Melbourne Bayesian Econometrics Workshop 2014

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Thursday 5th of June, 2014
Seminar Room 605, Level 6, FBE Building
111 Barry Street, Carlton, VIC 3053
Session 1: Recent Advances in Nonlinear Time Series Analysis

9:15 - 10:00  **Gael Martin** (Monash University)

**Approximate Bayesian Computation in State Space Models**

(with Brendan P.M. McCabe, Christian P. Robert and Ole Maneesoonthorn)

Abstract: Exploiting the likelihood-free techniques of approximate Bayesian computation (ABC), a new approach to inference in state space models is proposed. ABC avoids direct evaluation of the likelihood function by matching summary statistics calculated from the observed data with corresponding statistics computed from data simulated from the true process. Exact inference is feasible only if the matching statistics are sufficient for the unknown parameters. We demonstrate that finite sample sufficiency is not attainable in the state space setting. Hence, we are motivated to seek asymptotic sufficiency via the maximum likelihood estimator (MLE) of the parameters of an auxiliary, or approximating, model. We prove that this auxiliary model-based approach achieves Bayesian consistency, as well as showing that - in a precise limiting sense - the proximity to (asymptotic) sufficiency yielded by the use of the MLE is replicated by the use of the approximate score. The application of the proposed method in multiple parameter settings is addressed, with a separate treatment of scalar parameters, based on integrated likelihood techniques, advocated as a possible way of avoiding the curse of dimensionality. Some attention is given to non-linear models in which the state variable is driven by a continuous time process, with exact Bayesian inference typically infeasible in this case as a result of intractable transitions. The ABC method is demonstrated using the augmented unscented Kalman filter as a fast and simple way of producing an approximation in this setting. A stochastic volatility model for financial returns, based on a square root specification for volatility, is used for illustration, with the ABC method seen to produce quite accurate estimates of the exact marginal posteriors, which are accessible in this case.

10:00 - 10:45  **Michael Smith** (Melbourne Business School)

**Copula Modelling of Dependence in Multivariate Time Series**

Abstract: Almost all existing nonlinear multivariate time series models remain linear, conditional on a point in time or latent regime. Here, an alternative is proposed, where nonlinear serial and cross-sectional dependence is captured by a copula model. The copula defines a multivariate time series on the unit cube. A drawable vine copula is employed, along with a factorization which allows the marginal and transitional densities of the time series to be expressed analytically. The factorization also provides for simple conditions under which the series is stationary and/or Markov, as well as being parsimonious. A parallel algorithm for computing the likelihood is proposed, along with a Bayesian approach for computing inference based on model averages over parsimonious representations of the vine copula. The model average estimates are shown to be more accurate in a simulation study. Two five-dimensional time series from the Australian electricity market are examined. In both examples, the fitted copula captures substantial asymmetric tail dependence, both over time and between elements in the series.

10:45 - 11:15  **Tea Time**
Issues in Comparing Stochastic Volatility Models Using the Deviance Information Criterion

(with Angelia Grant)

Abstract: The deviance information criterion (DIC) has been widely used for Bayesian model comparison. In particular, the DIC based on the conditional likelihood—obtained by conditioning on the latent variables—is a popular metric for comparing stochastic volatility models. Nevertheless, some recent studies have argued against the use of the conditional DIC for both theoretical and practical reasons. We show via a Monte Carlo study that the conditional DIC tends to favor overfitted models, whereas the DIC calculated using the observed-data likelihood—obtained by integrating out the latent variables—seems to perform well. However, the main challenge for obtaining the latter DIC for stochastic volatility models is that the observed-data likelihoods are not available in closed-form. To overcome this difficulty, we propose fast algorithms for estimating the observed-data likelihoods for a variety of stochastic volatility models using importance sampling. We demonstrate the methodology with an application involving returns on the S&P 500.

