

Melbourne Workshop on Spatial and Spatial-Temporal Data Analysis

Event Details

Date: 21 July 2025

Venue: Mawby Theatre, Melbourne Business School, 200
Leicester St, Carlton VIC 3053

Description

The workshop aims to bring together academics, researchers and research scholars who are interested in or are working on theoretical, methodological and empirical topics associated with spatial and spatio-temporal data, coming from but not limited to real estate, climate, network data. The program will consist of keynote, invited and contributed speakers and the program collectively covers theoretical, methodological and empirical topics. There is no participation fee to attend this workshop. This is a face-to-face workshop being held at Melbourne Business School and will not be streamed online.

Acknowledgement of Country

In the spirit of reconciliation, Melbourne Business School acknowledges that our Calton campus is on the lands of the Wurundjeri People who have been custodians of this land for thousands of years. We also acknowledge the Traditional Custodians of country throughout Australia and their connections to land, sea and community, and pay our respect to their Elders past and present.

Keynote speaker



[Ruey S. Tsay](#)

**H.G.B. Alexander Professor of Econometrics and Statistics Emeritus,
University of Chicago**

Invited speakers



[Zhenlin Yang](#)

Singapore Management University



[Alicia N. Rambaldi](#)

University of Queensland

Program

Time	Session
8.30 – 9.00	Registration
9.00 – 9.10	Opening Address: Tava Olsen (Melbourne Business School)
9.10 – 11.30	Session 1
9.10 – 10.30	Keynote Talk: Ruey S. Tsay (University of Chicago) Title: Personalized Functional Principal Component Analysis with application to Argo data
10.30 – 11.00	Toshinari Morimoto (Academia Sinica / National Taiwan University) Title: Mean shift for functional data: a scalable algorithm and convergence analysis
11.00 – 11.30	Yong Song (University of Melbourne) Title: Bayesian inference for dynamic spatial quantile models with interactive effects
11.30 – 12.50	Lunch Break
12.50 – 14.30	Session 2
12.50 – 13.30	Invited Talk: Zhenlin Yang (Singapore Management University) Title: Identification and Estimation of Endogenous and Dynamic Social Effects with Network Panels Xiaoyi Han (Xiamen University)
13.30 – 14.00	Title: Profile GMM estimation of dynamic spatial panels with multidimensional endogeneity and interactive fixed effects Natalia Bailey (Monash University)
14.00 – 14.30	Title: My neighbour's neighbour is not my neighbour: Instrumentation and causality in spatial models
14.30 – 15.00	Coffee Break
15.00 – 16.20	Session 3
15.00 – 15.50	Invited Talk: Alicia N. Rambaldi (University of Queensland) Title: Spatial Heterogeneity within Housing Markets
15.50 – 16.20	Jyoti Shukla (University of Melbourne) Title: Examining Housing Satisfaction through the Lens of “Capability Approach”: Case of Japan
16.20 – 16.30	Closing Address

Abstracts of Presentations

Title: Personalized Functional Principal Component Analysis with application to Argo data

Presenter: Ruey S. Tsay

Abstract: Large spatio-temporal functional data are widely available nowadays. They are important in investigating global warming and environmental changes. Dimension reduction becomes essential in studying those large functional data and functional principal component analysis is one of the commonly used dimensional reduction methods. On the other hand, similarly to other big data, large spatio-temporal functional data often exhibit certain commonality and some specific local features. The conventional functional principal component analysis becomes inadequate to handle such heterogeneous functional data. In this talk, we generalize personalized PCA to personalized functional PCA. We address both the computational and theoretical issues. For applications, we apply the proposed personalized functional PCA to the Argo data, consisting of many Argo profiles across the globe measuring sea temperature. This work is joint with Drs. Ming-Chung Chang and Yen-Shiu Chin of the Institute of Statistical Science, Academia Sinica.

Title: Mean shift for functional data: a scalable algorithm and convergence analysis

Presenter: Toshinari Morimoto

Abstract: This talk extends the mean shift algorithm from vector-valued data to functional data, enabling effective clustering in infinite-dimensional settings. To address the computational challenges posed by large-scale datasets, we introduce a fast stochastic variant that significantly reduces computational complexity while preserving the mode-seeking behavior of the full algorithm. We further present a rigorous convergence and stability analysis of the full functional mean shift procedure, providing theoretical guarantees for its behavior. The proposed method is evaluated using the Argo oceanographic dataset, demonstrating its practical utility and scalability in real-world applications. Our key contributions include: (1) a novel extension of mean shift to functional data, (2) a theoretical framework establishing convergence and stability, (3) a scalable stochastic implementation, and (4) a real-data application that illustrates the algorithm's effectiveness in oceanographic clustering tasks. (Joint work with Ting-Li Chen, Su-Yun Huang and Ruey S. Tsay)

Title: Bayesian inference for dynamic spatial quantile models with interactive effects

Presenter: Yong Song

Abstract: With the rapid advancement of information technology and data collection systems, large-scale spatial panel data presents new methodological and computational challenges. This paper introduces a dynamic spatial panel quantile model that incorporates unobserved heterogeneity. The proposed model captures the dynamic structure of panel data, high-dimensional cross-sectional dependence, and allows for heterogeneous regression coefficients. To estimate the model, we propose a novel Bayesian Markov Chain Monte Carlo (MCMC) algorithm. Contributions to Bayesian computation include the development of quantile randomization, a new Gibbs sampler for structural parameters, and stabilization of the tail behavior of the inverse Gaussian random generator. We establish Bayesian consistency for the proposed estimation method as both the time and cross-sectional dimensions of the panel approach infinity. Monte Carlo simulations demonstrate the effectiveness of the method. Finally, we illustrate the applicability of the approach through a case study on the quantile co-movement structure of the gasoline market.

