuring Cultural Diversity

David Maré, University of Waikato, New Zealand [Co-authors: Jacques Poot]

**Abstract:** In this paper we introduce a measure of cultural diversity that takes 'social difference' between country of birth and ethnic groups into account. We measure social difference using exploratory factor analysis of subjective identity, attitude and value responses in Aotearoa New Zealand's 2016 General Social Survey. We examine the level of, and change in, our social difference-based measure of cultural diversity in 31 urban areas between 1976 and 2018, using census data. We compare these patterns with those derived from a standard fractionalisation measure of diversity based on population composition by country of birth and ethnicity. We find that the two diversity measures are highly correlated across the urban areas. Diversity increased everywhere between 1976 and 2018, whether social difference is taken into account or not. However, the social difference-based measure increased much faster than the standard measure in all but one of the urban areas. This suggests that growth in the fractionalisation measure of diversity is likely to have underestimated the trend in experienced social difference. Both measures also show evidence of spatial convergence in diversity: urban areas with low diversity in 1976 – which tended to be in the South Island – exhibited faster increases. Population diversity increased strikingly in Queenstown, which was the 19th most diverse urban area in 1976, in terms of social difference, but second only to Auckland in 2018.

Keywords: cultural diversity, social difference, fractionalisation, New Zealand, urban areas

#### Submission ID #4944:

#### The Alternate View on Multilevel Modelling

#### Paul Dewick, University of Canberra, Australia [Co-authors: Shuangzhe Liu]

**Abstract:** Multilevel modelling is common within the statistical field and is approached differently depending on the modelers discipline. Multilevel modelling usually implies hierarchical modelling that is undertaken by using random effect models. There exists an alternate method in undertaking a hierarchical multilevel model by using fixed effects models. Different statistical disciplines can be interested in the calculation of two different effects, being means and variances. Treating these two effects as separate methodologies has introduced confusion into the multilevel modelling approach. This study I talk about an alternative view on multilevel modelling as a different modelling approach. This approach treats multilevel modelling as a holistic approach by identifying and choosing between fixed and random effects models, contextual effects selection and strategies, and why and when to model random intercept and random slope models. This will enable researchers to undertake multilevel modelling with a better understanding of the multilevel modelling process.

Keywords: Multilevel modelling, Fixed effects, Random effects

#### Submission ID #7863:

#### A mathematical model for COVID-19 transmission dynamics in Bangladesh

*Md. Abdul Kuddus, University of Rajshahi, Bangladesh* [Co-authors: M. Mohiuddin, Khalifa Helal, Farzana Alam and Oyelola Adegboye]

**Abstract:** Coronavirus disease (COVID-19) has caused unprecedented devastation to all sectors globally. In this study, we used a five compartmental deterministic mathematical model to study the transmission dynamics of this highly contagious disease in Bangladesh. To understand and control the system's dynamics in our model, we investigated the basic reproduction number, the existence of the model's solution, stability analysis at equilibrium states and sensitivity analysis, and determined the behavioural dynamics of COVID-19 using numerical simulations. We also assessed the impact of progression and recovery rates on the dynamics of COVID-19 cases in Bangladesh. Further, this model determines the set of significant parameters from Bangladesh COVID-19 data. The findings in this study can help quantify different parameters in deciding the severity of the disease and other measures to inform decisions targeted at control strategies to accelerate the inhibition of the spread of the virus in Bangladesh.

**Keywords:** COVID-19, Compartmental model, Stability and sensitivity analysis, Basic reproduction number, Bangladesh

#### Submission ID #6141:

#### Rise and fall of dairy industry in NSW, Australia- A supply-demand relationship analysis

*Gillian Walker, Central Queensland University, Australia* [Co-authors: Azad Rahman, Vanita Yadav and Delwar Akbar]

**Abstract:** Dairy has been a major national food commodity in Australia since 1788 and a core export commodity since the 1930s, with rapid growth in the 1980s and a rapid decline in 2000 with the introduction of dairy deregulation policy. The high rate of decline of dairy farms within Australia, particularly in New South Wales (NSW) and Queensland, has left the industry and market unprepared for future development. One of the reasons of this decline would be domestic supply and demand mismatch. Therefore, this study examines relationship between supply (i.e., whole milk production), market demand (both domestic and international market) and policy variables. This study used ordinary least square (OLS) regression model to depict the significance of the relationship between the supply and demand variables. The study found there is a significant relationship between total whole milk production and domestic demand as well as policy change but its (i., e., supply) relationship with export market has not been identified clearly. So, Dairy Australia and the government should focus on promoting export market to halt further decline of the dairy industry as well as to increase the production in future.

