THE UNIVERSITY OF SYDNEY
Business School

Time Series and Forecasting Symposium TSF2019

11-12 November 2019

ABS Case Study Lecture Theatre 2080 and 2090
Level 2, Abercrombie Building H70
Corner of Abercrombie Street and Codrington Street
The University of Sydney Business School
Map Parking Public Transport

Sponsor:

Time Series and Forecasting Research Group

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Discipline of Business Analytics, Business School, The University of Sydney

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School of Economics, Faculty of Arts & Social Science, The University of Sydney

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WiFi Instructions

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Step 3: Enter the username **TSF2019** and password **14999923**

Program

Monday 11 November 2019

Registration, morning tea, lunch and afternoon tea will be held at Level 2 lobby area between ABS Case Study Lecture Theatre 2080 and 2090, Abercrombie Building H70.

8.45am – 9.00am **Registration**

9:00am – 10:15am **Opening Ceremony and Keynote Address (ABS Case Study Lecture Theatre 2080)**

9:00am – 9:15am	**Welcome -** **Prof Elizabeth Cowley** (Deputy Dean, Business School, The University of Sydney) **Prof Richard Gerlach** (Leader, Time Series and Forecasting Research Group, Business School, The University of Sydney)
9:15am – 10:15am	**Keynote Address -** 'Inference on the dimension of the nonstationary subspace in functional time series' **Professor Morten Ørregaard Nielsen** (Queen's University)

10:15am – 10:45am **Morning Tea**

10:45am – 11:30am **Invited Session (ABS Case Study Lecture Theatre 2080)**

10:45am – 11:30am	**Invited talk -** 'Can we improve modelling and forecasting the implied volatility surface?' **Professor Dick van Dijk** (Erasmus University Rotterdam)

11:30am – 12:30pm **Parallel Sessions (ABS 2080 & ABS 2090)**

11:30am – 12:30pm	**Session 1A – Financial Econometrics and Volatility Forecasting I** **(ABS Case Study Lecture Theatre 2080)** Session Chair: **Dr Simon Kwok** (The University of Sydney)
11:30am – 12:00pm	**Contributed Talk -** 'Dynamic quantile models for financial returns' **Professor Richard Gerlach** (The University of Sydney)
12:00pm – 12:30pm	**Contributed Talk -** 'Inferring financial bubbles from option data' **Dr Simon Kwok** (The University of Sydney)

11:30am – 12:30pm	**Session 1B – Stochastic Volatility** **(ABS Case Study Lecture Theatre 2090)** Session Chair: **Dr Nuttanan Wichitaksorn** (Auckland University of Technology)
11:30am – 12:00pm	**Contributed Talk -** 'Density forecasting in nonlinear models with stochastic volatility' **Dr Peter Exterkate** (The University of Sydney)
12:00pm – 12:30pm	**Contributed Talk -** 'Analyzing stock returns through mixture of normal and generalized Pareto distributions' **Dr Nuttanan Wichitaksorn** (Auckland University of Technology)

12:30pm – 1:30pm **Lunch**

1:30pm – 2:15pm **Invited Session (ABS Case Study Lecture Theatre 2080)**

1:30pm – 2:15pm	**Invited talk –** 'Representation of I(1) and I(2) autoregressive Hilbertian processes' **Professor Brendan Beare** (The University of Sydney)

2:15pm – 3:15pm **Parallel Sessions (ABS 2080 & ABS 2090)**

2:15pm – 3:15pm	**Session 2A – Economics and Time Series Modelling I (ABS Case Study Lecture Theatre 2080)** Session Chair: **Dr Mengheng Li** (University of Technology Sydney)
2:15pm – 2:45pm	**Contributed Talk -** 'Forecasting Related Time Series: Fundamentals and a New Approach' **Dr Pablo Montero-Manso** (Monash University)
2:45pm – 3:15pm	**Contributed Talk -** 'Forecasting economic time series using score-driven dynamic models with mixed-data sampling' **Dr Mengheng Li** (University of Technology Sydney)

2:15pm – 3:15pm	**Session 2B – Multivariate Time Series Modelling (ABS Case Study Lecture Theatre 2090)** Session Chair: **Associate Professor Jennifer Chan** (The University of Sydney)
2:15pm – 2:45pm	**Contributed Talk -** 'Forecasting using multivariate HAR models: The benefits of using Weighted Least Squares' **Professor Adam Clements** (Queensland University of Technology)
2:45pm – 3:15pm	**Contributed Talk -** 'Bayesian inference for multivariate two stage CARR-returns models with applications to cryptocurrencies' **Associate Professor Jennifer Chan** (The University of Sydney)

