UNIVERSITY OF OREGON
Department of Economics

EC 607, Spring 2018
Bayesian Econometrics
MW 10:00 – 11:50 in PLC 410

Instructor: Jeremy Piger
Contact Information: Office: 536 PLC; Email: jpiger@uoregon.edu
Office Hours:
There are two options to be guaranteed of catching me in my office:

1) Send me an email and we will set up a time to meet (usually same or next day.)

2) Come to my EC 320 office hours on Fridays from 12:00 p.m. – 2:00 p.m. Note: EC 320 students will have priority during this time.

Course Description: This is a course on the Bayesian approach to econometrics. We will begin with a detailed discussion of the Bayesian framework to approach econometric questions. We will then discuss the leading simulation techniques used to implement Bayesian econometrics in practice. Lastly, we will apply the toolkit we have developed to Bayesian estimation of a variety of popular econometric models.

Course Requirements and Grading: Your grade will be partly determined by your performance on problem sets. This will make up 50% of your grade. The remaining 50% of your grade will be determined by an "implementation" project. The implementation project will have the following elements:

1) Choose an econometric model. The model you choose should **not** be one I cover in class.

2) Write a description of how this model can be estimated and evaluated using Bayesian techniques. This description should be approximately 5-10 pages in length.

3) Write computer code that implements Bayesian estimation of the model. This will be turned in, so work to write efficient, well commented, code.

4) Apply your code to a dataset. The dataset can be either a "real-world" dataset, or a simulated one. In doing this application you should be a "good Bayesian" (you will learn how to do this in class.) Report the results of this application in your written description.

5) Teach the class about the Bayesian estimation of your chosen model in a lecture (length of lecture TBA.)

Listed below are some examples of models that could be appropriate for the implementation project.

Discrete Data Models

1) Logit model
2) Mixed Logit model
3) Dynamic Probit model
4) Multinomial Logit/Probit model
5) Ordered Probit model
6) Models for count data (e.g. Poisson regression, negative binomial model)

Limited Dependent Variable Models

1) Truncated Regression model
2) Stochastic Frontier model
3) Censored Regression model (Tobit model)
4) Models for duration data (survival, hazard models)
5) Incidental Truncation/Sample selection model (Heckman model)

Time Series Models

1) Markov-switching model
2) Changepoint (structural break) model
3) Stochastic Volatility model
4) Dynamic Factor model
5) ARMA model
6) Bayesian Vector Autoregressions (BVARs) with a forecasting application

Other Models and Methods

1) Panel Regression (with extensions over what is covered in class)
2) Multilevel linear regression models (with extensions over what is covered in class)
3) Bayesian model averaging via Markov Chain Monte Carlo Model Composition (MC3)
4) Make a proposal!

As is department policy, a grade of incomplete will only be given in very unusual circumstances.

Important Dates:

All written assignments are due by 11:59 p.m. on their due date and should be submitted via Canvas. There will be a five-percentage point reduction in your assignment score for every hour an assignment is late.

Your written description from the implementation project is due on Thursday, June 14.

Your timeslot to teach the estimation of your chosen econometric model will be sometime in the last two weeks of class.

Computer Software: Portions of the problem sets will require writing estimation routines using suitable software. I will provide examples written in Matlab. I may (no promises) also provide examples in Julia. For those of you with a GE appointment, you can download Matlab for free here:

https://it.uoregon.edu/software/matlab

The amount of "canned" Bayesian software has exploded in recent years. Most software packages (Stata, Matlab, Julia, Python, R) now have many built in Bayesian routines. We will not use these canned routines in this class, but you may find them useful once you have a grasp of Bayesian econometrics.

Course Website: Canvas will be used to distribute documents and information relevant to the course.

Textbook: There are no required texts for the course. However, my lectures will be most closely related to the following books:

- Koop, G., 2003, *Bayesian Econometrics*, Wiley.
- Lancaster, T., 2004, *An Introduction to Modern Bayesian Econometrics*, Blackwell Publishing.

There are a number of other texts that you may also find useful / entertaining:

- Kim C.J. and C. Nelson, 1998, *State Space Models with Regime Switching: Classical and Gibbs Sampling Approaches with Applications*, MIT Press.
- Poirier, D.J., 1995, *Intermediate Statistics and Econometrics,* MIT Press.
- Gelman, A., Carlin, J.B., Stern H.S., and D.B. Rubin, 2004, *Bayesian Data Analysis*, Chapman & Hall/CRC.
- Berger, J.O. and R.L. Wolpert, 1984, *The Likelihood Principle*, Institute of Mathematical Statistics.
- Koop, G. and D. Korobilis, 2010, *Bayesian Multivariate Time Series Methods for Empirical Macroeconomics,* now Publishers.
- Koop, G., Poirier, D. J., and J. L. Tobias, 2007, *Bayeisan Econometric Methods*, Cambridge University Press.
- Herbst, E. P. and F. Schorfheide, 2016, *Bayesian Estimation of DSGE Models*, Princeton University Press.

Tentative Outline

Weeks 1-3: The Bayesian Approach to Econometrics

Topics: *Review of probability distributions and densities, assumptions justifying a Bayesian approach, subjective vs. objective probability, prior and posterior densities, conjugate priors, point estimation with alternative loss functions, interval estimation, Highest Posterior Density intervals and comparison with confidence intervals, prediction, model comparison, hypothesis testing, marginal likelihood, posterior odds, Bayes factor, Bartlett's paradox, Savage-Dickey density ratio, Bayesian model averaging, identification and Bayesian inference.*

Examples: *Bernoulli Trials with Conjugate Prior, Poisson Model with Conjugate Prior, Classical Linear Regression Model with Conjugate Priors*

Weeks 4-6: Bayesian Econometrics in Practice - Computation

Topics: *large sample Bayesian estimation, Laplace approximations, Bayesian information criterion, direct simulation methods (Monte Carlo integration, rejection sampling, distribution function inversion, Markov-chain Monte Carlo (MCMC) Simulation methods (Gibbs sampling, Metropolis-Hastings algorithm), blocking, convergence diagnostics, numerical standard errors, checking for errors in a posterior simulator, generated data experiments, posterior predictive p-values, methods to simulate the marginal likelihood, Bayesian model averaging, Markov-chain Monte Carlo Model Composition, g-prior, Rao-Blackwell.*

Examples: *Classical Linear Regression Model with non-conjugate priors, Probit Model, Nonlinear Regression Models*

Weeks 7-10: Bayesian Estimation of Selected Econometric Models

Topics: *linear regression models with non-spherical errors, seemingly unrelated regression models, models of panel data, system of equations, discrete data models, limited dependent variable models, data augmentation, simultaneous equation models, instrumental variable models, mixture of normals models, ARMA models, unit roots, Markov-switching models, state-space models, Bayesian vector autoregressive models, changepoint models, time-varying parameter models, dynamic factor models, stochastic volatility, vector error correction models.*