Syllabus

Economics 690

Bayesian Econometrics I

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Overview:

The course is intended to expose the student to the Bayesian viewpoint, to contrast this viewpoint with the frequentist perspective, and, importantly, to get the student up-to-speed with modern simulation methods. This module begins by very briefly covering Bayesian fundamentals, including a review of basic prior-posterior analysis, point estimation and hypothesis testing. We continue to discuss simulation methods - including iterative schemes and Markov Chain Monte Carlo (MCMC) methods - and illustrate their use on basic models. Problem sets for the course will involve some programming, and I strongly encourage students to do this programming in MATLAB. For some of the problem sets, when needed, I will provide supporting MATLAB files.

Grading: Grades will be determined through problem set scores as well as a final examination. Problem sets will comprise 70% of your final grade, while the examination score will count for the remaining 30%. The only way to really *learn* Bayesian econometrics is to *do* Bayesian econometrics and so I encourage you to complete the problem sets individually rather than in groups.

I plan to have 7 problem sets for the course - roughly one for each week of class. I will allow you to drop the lowest of your problem set scores when calculating your final grade. Thus, you can choose not to submit a problem set, or submit them all and be able to drop the

lowest grade. I would recommend the latter option rather than the former, both because it will help you better prepare for the final and because completion will help facilitate understanding the material.

Textbooks: The course is designed to be self-contained. That is, the student should find the lecture notes for the course (which are posted on the website) to be sufficient. The following books are recommended to supplement this material:

Bayesian econometrics by Gary Koop (2003). I think you will find this to be a nice complement to the material presented in the lectures. Koop does sometimes use a different notation/parameterization than I use, so you should be aware of this when going through the text.

The lecture notes themselves draw extensively upon material presented in *Bayesian Econometric Methods* (2007 by Koop, Poirier and Tobias.)

Finally, Tony Lancaster's *An Introduction to Modern Bayesian Econometrics* (2003) is an excellent text, as is Geweke's (2005) *Contemporary Bayesian Econometrics and Statistics*, though at a slightly higher theoretical level. Poirier (1995) is also detailed source, offering insightful comparisons between the Bayesian and frequentist perspectives.

The above books are written by econometricians, and contain information on models and issues relevant for economists. Other books written by statisticians include *Bayes and Empirical Bayes Methods for Data Analysis* [Carlin and Louis, (2000)] and *Bayesian Data Analysis* [Gelman, Carlin, Stern and Rubin (2003)]. These books are outstanding and are presented at a slightly more general level.

Course Outline:

1. ***Prior-PosteriorAnalysis:*** Conjugacy, Poisson-Gamma Models, Beta-Binomial Models. Linear regression model, matrix completion of square formulas. *Koop:* Chpaters 1 and 2.

2. ***Point Estimation:*** Basic framework, quadratic loss, absolute loss, other loss functions. *Lecture Notes*

3. ***Hypothesis Testing:*** Marginal likelihood calculations, Bayes factors, posterior odds, marginal likelihoods in the linear regression model, Bartlett's paradox, the Savage-Dickey density ratio.*Lecture Notes*

4. ***Direct simulation methods:*** Monte Carlo integration, the method of composition, the inverse transform, weighted bootstrap, importance sampling. *Koop:* Section 4.3.3

5. ***Iterative simulation methods:*** Gibbs sampling and the Metropolis-Hastings algorithm. convergence diagnostics, numerical standard errors. *Koop:* Sections 4.2.3

6. ***Some examples of Gibbs sampling:*** Gibbs sampling in the linear regression model, single changepoint models, the seemingly unrelated regressions (SUR) model. *Koop:* Section 6.6.

7. ***Data augmentation and latent variable models:*** Probit models, equation systems with endogeneity concerns. *Koop:* Chapter 9.

8. ***Mixture Models:*** Scale mixture of normals models, finite Gaussian mixture models. *Koop:* Section 10.3.