3:15pm -3:45pm **Afternoon Tea**

3:45pm – 4:45pm **Parallel Sessions (ABS 2080 & ABS 2090)**

3:45pm – 4:45 pm	**Session 3A – Economics and Time Series Modelling II (ABS Case Study Lecture Theatre 2080)** Session Chair: **Associate Professor Valentin Zelenyuk** (University of Queensland)
3:45pm – 4:15 pm	**Contributed Talk -** 'Estimating the Output Gap with Survey Expectations' **Dr Yunjong Eo** (The University of Sydney)
4:15pm – 4:45 pm	**Contributed Talk -** 'Predicting Recessions: A New Measure of Output Gap as Predictor' **Associate Professor Valentin Zelenyuk** (University of Queensland)

3:45pm – 4.45pm	**Session 3B – Bootstrapping and Sampling (ABS Case Study Lecture Theatre 2090)** Session Chair: **Associate Professor Hanlin Shang** (Australian National University)
3:45pm – 4:15pm	**Contributed Talk -** 'Bootstrapping self-exciting point processes' **Dr Ye Lu** (The University of Sydney)
4:15pm – 4:45pm	**Contributed Talk -** 'Bootstrap prediction intervals for functional time series that incorporate model uncertainty' **Associate Professor Hanlin Shang** (Australian National University)

7:00pm – 9:00pm **Symposium Dinner**

Venue: The Little Snail, 3/50 Murray Street, Pyrmont NSW 2009

Tuesday 12 November 2019

9:00am – 10:00am **Plenary Session (ABS Case Study Lecture Theatre 2080)**

9: 00am – 10:00am	**Plenary talk –** Quantile co-movement in stock markets with production linkages of firms: A spatial panel quantile model with unobserved heterogeneity **Associate Professor Tomohiro Ando** (The University of Melbourne)

10.00am-10.30am **Morning Tea**

10:30am – 12:35pm **Student Session (ABS Case Study Lecture Theatre 2080)**

10:30am – 12.35pm	**Session 4** Session Chair: **Dr Boris Choy** (The University of Sydney)
10:30am – 10:55am	'Forecasting Australian house prices: Does anything beat a bivariate VAR?' **Zachary Orlando** (The University of Sydney)
10:55am – 11:20am	'Modelling electricity price spikes using Poisson autoregression with exogenous covariates (PARX)' **Neyavan Suthaharan** (The University of Sydney)
11:20am – 11:45am	'Solar: a least-angle regression for accurate and stable variable selection in high-dimensional data' **Ning Xu** (The University of Sydney)
11:45am – 12:10pm	'Distributional temporal difference learning for finance: Dealing with leptokurtic rewards' **Shijie (Harvey) Huang** (The University of Melbourne)
12:10pm – 12:35pm	'Analysis of fractionally differenced processes with heteroscedastic errors' **Cindy Yuan** (Toyota Financial Services / The University of Sydney)

12.35pm-1.30pm **Lunch**

1:30pm – 2:30pm **Parallel sessions (ABS 2080 & ABS 2090)**

1:30pm – 2:30pm	**Session 5A – Financial Econometrics and Volatility Forecasting II** **(ABS Case Study Lecture Theatre 2080)** Session Chair: **Dr Wenying Yao** (Deakin University)
1:30pm – 2:00pm	**Contributed Talk -** 'A new parametric MIDAS model' **Dr Jonathan Dark** (The University of Melbourne)
2:00pm – 2:30pm	**Contributed Talk -** 'Forecasting the volatility of asset returns: The informational gains from option prices' **Dr Wenying Yao** (Deakin University)

1:30pm – 2:30pm	**Session 5B – Time Series and Statistical Testing** **(ABS Case Study Lecture Theatre 2090)** Session Chair: **Dr Rami Tabri** (The University of Sydney)
1:30pm – 2:00pm	**Contributed Talk -** 'Unit root test with high-frequency data' **Professor Shuping Shi** (Macquarie University)
2:00pm – 2:30pm	**Contributed Talk -** 'Jackknife empirical likelihood for inequality constraints on regular functionals' **Dr Rami Tabri** (The University of Sydney)

2:30pm – 3:15pm **Invited session (ABS Case Study Lecture Theatre 2080)**

2:30pm – 3:15pm	**Invited talk –** 'Long monthly temperature series and vector seasonal shifting mean and covariance autoregressive model' **Professor Timo Teräsvirta** (Aarhus University)

