Recent Developments of Bayesian Econometrics:
Bayesian Inference Using MCMC Algorithms

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Over the last decade Bayesian statisticians and econometricians been using Markov Chain Monte Carlo (MCMC) algorithms at an increasing rate. So prevalent is the application of MCMC algorithms, Bayesian inference, at least at the graduate and research levels, cannot be discussed without understanding MCMC algorithms. There are ready-to-use computer software for MCMC algorithms, a leading one being WinBugs. Many papers have been written using WinBugs. However, I believe that one should write one's own MCMC algorithms so that one needs not rely on canned software.

I will explain MCMC algorithms using recent published and unpublished papers. To do so, I have put together these lecture notes so that the reader will first run a relevant GAUSS program and and then check the lecture notes. With this "hands-on" or "do it by yourself" approach, I hope that the reader will learn MCMC algorithms. I will cover linear regression model, convergence tests, probit and logit models, and various time series models. Let me explain each major topic in the lecture notes.

1. linear regression model

This section is written to understand Gibbs sampler and Metropolis-Hastings algorithms. Predictive densities (pp.16–23) and densities of the mean squared forecast errors are original materials. A proof that the Metropolis-Hastings algorithm yields an invariant distribution is given in Appendix A, and in Appendix B three ways to draw random numbers from an inverted Wishart distribution are discussed. All the computer programs are in GAUSS.

2. Convergence tests

This section is taken from a paper by Goldman, Valieva, and Tsurumi (2005) "Kolmogorov-Smirnov, Fluctuation, and Z_g Tests for Convergence of Markov Chain Monte Carlo Draws." See the pdf file:**flks_modc.pdf**. The GAUSS program is **ftks_pw.pro**.

3. Probit and Logit Models

Probit and logit models have been used predominantly in micro econometric applications under the title of qualitative choice models. Recently probit and logit models have been used in marketing to analyze consumer behavioral patterns in choosing different brands and models. I shall discuss the basic probit model and nested multinomial logit model. Applications are (i) consumer choice of organic produce (using probit) and (ii) medical treatment case (using nested multinomial logit model.)

4. Asset Pricing Models

Focusing on the CKLS model, I will explain Griddy Gibbs and Efficient Jump algorithms. Also, the CKLS model with ARMA-GARCH error processes will be discussed.

5. Bayesian Unit Root Test

The posterior probability density function (pdf) of the maximum of the absolute value of the inverted roots of an autoregressive process is used to test a unit root. The text for this topic is Goldman, E., S. Radchencko, T. Nakatsuma and H. Tsurumi."A Bayesian test of stationarity in a regression model with an ARMA or ARMA-GARCH error term," *Proceedings of the American Statistical Association* Section B, 2001, 61–68

6. Bayesian Cointegration Test and Pairwise Granger Causality Test

The text for this topic is Chapter 3 of *Bayes Keriryokeizai Bunseki: Markov Chain Monte Carlo ho to sono oyou,* Toyokeizai Shimpo, Tokyo, 2005

7. Threshold Autoregressive and Moving Average (TARMA) and Fractional Autoregressive and Moving Average (FARMA) models

Threshold autoregressive models (TAR) have been popular in time series analysis. The standard TAR model is extended to threshold autoregressive and moving average (TARMA) models. Another popular

time series models are long memory models or fractional autoregressive and moving average (FARMA) models. We estimate TARMA and FARMA models using MCMC algorithms.

8. Stochastic Volatility Models

There are two approaches to estimate SV models: (i) use of a proposal density for the SV variable, and (ii) state-space representation for the SV variable. We discuss both of these approaches.