Keywords: Dairy, production, demand, policy, Australia

#### Submission ID #1599:

# Developing an Analytical Framework to Depict Disruptions in Pharmaceutical Supply Chain During COVID-19

*Jannatul Ferdous, Central Queensland University, Australia* [Co-authors: Delwar Akbar, Gulam Khandaker, Anita Medhekar and Md Rahat Hossain]

**Abstract:** The COVID-19 pandemic has significantly impacted the pharmaceutical supply chain (PSC) globally. As a result, all concerned stakeholders are subject to supply chain disruptions and business challenges. This article aims to identify reasons for PSC disruptions and minimize disruptions to increase product availability in regional Queensland, Australia, during COVID-19. A scoping review was performed according to the PRISMA guidelines. Based on inclusion/exclusion criteria, 19 full articles were included in this review. Studies show significant disruption to PSC where important contributing factors include: (i) reduction in product supply due to production disruptions in international trade due to border closures, (ii) increased demand in healthcare settings and at the consumer level, (iii) consumers' purchasing patterns are inconsistent due to psychosocial factors. The study systematically mapped evidence on PSC disruption, which can assist the development of evidence-based strategies in overcoming these challenges for efficient PSC management in future crises, especially for regional areas.

**Keywords:** COVID-19, Supply Chain Disruption, Pharmaceutical Supply Chain, Australian Pharmaceutical Supply Chain, Supply Chain resilience

#### Submission ID #7201:

# Development of an efficient water quality model using cutting-edge artificial intelligence techniques

*Md Galal Uddin, University of Galway, Ireland,* [Co-authors: Stephen Nash, Azizur Rahman and Agnieszka I. Olbert]

Abstract: For achieving the target level of satisfaction of water quality, several tools and techniques are utilized. The water quality index model is one of the widely used techniques. Recently, this approach has received much criticism in terms of model reliability and inconsistence assessment results. Since the development of the WQI model in 1965, the model's application has increased tremendously due to its simple mathematical architecture and ease of application. Many studies have revealed that the existing technique produces a significant amount of uncertainty in the final assessment. In order to obtain reliability and consistency of assessment results, it should be optimized and improved, considering the existing limitations of the model. Therefore, here, we present the Irish Water Quality Index (IEWQI) model for assessing transitional and coastal water quality in an effort to improve the method and develop a tool that can be used by environmental regulators to abate water pollution in Ireland. The developed model has been associated with the adoption of water guality standards formulated for coastal and transitional waterbodies according to the water framework directive legislation by the environmental regulator of Irish water. The model consists of five identical components, including (i) indicator selection technique to select the crucial water quality indicator; (ii) sub-index (SI) function for rescaling various water quality indicators' information into a uniform scale; (iii) indicators' weight method for estimating the weight values based on the relative significance of real-time information on water quality; (iii) aggregation function for computing the water quality index (WQI) score; and (v) score interpretation scheme for assessing the state of water quality. Each component of the model has been tested and validated using cutting-edge artificial intelligence and machine learning techniques in order to avoid the intervention of experts or humans in terms of reducing model uncertainty. The findings of this study reveal that the IEWQI model could be an efficient and reliable technique for the assessment of transitional and coastal water quality more accurately in any geospatial domain.

**Keywords:** coastal water quality, water quality index model, uncertainty, Irish water quality model, artificial intelligence

#### Submission ID #6851:

# Assessment of algorithms for atmospheric correction in the remote sensing technique to retrieve chlorophyll-a more precisely

*Mir Talas Mahammad Diganta, University of Galway, Ireland,* [Co-authors: Md Galal Uddin and Agnieszka I. Olbert]

Abstract: Monitoring of coastal water quality holds immense importance in the surveillance of coastal aquatic ecosystems. In that case, the widely used typical monitoring approach (in-situ-IS) has received much criticism due to its number of limitations, like extensive financial compliance, temporal endeavours, and spatio-temporal resolution. Recently, cutting-edge remote sensing techniques have gained widespread interest in monitoring water quality as a substitute of the traditional IS approach because it allows monitoring water quality on a large-geospatial scale. Many studies have investigated and revealed that various environmental factors are influencing the remote sensing technique(s); the atmospheric correction (AC) is one of them. The AC is the process of removing the effects of the atmospheric gases and particles on the reflectance values of images taken by satellite sensors in order to derive aquatic reflectance. Consequently, it is complicated to retrieve optically active water quality indicators, especially chlorophyll a (Chl-a), from remotely sensed data over optically complex water bodies due to heterogeneous nature of atmospheric aerosols and mutual interference in the spectrum of optically active water quality indicators. For the purposes of reducing the uncertainty of the remotely sensed Chl-a data, several studies have utilized various AC processors like Acolite, C2RCC, iCOR, I2gen, Polymer and Sen2Cor. In terms of the reliability of retrieving Chl-a data, to the best of our knowledge, there are no any robust technique for retrieving data more accurately that can be presented in the ground truth scenarios of water quality and prior to retrieval of Chl-a, the AC process holds great importance for deriving aquatic reflectance. The present study has been carried out to assess the performance of publically available AC processors (Acolite, C2RCC, iCOR, I2gen, Polymer and Sen2Cor) for developing an improved retrieval algorithm for Chl-a using state-of-the-art advanced artificial intelligence and machine learning techniques in order to assess transitional and coastal water quality. The findings of this research could be effective for obtaining Chl-a data from remotely sensed data more accurately. However, the results of the present study may be helpful for improving the current monitoring program in terms of addressing the existing limitations of this approach.