3:15pm – 3:30pm **Best Student Presentation Award and Closing Ceremony (ABS Case Study Lecture Theatre 2080)**

3:30pm – 4:30pm **Afternoon Tea**

List of Abstracts

Keynote Address

Keynote Speaker: Morten Ørregaard Nielsen, Queen's Economics Department, Queen's University, Canada
Title: Inference on the dimension of the nonstationary subspace in functional time series
Co-authors: Won-Ki Seo and Dakyung Seong

Abstract: This paper provides a statistical testing procedure to determine the number of stochastic trends of cointegrated functional time series taking values in the Hilbert space of square integrable functions defined on a compact interval. Our test is based on a variance ratio statistic, adapted to a possibly infinite dimensional setting. We derive its asymptotic null distribution and prove consistency of the test. Monte Carlo simulation results show good performance of our test and provide some evidence that it outperforms the existing testing procedure. The methodology is applied to three empirical examples: age-specific US employment rates, Australian minimum temperature curves, and hourly Ontario electricity demand.

Plenary Talk

Plenary Speaker: Tomohiro Ando, Melbourne Business School, The University of Melbourne
Title: Quantile co-movement in stock markets with production linkages of firms: A spatial panel quantile model with unobserved heterogeneity

Abstract: This paper introduces a spatial panel quantile model with unobserved heterogeneity. The proposed model is capable of capturing high-dimensional cross-sectional dependence and allows heterogeneous regression coefficients. For estimating model parameters, a new estimation procedure is proposed. When both the time and cross-sectional dimensions of the panel go to infinity, the uniform consistency and the asymptotic normality of the estimated parameters are established. In order to determine the dimension of the interactive fixed effects, we propose a new information criterion. It is shown that the criterion asymptotically selects the true dimension. Monte Carlo simulations document the satisfactory performance of the proposed method. Finally, the method is applied to study the quantile co-movement structure of the U.S. stock market by taking into account the input-output linkages as firms are connected through the input-output production network.

Invited Talks

Invited Speaker: Dick van Dijk, Department of Econometrics, Erasmus University Rotterdam
Title: Can we improve modeling and forecasting the implied volatility surface?
Co-authors: Michael Gong and Michel van der Wel

Abstract: Option implied volatility varies systematically with the moneyness and maturity of the contract. This feature has inspired the development of factor-based models to characterize the shape of the implied volatility surface (IVS), that is, the collection of implied volatilities for option contracts on a given underlying asset with different strike prices and expiration dates, see Dumas *et al*. (1998). Furthermore, this has been combined with time series models to capture the dynamics of the relevant factors, with the additional purpose of predicting (changes in) the IVS, see Goncalves and Guidolin (2006).
In this talk, we discuss three different approaches to extend the standard approach to modeling and forecasting the IVS. First, the standard approach leaves considerable systematic variation in the idiosyncratic component of implied volatilities, in the form of substantial autocorrelation and a strong link between these components for paired put and call options with the same moneyness and maturity. We augment the standard factor model to accommodate both features. We apply the extended models to S&P500 index options and options of 95 individual stocks, and find that they improve upon the standard approach with a 40% reduction of both in-sample RMSE and out-of-sample RMSFE. The extended models also provide economic value, leading to improved performance of delta-hedged trading strategies.
Second, we put forward a novel factor-based approach for modeling and forecasting the IVS for a cross-section of equity options. Inspired by the findings of Christoffersen *et al*. (2017) that equity volatility levels, smiles and term structures show strong co-movement, we postulate the presence of common factors in these characteristics. We argue that liquid index options can be used to obtain estimates of these common factors, which renders a feasible modeling approach even in high-dimensional settings. We implement the model for a cross-section of 95 equity options combined with options on the S&P 500 index. We document strong explanatory power of index options factors for the equity IVSs, and find that incorporating the index option information can improve the forecasting performance, particularly for illiquid stocks.
Third, the standard approach to modeling and forecasting the IVS is based on the assumption of linearity, both for the relation between observed implied volatilities and the underlying factors as well as for the factor dynamics. We explore the potential usefulness of allowing for nonlinearity in both parts of the model using machine learning techniques. We find that using autoencoders to retrieve the IVS factors and neural networks to describe their dynamics substantially improves the fit and forecasting performance for S&P 500 index options.

