Melbourne Bayesian Econometrics Workshop 2015

Bayesian Analysis and Modeling Research Group
University of Melbourne

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Wednesday, 3 June 2015

Seminar Room 605, Level 6, FBE Building
111 Barry Street, Carlton, VIC 3053

Session 1: Bayesian Nonparametrics

9:00 – 9:10 Welcoming and registration

9:10 – 10:20 **John Maheu** (McMaster University)

Nonparametric Conditional Beta

This paper investigates the effect of the market return on the value of systematic risk using a semiparametric multivariate GARCH model. We nonparametrically estimate the dynamic conditional beta without any restrictive assumption on the joint density of the data. This model captures movements in systematic risk over time, and we find that the time-varying beta of a stock nonlinearly depends on the contemporaneous value of excess market returns. The model is extended to allow nonlinear dependence in Fama-French factors. In general, in highly volatile markets, beta is almost constant, while in stable markets, the beta coefficient can be highly and asymmetrically dependent on the value of the market excess return.

10:20 – 11:00 **Qiao Yang** (University of Toronto)

An Infinite Hidden Markov Model for Short-term Interest Rates

The time-series dynamics of short-term interest rates are important as they are a key input into pricing models of the term structure of interest rates. In this paper we extend popular discrete time short-rate models to include Markov switching of infinite dimension. This is a Bayesian nonparametric model that allows for changes in the unknown conditional distribution over time. Applied to weekly U.S. data we find significant parameter change over time and strong evidence of non-Gaussian conditional distributions. Our new model with an hierarchical prior provides significant improvements in density forecasts as well as point forecasts. We find evidence of recurring regimes as well as structural breaks in the empirical application.

11:00 – 11:30 Morning tea

Read more about the BAM RG and their activities at: fbe.unimelb.edu.au/economics/bam.

Session 2: Bayesian Forecasting

11:30 – 12:10 **Peter Exterkate** (University of Sydney)

Distribution Forecasting in Nonlinear Models with Stochastic Volatility

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&P 500 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.

12:10 – 12:50 **Richard Gerlach** (University of Sydney)

Bayesian Dynamic Tail Risk Forecasting Using Intra-day Measures

A new framework for direct modelling of quantiles and expectiles is proposed, with applications to the forecasting of financial tail risk. In the spirit of the realized GARCH (Re-GARCH) framework of Hansen et al (2011), a measurement equation is added to the Conditional Autoregressive Expectile (CARE) model of Taylor (2008). Various realized measures are incorporated into the model, which is called the Realized CARE model. The asymmetric sum of squares criterion function can be minimised (ALS) for estimation of quantiles and expectiles, but a Bayesian approach that transforms this function into a density, which is subsequently employed in a pseudo-likelihood formulation, is proposed. An adaptive Markov chain Monte Carlo sampler is then employed for estimation and forecasting. Simulations highlight comparatively favourable results for the MCMC method over the ALS approach re estimation and forecast accuracy. An empirical application to nine financial market series highlights improved accuracy in forecasting tail risk, for the proposed Realized-CARE model, with the realized range being the optimal choice of realized measure, compared to several competitors.

12:50 – 1:50 Lunch

Session 3: Bayesian Methodology

1:50 – 3:00 **Jun Yu** (Singapore Management University)

Robust Deviance Information Criteria for Latent Variable Models

Deviance information criterion (DIC) is a widely used information criterion for Bayesian model comparison. In this paper a rigorous decision-theoretic justification of DIC is provided for models without latent variables or incidental parameters. For models with latent variables, however, it is shown that the data augmentation technique undermines the theoretical underpinnings of DIC, although it facilitates parameter estimation via Markov chain Monte Carlo (MCMC) simulation. Data augmentation invalidates the standard asymptotic arguments and conventional estimators of latent variables may be inconsistent. In this paper, a robust form of DIC, denoted as RDIC, is advocated for Bayesian comparison of latent variable models. RDIC is shown to be a good approximation to DIC without data augmentation. While the later quantity is difficult to compute, the expectation – maximization (EM) algorithm facilitates the computation of RDIC when the MCMC output is available. Moreover, RDIC is robust to nonlinear transformations of latent variables and distributional representations of model specification. The proposed approach is applied to several popular models in economics and finance.