Title: Identification and Estimation of Endogenous and Dynamic Social Effects with Network Panels

Presenter: Zhenlin Yang

Abstract: We consider identification and estimation of endogenous and dynamic social effects in the presence of contextual and correlated effects based on a network panel framework with cross-sectionally dependent and/or heteroskedastic errors. Identification of the correlated effects, including the time-varying group-specific effects and the purely ‘left-over’ individual and time effects, is achieved based on repeated observations on individuals over time by the given general specification that allows for multi-layer interactions including time-varying group effects. With this identification, the identification of the ‘common effects’ (including the endogenous and dynamic social effects and the contextual effects) is achieved. Consistent estimation of the common effects is achieved through a likelihood-based method, the M-estimation. Inference for the common effects is based on the established asymptotic normality of the proposed M-estimators and a novel corrected plug-in method for the variance-covariance matrix estimation. Monte Carlo results are presented to demonstrate the excellent finite sample performance of the proposed methods. An empirical application is given to illustrate the proposed methods.

Title: Profile GMM estimation of dynamic spatial panels with multidimensional endogeneity and interactive fixed effects

Presenter: Xiaoyi Han

Abstract: We study the estimation and inference of the spatial dynamic panel data (SDPD) model in the presence of interactive fixed effects (IFEs), where the spatial weight matrix can be constructed by some multidimensional socio/economic variables such as time-varying trade or mobility follows across regions. We model the time-varying spatial weights matrix using a three-dimensional (3D) panel data model with multi-level factor structure that consists of latent global factors and two distinct local factors, and capture the possible endogeneity of the spatial weights matrix through the correlation between error terms in the SDPD outcome equation and the local factors in the 3D panel equation. Using a control function approach, we propose a two-stage procedure for estimation: first, we estimate the local factors from the 3D panel equation of multidimensional economic variables, and plug the estimated local factors into the SDPD equation to control for the endogeneity of spatial weights matrix; second, we consider a nuclear norm regularization (NNR)-based profile generalized method of moments (GMM) method, which includes an initial consistent estimation step and a post NNR (PNNR)-based GMM step to correct penalization bias and improve estimation efficiency. We rigorously establish the asymptotic properties of these estimators and further study a most efficient GMM estimator (GMME) with the best moment conditions, as well as some tests for the endogeneity of spatial weights. Monte Carlo simulations demonstrate that the estimators and test statistics perform well in finite samples. We apply our models and estimation methods to study the regional spillover effect of technology through railway trade networks in China, and the virus transmission through the human mobility network across U.S. states.

Title: My neighbour's neighbour is not my neighbour: Instrumentation and causality in spatial models

Presenter: Natalia Bailey

Abstract: We analyse asymmetric spatial or network dynamics in a panel framework by first distinguishing them from stronger common effects. We eliminate pervasive influences by means of a de-factoring model and then uncover the weaker cross-sectional structures by identifying units with significant residual bivariate correlation. In order to assess the effect on a given unit i from shocks to 'neighbouring' units, we make use of spatial econometric techniques. Given that these effects can be directional, i.e. depend on factors such as a city's distance from other cities and their relative sizes appropriately defined, we measure network dependencies in terms of partial correlations instead. For this, we employ GMM and use the information in a regularised

version of the residual correlation matrix to identify instruments which comply with the required relevance and exclusion restrictions for instrumentation. Using terminology of the spatial or networks literature, we focus on the effects of each unit's neighbours' neighbours that are not their neighbours. This approach is consistent with estimating a variant of a gravity model of idiosyncratic shocks to variables such as house prices.

Title: Spatial Heterogeneity within Housing Markets

Presenter: Alicia N. Rambaldi

Abstract: Higher availability of data with spatial and temporal dimensions provides the opportunity to expand econometric modeling and estimation. Administrative data in particular, with rich and detailed information across economic agents and geographies, open opportunities but also bring new challenges to econometricians. Some of the key advantages of these new sources of data is that they make feasible the estimation at granular geographical levels. The talk will concentrate on the role of administrative data in estimating existing and new models. We will cover recent econometric approaches to predict the value of urban land for transport planning, and present some of the relevant estimators to study the spatial heterogeneity of the marginal willingness to pay for urban amenities, which can be implemented when linked administrative data are available. We present recent work that relies on the knowledge of the spatial distribution of housing supply constraints to estimate the effect of supply constraints on the distribution of the relative (buyer-to-seller) income when transacting homes (filtering). The estimates presented will be based on linked administrative datasets for Queensland and a customised dataset covering the census of property transactions linked to neighbourhood amenities, planning decisions, and buyers' and sellers' characteristics for the state of Victoria (Australia).

Title: Examining Housing Satisfaction through the Lens of “Capability Approach”: Case of Japan

Presenter: Jyoti Shukla

Abstract: A house accessed through ownership or rent creates many valuable functionings, although these multidimensional functions are less understood. This research makes a theoretical and empirical contribution to the housing satisfaction literature by answering: What are the indicators of housing-related-functionings that a household achieves, and what impact these functions have on housing satisfaction? This research delves into the question of housing satisfaction using the theoretical framework of the 'capability approach' and identifies the

determinants of housing satisfaction in terms of 'functionings'. The paper empirically estimates the impact of indicators of functionings on housing satisfaction using the Japan Household Panel Survey data. Findings suggest that housing creates the ability to seismically retrofit the house and prepare for disasters, enhances familial wellbeing through 'generational contract', and financial strength and empowerment for women homeowners. These findings are helpful for policymakers concerned with improving housing conditions of households.

Organizers

Tomohiro Ando (Melbourne Business School)

Tadao Hoshino (Waseda University)

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