Invited speaker: Brendan K. Beare, School of Economics, The University of Sydney
Title: Representation of I(1) and I(2) autoregressive Hilbertian processes
Co-author: Won-Ki Seo

Abstract: We develop versions of the Granger-Johansen representation theorems for I(1) and I(2) vector autoregressive processes that apply to processes taking values in an arbitrary complex separable Hilbert space. This more general setting is of central relevance for statistical applications involving functional time series. An I(1) or I(2) solution to an autoregressive law of motion is obtained when the inverse of the autoregressive operator pencil has a pole of first or second order at one. We obtain a range of necessary and sufficient conditions for such a pole to be of first or second order. Cointegrating and attractor subspaces are characterized in terms of the behaviour of the autoregressive operator pencil in a neighbourhood of one.

Invited Speaker: Timo Teräsvirta, CREATES, Aarhus University & C.A.S.E., Humboldt-Universität zu Berlin
Title: Long monthly temperature series and Vector Seasonal Shifting Mean and Covariance Autoregressive model

Abstract: A vector version of the Shifting Seasonal Mean Autoregressive model is considered. In this model, the seasonal means, error variances and correlations can all be time-varying. Asymptotic theory for maximum likelihood estimators of parameters is developed. The model is applied to describing the dynamic behaviour of twenty long monthly European temperature series extending from the second half of the 19th century until the present decade, and contemporaneous dependence between them. The results (with some exceptions) indicate strong warming in the winter months, February excluded, and cooling followed by warming during the summer months. No clear pattern for changing correlations can be detected, but some of them are different in the summer compared with the other seasons.

Contributed Talks: Session 1A – Financial Econometrics and Volatility Forecasting

Presenter: Richard Gerlach, Discipline of Business Analytics, The University of Sydney
Title: Dynamic quantile models for financial returns

Abstract: A novel way of thinking about the modelling of the time-varying distributions of financial asset returns is presented. Borrowing ideas from symbolic data analysis, data representations beyond scalars and vectors are considered. Specifically, a quantile function is considered as an observation, and a new class of dynamic models for quantile-function-valued (QF-valued) time series is developed. In order to make statistical inferences and account for parameter uncertainty, a method whereby a likelihood function can be constructed for QF-valued data is proposed, and an adaptive MCMC sampling algorithm for simulating from the posterior distribution is developed. Compared to modelling realized measures, modelling the entire quantile function of intra-daily returns allows one to gain more insight into the dynamic structure of price movements. Via simulations, we show that the proposed MCMC algorithm is effective in recovering the posterior distribution. In the empirical study, the new model is applied to analyze one-minute returns for major international stock indices. Through quantile scaling, we further demonstrate the usefulness of our method by forecasting one-step-ahead the Value-at-Risk and Expected Shortfall of daily returns.

Presenter: Simon Kwok, School of Economics, University of Sydney
Title: Inferring financial bubbles from option data

Abstract: Financial bubbles arise as the price of the underlying asset departs from its fundamental value. While there exist statistical methods dedicated to the inference of bubbles, many of them rely on the use of past asset prices as inputs and explosive process as the reduced-form model. In this paper, we take a different approach by inferring bubbles from option prices. Under the no-arbitrage trading environment satisfying no-free-lunch-with-vanishing-risk and no-dominance conditions, we can identify the term structure of bubbles for the underlying asset using out-of-the-money options. In the empirical application, we study both the time series dynamics and the term structure of S&P 500 Index bubbles using European-style index options. We find that the bubble process behaves like a supermartingale when it "bursts", and that the term structure of bubble contains forward-looking information useful for prediction.

Contributed Talks: Session 1B – Stochastic Volatility

Presenter: Peter Exterkate, School of Economics, The University of Sydney
Title: Density forecasting in nonlinear models with stochastic volatility

Abstract: Kernel ridge regression is a technique to perform ridge regression with a potentially infinite number of nonlinear transformations of the independent variables as regressors. This makes it a powerful forecasting tool, which is applicable in many different contexts. However, it is usually applied only to independent and identically distributed observations. This paper introduces a variant of kernel ridge regression for time series with stochastic volatility. The conditional mean and volatility are both modelled as nonlinear functions of observed variables. We set up the estimation problem in a Bayesian manner and derive a Gibbs sampler to obtain draws from the predictive distribution. A simulation study and an application to forecasting the distribution of returns on the S&P500 index are presented, and we find that our method outperforms most popular GARCH variants in terms of one-day-ahead predictive ability. Notably, most of this improvement comes from a more adequate approximation to the tails of the distribution.