**Keywords:** surface water quality, chlorophyll a, remote sensing, atmospheric correction, artificial intelligence

#### Submission ID #5743:

# Assessment of groundwater quality using improved water quality index in Siliguri city, West Bengal, India

*Samsad Paeween, University of Galway, Ireland,* [Co-authors: Nigar Alam Siddique, Agnieszka I. Olbert and Md Galal Uddin]

Abstract: Like surface water, groundwater contamination has increased rapidly in urban areas due to both natural and anthropogenic factors. For the assessment of groundwater guality, a range of tools and techniques are used. The water quality index (WQI) model is one of the most widely utilized techniques. The aim of this research was to assess the groundwater quality using a recently developed root mean squared (RMS)-WQI model in terms of the spatio-temporal variation of groundwater in Siliguri city. For the purposes of assessing water guality, water samples were collected from thirteen locations for the pre and post-monsoon seasons (December 2020 to November 2021), which covered the full extent of the study area. In order to obtain water quality indicator measures, fourteen common water quality indicators were analysed in this study. The results of the RMS-WQI score ranged from 57.52 to 89.02, and 68.24 to 87.94, respectively, during pre-monsoon and postmonsoon across the all-sampling sites. Based on the statistical summary of WQIs, there were no significant differences in WQI scores between pre-monsoon and post-monsoon. The results of the RMS-WQI model indicate that the groundwater guality was "fair" to "good" throughout the study period. Therefore, the index results reveal that groundwater quality was suitable for drinking and domestic purposes except at certain locations, whereas the concentration of particular indicators exceeded the guidelines of BIS and WHO. However, the findings of this research could be effective for management of groundwater quality in Siliguri city.

**Keywords:** Groundwater quality, spatio-temporal assessment, improved water quality index model, root mean square function, Siliguri city

#### Submission ID #5759:

# Improving water quality monitoring program using cutting-edge artificial intelligence-machine learning-remote sensing techniques

Abdul Majed Sajib, University of Galway, Ireland [Co-authors: Md. Galal Uddin and Agnieszka Indiana Olbert]

Abstract: The water quality-monitoring program is an essential and mandatory component for achieving "good" water quality status in all states. Recently, this technique has received much more criticism due to the data quality and reliability. Moreover, the typical monitoring program requires several crucial components, including an advanced analytical laboratory with well equipped, skilled manpower, adequate financial support, etc. Due to the various environmental settings, the existing monitoring program has a few complicities in terms of spatio-temporal regulation of the domain. Consequently, recently, several countries/organizations have been exploring alternative solutions for monitoring water resources. Many studies have demonstrated that the advanced remote sensing technique would be a fantastic substitute for that in the case of further exploration. Unfortunately, most studies have investigated widely optically active water guality indicators like chlorophyll-a, sea surface temperature, etc. Nevertheless, most monitored water quality indicators consist of both optically active and inactive indicators like biological oxygen demand, pH, dissolved oxygen, total phosphate, dissolved inorganic nitrogen, etc. In that circumstance, the present study focused on optically inactive indicators for algorithm(s) development in order to retrieve data from the remote observation technique using cutting-edge artificial intelligence and machine learning techniques. The findings of this study may be useful for enhancing the current monitoring program by optimizing the limitations of the existing technique(s).