A Nonparametric Regression Model of Cross-market Dependence Under Conditional Heteroscedasticity

Abstract: Financial analysts have found that the Australian stock market often follows the overnight U.S. stock market. Therefore, it is of great interest and crucial importance to model the interdependence of one stock market on another under conditional heteroscedasticity. This paper aims to present a new nonparametric regression model of one asset's return on another asset's return, where the error process is conditional heteroscedastic with an unknown marginal density, which we propose to approximate by a Gaussian kernel density. A Markov chain Monte Carlo simulation algorithm is developed to sample all parameters including the smoothing parameters in the kernel estimator of the regression function and Gaussian kernel error density. This model allows for not only the asymmetric effect of past discrepancy between the observed response and the model-implied return, but also possible breaks in the mean function. Thus, this mean-break model allows for Bayesian inference on the existence of a change in the mean function. An empirical study on the mean-break model of the ASX SPI 200 daily return regressed on its corresponding overnight S&P 500 return shows that the collapse of Lehman Brothers had changed the nonlinear relationship between these two stock-index returns during the period from January 2004 to July 2013.
Session 3: Macroeconometrics

14:00 - 14:45  Sarantis Tsiaplias (Melbourne Institute)

A model of time-varying cointegration and cointegrating rank
(with Michael Chua)

Abstract: A bivariate model that allows for both a time-varying cointegrating matrix and time-varying cointegrating rank is presented. The model addresses the issue that, in real data, the validity of a constant cointegrating relationship may be questionable. The model nests the sub-models implied by alternative cointegrating matrix ranks and allows for transitions between stationarity and non-stationarity, and cointegrating and non-cointegrating relationships in accordance with the observed behaviour of the data. A Bayesian test of cointegration is also developed. The model is used to assess the validity of the Fisher effect and is also applied to equity market data.

14:45 - 15:30  Tomasz Woźniak (University of Melbourne)

Bayesian Inference for Heteroskedastic Structural Vector Autoregressions
(with Helmut Lütkepohl and Matthieu Droumaguet)

Abstract: The problem of assessing the impact of monetary policy authorities actions on the real economy with Structural Vector Autoregressions was investigated in multiple studies. In order to identify the monetary policy and other shocks that influence economic variables, restrictions need to be imposed on the original parameters of the model. Economic theory is a primary source of such restrictions. However, only over-identifying restrictions may be statistically tested, unlike just-identifying restrictions. We use a novel method for statistical identification of the matrix representing the impact of the shocks on the considered variables. We exploit properties of data such as heteroskedasticity. In such a case the restrictions that were before just-identifying become over-identifying and can be tested. Estimation of unrestricted and restricted models is performed with an innovative Gibbs sampling algorithm. For the testing purposes we employ Bayes factors, hence we are capable of comparing non-nested restrictions resulting from various theoretical economic models. The methodology is applied to test the economic theory behind different identification schemes that were used for monetary policy shocks in the U.S. economy.

15:30 - 16:00  Tea Time
16:00 - 17:15    Siddhartha Chib (Washington University in St. Louis)

Estimating and Comparing Affine Term-Structure Models

(with Kyu Ho Kang)

Abstract: Arbitrage-free affine term-structure models are widely used in the dynamic modeling of the yield curve of default-free bonds. From a statistical perspective, these models have the form of Gaussian state space structure that is linear in unobserved and unobserved factors but nonlinear in the deep parameters of the model, such as those that measure the market price of factor risks. On account of the nonlinearity of the parameters, the likelihood function can be quite irregular, and the consequent fitting can be fraught with difficulties. In this talk, building on prior work in Chib and Ergashev (2009), we describe ways in which the Bayesian perspective can be helpful in surmounting those difficulties. One way is through careful modeling of the prior distribution to reflect meaningful economic information, such as the belief that the yield curve is upward sloping on average. Another is through careful application of MCMC fitting methods. In this connection, we demonstrate the value of the Tailored Randomized Block Metropolis-Hastings (TaRB-MH) method in the fitting process and contrast the gains that accrue from this approach with those from other M-H variants, such as the fixed block M-H method, and the Hamiltonian Monte Carlo method. Finally, the Bayesian perspective is helpful in the comparison of alternative affine models. The ideas are illustrated with both simulated and real data on affine models that contain 3 factors and six yields.

18:00    Dinner