Presenter: Nuttanan Wichitaksorn, School of Engineering, Computer and Mathematical Sciences, Auckland University of Technology
Title: Analyzing stock returns through mixture of normal and generalized Pareto distributions

Abstract: In this talk, I will present a couple of models with errors following the mixture of normal and generalized Pareto distributions. The advantage of this mixture is to allow us in analysing the tail behaviours at the desired quantiles. For illustration, a simulation study with a linear regression model and a generalized autoregressive conditional heteroskedasticity (GARCH), and an empirical study with real data on stock returns will be shown.

Contributed Talks: Session 2A – Economics and Time Series Modelling I

Presenter: Pablo Montero-Manso, Department of Econometrics and Business Statistics, Monash University
Title: Forecasting Related Time Series: Fundamentals and a New Approach

Abstract: The need to forecast a group of time series with some degree of similarity is very common: Tourism arrivals in areas with similar climate or geographical proximity, sales of similar products or econometric indicators for similar firms. Methods that exploit this relatedness (usually in an inadvertent way) have recently started to outperform methods that consider each series in isolation, such as ARIMA or Exponential Smoothing. Surprisingly, this happens in datasets that defy an intuitive notion of relatedness, e.g. they bundle together series from completely different domains, time periods, etc. We study this problem from a Statistical Machine Learning point of view, providing some insights and suggesting a formal definition of ¨relatedness¨. From this definition follows a new learning algorithm which has ties to a well-known problem in optimization. This method is able to exploit prior knowledge about the degree of relatedness in a group. It works with any kind of model, including deep networks. Our experiments show improved performance across the main forecasting benchmark datasets (M1-M4). We will illustrate the method on the FRED-MD Macroeconomic Database.

Presenter: Mengheng Li, Economics Discipline Group, University of Technology Sydney
Title: Forecasting economic time series using score-driven dynamic models with mixed-data sampling
Co-authors: Paolo Gorgi and Siem Jan Koopman
Abstract: We introduce a mixed-frequency score-driven dynamic model for multiple time series where the score contributions from high-frequency variables are transformed by means of a mixed-data sampling weighting scheme. The resulting dynamic model delivers a flexible and easy-to-implement framework for the forecasting of low-frequency time series variables through the use of timely information from high-frequency variables. We verify in-sample and out-of-sample performances of the model in an empirical study on the forecasting of U.S. headline inflation and GDP growth. In particular, we forecast monthly headline inflation using daily oil prices and quarterly GDP growth using a measure of financial risk. The forecasting results and other findings are promising. Our proposed score-driven dynamic model with mixed-data sampling weighting outperforms competing models in terms of point and density forecasts.

Contributed Talks: Session 2B – Multivariate Time Series Modelling

Presenter: Adam Clements, Queensland University of Technology
Title: Forecasting using multivariate HAR models: The benefits of using Weighted Least Squares

Abstract: Forecasting the covariance matrix of financial asset returns is an important issue for financial decision making and as such, a great deal of research effort has focused on developing forecasting models. With the widespread availability of high-frequency financial data, the recent literature has focused on employing the realized (variance)-covariance (RCOV) matrix to build forecasting models. The Heterogeneous AutoRegressive (HAR) model, initially designed to parsimoniously capture the strong persistence typically observed in univariate realized volatility, has been extended to deal with the multivariate setting to forecast the RCOV matrix. Recent research has extended the standard HAR model to deal with heteroscedastic measurement error in the elements of the RCOV. This paper shows how to estimate the coefficients of the multivariate HAR model under weighted least squares (WLS) as an alternative to deal with heteroscedasticity. The goal here is not to extend the existing multivariate HAR models, but instead to investigate how to get the most of out the models by carefully choosing the estimation scheme. Results show that using WLS leads to significant improvements in forecast accuracy.

Presenter: Jennifer Chan, School of Mathematics and Statistics, The University of Sydney
Title: Bayesian inference for multivariate two stage CARR-returns models with applications to cryptocurrencies

Abstract: In cryptocurrency research, recent studies focus on analysing the volatility properties. This study analyses the volatility and correlation between pairs of the four most popular cryptocurrencies by market capitalisation. The analyses begin with a two-stage model first measuring volatilities using the efficient Parkinson range-based measure and fitting the measures to the Multivariate Conditional Autoregressive Range (MCARR) model. To enhance the model applicability, we consider the multivariate Log-t distribution. In the second stage, these fitted volatility and correlation estimates are applied to return models with multivariate normal or Student-t error distributions. Model performance is compared with the multivariate GARCH models including the Dynamic Conditional Correlation (DCC) Multivariate GARCH. Model parameters are estimated using the Bayesian Markov chain Monte Carlo method via the RStan package. Model selection is performed via the Deviance Information Criterion. The volatilities and returns are forecasted one step ahead based on the best models.