3:00 – 3:40 **Patrick Leung** (Monash University)

Data-driven Particle Filter for Particle Markov Chain Monte Carlo

This paper proposes new automated proposal distributions for sequential Monte Carlo (SMC) algorithms, including particle filtering and related sequential importance sampling methods. The weights for these proposal distributions are easily established, as is the unbiasedness property of the resultant likelihood estimators, so that the methods may be used within a particle Markov chain Monte Carlo (PMCMC) inferential setting. Simulation exercises, based on a range of important financial models, are used to demonstrate the linkage between the signal to noise ratio of the system and the performance of the new particle filters, in comparison with existing filters. In particular, we demonstrate that one of our proposed filters performs well in a high signal-to-noise ratio setting, that is, when the observation is informative in identifying the location of the unobserved state. A second filter, deliberately designed to draw proposals that are informed by both the current observation and past states, is shown to work well across a range of signal-to-noise ratios. We then extend the study to a PMCMC setting in which we document the performance of the PMCMC algorithm using the new filters to estimate the likelihood function, once again in comparison with existing alternatives. The comparison is based on the optimal computing time required to estimate the posterior distribution of the parameter of interest.

3:40 – 4:10 Afternoon tea

Session 4: Bayesian Modeling

4:10 – 4:50 **Kelly Trinh** (University of Queensland)

Time Varying Effects of Environmental Variables on the Levels of Technical Efficiency

We propose a non-linear Gaussian state space stochastic frontier model to jointly estimate the impacts of external factors on production process: the impact on the attainable production set and the impact on the distribution of technical efficiencies. One of the appealing features of the proposed model is that a prior specification on an one-sided distribution of technical efficiencies is not required. Furthermore, the model allows the impact of external factors on the distribution of efficiencies to vary across time and individuals. We use the proposed model to investigate how the external factors (i.e., foreign direct investment (FDI), economic freedom index, etc.) foster productivity growth by considering the impact on technological change (shift of the production frontier) and the impact on efficiency change (movement away/towards the production frontier). By using a dataset of 21 countries over 1995-2011, we find that FDI plays an important role as influencing efficiency distribution and affecting, to a smaller extend, the shift of production frontier. The impact on the distribution of technical efficiencies does not seem to vary much over time, but seems to vary across the countries. With regard to economic freedom index, its impact on technological change is more profound than its impact on the distribution of efficiencies, which is found to be insignificant for some countries.

4:50 – 5:30 **Valentyn Panchenko** (University of New South Wales)

Bayesian Estimation of the Heuristic Switching Model Using Experimental Data

We estimate the hidden Markov model of switching between several heuristics on data of the "Learning-to-Forecast" experiments. In these experiments participants predict an evolution of the endogenous time series of price of the financial asset. The price was a function of the average of the participants' forecasts. The functional form varied under different treatments. A peculiar feature of these experiments is that the resulting time series may vary qualitatively even under the same treatment: in some cases the convergence to the fundamental price is observed, while in other cases the price exhibits volatility and repeated patterns of bubbles and crashes. To explain this variety of outcomes Anufriev and Hommes (2012) propose the Heuristic Switching Model where participants follow behavioural prediction heuristics and switch between them on the basis of their past performance. In this paper we take Bayesian approach to estimate such a model on the available data from the previous learning-to-forecast experiments. The observed variable is the individual numerical point forecasts. In the experiment individuals may condition their forecasts on the price from the previous rounds displayed on the screen. We assume that the individual point forecasts are generated by certain unobserved behavioural forecasting heuristics (e.g., adaptive, trend-following, constant, rational) and that individuals may switch between these heuristics. We parameterise this hidden Markov Model. The probabilities of switching are conditioned on the past performances of the rules. We estimate the parameters of the rules and the probabilities of choosing a specific rule by an individual at a given time using MCMC Gibbs sampler. We find that individual switching is an important characteristics helping to explain experimental data as opposed to the constrained model without switching. Depending on the treatment (functional form of price determination) we observed prevalence of different sets of heuristics.