**Keywords:** Artificial intelligence, Machine learning, Remote sensing, Inactive water quality indicators, Coastal water quality

#### Submission ID #8275:

#### Perceived and observed corruption in Indonesia' Regions: A spatiotemporal analysis

*Zuhairan Yunmi Yunan, University of Canberra, Australia* [Co-authors: Yogi Vidyattama, Ben Freyens and Itismita Mohanty]

**Abstract:** This paper's aim is to utilise subjective and objective measures to analyse the pattern of corruption in Indonesia's districts and municipalities and examine how this pattern has evolved after decentralisation. This paper uses a regional corruption perception indicator (the Regional Corruption Perception Index) and judicial reports of corruption at the district level to investigate these distribution patterns. In particular, spatiotemporal analysis methods are used to examine the dynamics across the period from 2004 to 2010. This paper found that, over time, the perception index suggests that the fight against corruption has resulted in improvements, despite the increasing number of corruption incidents and greater financial loss reported by the judicial system. On the other hand, a cross-sectional comparison showed that businesspeople still perceived less corruption in regions where the judicial system reported less incidents of corruption. This highlights the disparity in the corruption levels perceived by businesspeople and how much corruption is uncovered by the judicial system.

Keywords: Corruption perception indicator, judicial report data, spatiotemporal

#### Submission ID #6331:

#### Remotely (and wrongly) too equal: Popular night-time lights data understate spatial inequality

John Gibson, University of Waikato, New Zealand [Co-authors: Xiaoxuan Zhang and Xiangzheng Deng]

**Abstract:** Several studies in economics and regional science use Defense Meteorological Satellite Program (DMSP) night-time lights data to measure spatial inequality. These DMSP data are a poor proxy because they have spatially mean-reverting errors, yielding significantly lower inequality estimates than what sub-national GDP data show. Inequality estimates from DMSP are also lower than what newer, research-focused and more accurate, satellites show from their observations of the earth at night. In this paper, county-level data from the United States and China are used to demonstrate understatement of spatial inequality when DMSP data are used. In both settings, benchmark data on sub-national GDP are available for establishing the level and trend in spatial inequality, which is then used to assess the accuracy of the estimates coming from remote sensing sources. In the rush to use big data it is important to not lose sight of basic measurement error features of some of these data sources.

Keywords: DMSP, mean-reverting error, night lights, spatial inequality, VIIRS

#### Submission ID #1091:

#### Rebalancing Australia: Setting a Regionalisation Ambition

Kim Houghton, Regional Australia Institute, Australia [Co-authors: Liz Ritchie and Sarah McCosker]

**Abstract:** The Regional Australia Institute (RAI) has set a target of 11 million people living prosperously outside the capital cities by 2032, a key goal of the Regionalisation Ambition 2032. Achieving this target will see an extra 500,000 people living in the regions, above the business-as-usual projection of 10.5 million. The Ambition places 20 key targets at the centre of strengthening regional Australia which will close the divide between life in the city and the country. It focusses on regional housing, education, health, jobs and skills, digital inclusion, transport, childcare, community participation, migration, climate, innovation, and the resilience of regional communities – as well as population. Modelling undertaken in developing the Ambition shows a net GDP gain for Australia with a higher level of regional population growth.

Keywords: Population growth, Regional Policy, Sustainability, Workforce, Housing, Liveability

# **Small Area Estimation and Microsimulation** Modeling

**Azizur Rahman** Charles Sturt University, Australia

**Ann Harding** University of Canberra, Australia

This book gathers valuable information on the theories, applications, advantages, and limitations of all the small area estimation methodologies. It covers direct small area estimation methods and indirect statistical approaches, including empirical best linear unbiased prediction (EBLUP), empirical Bayes (EB) and hierarchical Bayes (HB) estimation methods. The book also presents indirect geographic estimation methods as well as a new, sophisticated spatial microsimulation modeling technology and its means of statistical reliability measures, including confidence interval estimations.

#### **KEY FEATURES**

- Discusses the usefulness of small area estimation methodologies, including direct and indirect model-based approaches
- Covers various techniques for creating spatial microdata
- Produces empirical solutions to the problems using real-world data sets •
- Includes SAS codes and programming for the methodologies and for obtaining results

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# Data Science Research Unit (DSRU)











Advanced Networks Research Lab: The research emphasis of this group spans a wide range of basic and applied topics in wired and wireless networks, addressing the challenges in Mobile Ad Hoc Networks (MANETs), Wireless Sensor Networks (WSNs), Vehicular Area Networks (VANETS), Wireless Body Area Networks (WBANs) and Cloud Computing.

**Data Mining Research Area:** This research group focuses on topics including data collection, pre-processing, cleansing, knowledge discovery, making sense of data, future prediction, designing and implementing decision support systems, statistical modelling, data mining on mobile phones, and application of data mining for solving real world problems.

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**E-Health Research Group:** The E-health research group aims to work in collaboration with health service professionals, local health bodies and government agencies to conduct research across a number of research themes: remote health services for elderly health, Indigenous health, mental health, healthier food processing, and health data transmission and storage.