Contributed Talks: Session 3A – Economics and Time Series Modelling II

Presenter: Yunjong Eo, School of Economics, The University of Sydney
Title: Estimating the output gap with survey expectations

Abstract: I estimate the output gap based on unobserved components (UC) models with U.S. quarterly real GDP augmented with professional forecasters' expectations. The unobserved components model decomposes real GDP growth into permanent and transitory components. The model parameters are restricted in that the UC-based forecasts are consistent with those from professional forecasters. This additional information from the forecasts helps identify the model parameters and produce intuitive estimates of the output gap. The bivariate UC decomposition implies a larger cycle-trend variance ratio and more persistent cycles than the univariate decomposition. As a result, the bivariate estimates of cyclical components are positively associated with NBER reference cycles while the univariate estimates are not. The bivariate UC model allows for structural interpretation of permanent and transitory shocks. Furthermore, the estimates of the output gap are robust to allowing for structural breaks in the long-run growth rate of real GDP.

Presenter: Valentin Zelenyuk, School of Economics and Centre for Efficiency and Productivity Analysis (CEPA), The University of Queensland
Title: Predicting recessions: A new measure of output gap as predictor
Co-authors: Camilla Mastromarco and Léopold Simar

Abstract: In this paper, we merge two streams of literature: non-parametric methods to estimate frontier efficiency of an economy, which allows us to develop a new measure of output gap, and nonparametric methods to estimate probability of economic recession. To illustrate the new framework we use quarterly data for Italy from 1995 to 2019, and find that our model, using either non-parametric or the linear probit model is able to provide useful insights.

Contributed Talks: Session 3B – Bootstrapping and Sampling

Presenter: Ye Lu, School of Economics, The University of Sydney
Title: Bootstrapping self-exciting point processes

Abstract: Many social and economic events that are observed in time frequently cluster. This phenomenon can be analyzed effectively by a class of self-exciting point process models, which specify the event occurrence rate as a function of time and previous history of events. Models in this class are most commonly estimated using maximum likelihood and implemented by numerical evaluation or expectation maximization (EM) algorithms. However, the standard errors based on the asymptotic normality of MLE can be heavily biased in finite sample, thus potentially invalidating inference. In this paper, we propose a novel bootstrap approach and develop the bootstrap theory for the statistical inference of Hawkes processes. In particular, we apply the time-rescaling theorem from point process theory in order to reconstruct an independently identically distributed exponential random sample from the original observations, and then subsequently draw bootstrap samples from it. We show both in theory and simulations that the proposed approach yields more reliable inference in finite samples.

Presenter: Han Lin Shang, Research School of Finance, Actuarial Studies and Statistics, Australian National University
Title: Bootstrap prediction intervals for functional time series that incorporate model uncertainty
Co-authors: Efstathios Paparoditis

Abstract: A bootstrap procedure for constructing pointwise or simultaneous prediction intervals for stationary functional time series is proposed. The sieve-type bootstrap procedure exploits a general backward vector autoregressive representation of the time series of Fourier coefficients appearing in the well-known Karhunen-Loève expansion of the functional process. By running backward in time, the procedure generates functional replicates which adequately mimic the dependence structure of the underlying process and which all have the same conditionally fixed curves at the end of every functional pseudo time series. The bootstrap prediction error distribution is then calculated as the difference between the model free, bootstrap generated future functional observations and the functional forecasts obtained from a model used for prediction. In this way, the estimated prediction error distribution that takes into account not only the innovation and estimation error associated with prediction, but also the possible error due to model uncertainty or misspecification. We prove asymptotic validity of the bootstrap in estimating the prediction error distribution of interest. Furthermore, through a series of simulation studies and a real-world data set, we demonstrate the good finite-sample performance of the proposed sieve bootstrap method.

Student Session: Session 4

Presenter: Zachary Orlando, School of Economics, The University of Sydney
Title: Forecasting Australian house prices: Does anything beat a bivariate VAR?
Co-authors: Peter Exterkate and Christopher Gibbs

Abstract: Forecasting approaches designed to use large amounts of predictive information have been shown to improve house price forecasting overseas but have not yet been examined in Australia. This paper investigates how well four such approaches, Bayesian Vector Autoregressions, Factor-Augmented Vector Autoregressions, Dynamic Model Averaging and Kernel Ridge Regression, forecast quarterly Australian house price growth compared to a benchmark bivariate VAR with house price growth and interest rates. For this purpose, it utilizes a predictive dataset consisting of 50 macroeconomic variables and evaluates performance out-of-sample from 2010:Q1 to 2018:Q4 using rolling windows. The empirical results show that the simple benchmark generally performs well against the alternatives, however significant improvement was observed over longer horizons by using a large Bayesian VAR.

Presenter: Neyavan Suthaharan, School of Economics, The University of Sydney
Title: Modelling electricity price spikes using Poisson autoregression with exogenous covariates (PARX)
Co-author: Ye Lu

Abstract: Sudden dramatic rises in electricity prices, known as electricity "price spikes", are ubiquitous in electricity spot markets worldwide. Energy retailers in many counties, including Australia, purchase electricity in an unregulated spot market and sell it to consumers at a heavily regulated price. As a result, the occurrence of spikes in the spot electricity price is particularly hazardous for retailers, and the precise forecasting of these spikes is of foremost importance for effective risk management. In spite of this, there have been few papers in the literature which focus specifically on modelling the spiking process, and the existing methods are still rudimentary. This thesis aims to fill this gap by proposing a Poisson autoregression model with exogenous covariates (PARX) for the time series counts of price spikes. This model is shown to well capture the salient features in electricity price spikes, and will provide effective rolling forecasts of the probability of a price spike in the future. We apply the proposed methodology to analyse the half-hourly spot prices in the Australian National Electricity Market (NEM) over the period 1 January 2010 to 1 March 2019.

Presenter: Ning Xu, School of Economics, The University of Sydney
Title: Solar: a least-angle regression for accurate and stable variable selection in high-dimensional data
Co-author: Jian Hong and Timothy Fisher

Abstract: We propose a new least-angle regression algorithm for variable selection in high-dimensional data, called subsample-ordered least-angle regression (solar). Solar relies on the average L_0 solution path computed across subsamples and largely alleviates several known high-dimensional issues with least-angle regression. Using examples based on directed acyclic graphs, we illustrate the advantages of solar in comparison to least-angle regression, forward regression and variable screening. Simulations demonstrate that, with a similar computation load, solar yields substantial improvements over two lasso solvers (least-angle regression for lasso and coordinate-descent) in terms of the sparsity, stability and accuracy of variable selection. Simulations also demonstrate that solar enhances the robustness of variable selection to different settings of the irrepresentable condition and to variations in the dependence structures assumed in regression analysis. We provide a Python package solarpy for the algorithm.

Presenter: Shijie Huang, Department of Finance, University of Melbourne
Title: Distributional temporal difference learning for finance: Dealing with leptokurtic rewards
Co-authors: Nitin Yadav and Peter Bossaerts

Abstract: In traditional Reinforcement Learning (RL), agents aim at optimizing state-action choices based on recursive estimation of expected values. Here, we show that this approach fails when the period rewards are generated by a leptokurtic law, as is common in financial ap Neyava plications. Under leptokurtosis, outliers are frequent and large, causing the estimates of expected values, and hence, optimal policies, to change erratically. Distributional RL improves on this because it takes the entire distribution of outcomes into account, and hence, allows more efficient estimation of expected values. We take this idea further and use the outcome distribution to obtain the asymptotically most efficient estimator of expected values. In addition, since in a financial context the period reward distribution and the asymptotic distribution of action-values are distributed in a fundamentally different way, with leptokurtosis affecting the former but not the latter, we estimate their means separately. We show how the resulting distributional RL (d-RL-MLE) learns much faster, and is robust once it settles on an optimal policy. Altogether, our results show that introducing domain-specific knowledge in a disciplined way improves performance and robustness of distributional RL.

Presenter: Huimin (Cindy) Yuan, School of Mathematics and Statistics, The University of Sydney
Title: Analysis of fractionally differenced processes with heteroscedastic errors
Co-authors: Shelton Peiris and Boris Choy

Abstract: The article considers the fitting long-range dependency and volatility factors of a long memory tme series using fractionally differenced Gegenbauer autoregressive moving average model. This extends the theory and application of simple long memory process with heteroskedastic errors. We investigate the conditional quasi maximum likelihood (QMLE) method, and in particular develop an algorithm in order to increase the accuracy of estimators. Monte Carlo simulation methods are used to study the finite sample properties of the parameter estimates. As an illustration, a generalised long memory with heteroskedastic errors (GARMA-GARCH) is fitted to analyse the China Great Bull Stock Market of 2015 and the global financial crisis of 2007-2008.

Contributed Talks: Session 5A – Financial Econometrics and Volatility Forecasting II

Presenter: Jonathan Dark, The University of Melbourne
Title: A new parametric MIDAS model

Abstract: We propose a flexible parametric MIDAS model that draws on the physics literature for oscillating systems. Unlike the exponential Almon and beta lags, the polynomial allows the weights to change sign. The model is parsimonious, easy to estimate, and includes a parameter that captures the rate of decay of the polynomial. This latter feature lets the data determine the number of lags, and helps to avoid non-damping lag polynomials and endpoint restrictions. Monte Carlo simulation demonstrates: i) the flexibility of the proposed model, including its ability to approximate exponential Almon lags; ii) the stability of the estimated polynomial and forecast performance in the presence of lag misspecification; and iii) the excellent fit and superior out of sample forecast performance relative to a number of MIDAS competitors. These findings are corroborated by an empirical application that forecasts monthly changes in inflation rates as a function of a daily commodity price index.

Presenter: Wenying Yao, Deakin University
Title: Forecasting the volatility of asset returns: The informational gains from option prices

Abstract: The Realized GARCH class of models is extended to include option prices to forecast the volatility of asset returns. As analytical expressions are not available to evaluate option prices in the presence of GARCH volatility specifications, the VIX is used to approximate option prices by imposing a set of cross-equation restrictions on the models' parameters. The full model is characterized by a nonlinear system of three equations containing asset returns, RV and the VIX, which is estimated by maximum likelihood methods. The forecasting properties of the joint model are investigated by forecasting daily volatility on the S&P500 using daily and intra-day data from July 2001 to November 2017. For comparison a number of special cases are also considered. The forecasting results provide strong support for including options to improve the volatility forecasts of U.S. equities. There is some evidence of including realized variance estimates to improve forecastability, but only when combined with option prices. We also find that linear GARCH specifications produces superior forecasting performance than the EGARCH class at short-horizon (1-day ahead), but EGARCH performs better when forecasting 5-day ahead cumulative volatility.

Contributed Talks: Session 5B – Time Series and Statistical Testing

Presenter: Shuping Shi, Macquarie University
Title: Unit Root Test with High-Frequency Data
Co-author: Sébastien Laurent

Abstract: Deviations of asset prices from the random walk dynamic imply the predictability of asset returns and thus have important implications for portfolio construction and risk management. This paper proposes a real-time monitoring device for such deviations using intraday high-frequency data. The proposed procedure is based on unit root tests with in-fill asymptotics but extended to take the empirical features of high-frequency financial data (particularly jumps) into consideration. We derive the limiting distribution of the test statistic under both the null hypothesis of a random walk with jumps and the alternative of mean reversion/explosiveness with jumps. The limiting results show that ignoring the presence of jumps could potentially lead to severe size distortions of both the left-sided (against mean reversion) and right-sided (against explosive) unit root tests. The simulation results reveal the satisfactory performance of the test even with data from a relatively short time span (i.e., one quarter). As an illustration, we apply the procedure to the Nasdaq composite index at the 10-minute frequency from January 2, 1996 to December 8, 2017. We find strong evidence of explosiveness dynamics in asset prices during the dot-com bubble and the subprime mortgage crisis periods and mean reversion in the late 2015 and early 2016.

Presenter: Rami Tabri, School of Economics, The University of Sydney
Title: Jackknife Empirical Likelihood for Inequality Constraints on Regular Functionals.
Co-author: Ruxin Chen

Abstract: Empirical likelihood is effective in many different practical situations involving moment equality and/or inequality restrictions. However, in applications with nonlinear functionals of the underlying distribution, it becomes computationally more difficult to implement. We propose the use of jackknife empirical likelihood (Jin et al., 2009, JASA, 104(487), 124-1232) to circumvent the computational difficulties with nonlinear inequality constraints and establish the chi-bar-square distribution as the limiting null distribution of the resulting empirical likelihood-ratio statistic, where a finite number of inequalities on functionals that are *regular*, in the sense of Hoeffding (1948, Ann. Math. Statist., 19(3), 283-325), defines the null hypothesis. The class of regular functionals includes many nonlinear functionals that arise in practice and has moments as a special case. To overcome the implementation challenges with this non-pivotal asymptotic null distribution, we propose an empirical likelihood bootstrap procedure that is valid with uniformity. Finally, we investigate the finite-sample properties of the bootstrap procedure using Monte Carlo simulations and find that the results are promising.

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