Web materials for BAYESIAN ECONOMETRICS by Gary Koop

This document describes the material on the website for the book *Bayesian Econometrics* by Gary Koop (published by John Wiley, 2003).

Legal disclaimer: Although the author has done his best to ensure the programs on this website are error free, he does not assume any responsibility for any errors which do exist. The author does not commit to provide user support for these programs. These programs may be freely used for educational and non-commercial research purposes.

Introduction

Bayesian econometrics, although theoretically and conceptually elegant, is often computer-intensive. In the book, I have described many methods of Bayesian computation (and sometimes even sketched out sample programs). However, the best way for the reader to learn Bayesian computation is to do it him/herself. To this end, this website contains all the programs that I used to do the empirical illustrations in the book. Since virtually every model discussed in the book is accompanied by an empirical illustration, this website contains computer code which allows the user to carry out Bayesian inference in a wide variety of models. In addition, the website contains all the data sets used in the book.

The reader should not assume that these programs can be used without understanding their structure. For instance, the reader should not expect to simply take a data set and do Bayesian analysis of the multinomial probit model using the program chapter9c.m without taking the time to go through the program to understand how the data are loaded in, how prior hyperparameters are set, how the number of replications is set, how the posterior simulator works, etc. In other words, these are examples of programs that the reader can use to gain a general understanding of Bayesian programming in the relevant model. Once such an understanding is gained, the reader can adapt or extend my programs or write his/her own when doing empirical work with a model.

The programs on this website are all MATLAB programs. MATLAB is a popular and powerful computer package commonly used in Bayesian econometrics. I assume the reader is familiar with the basics of MATLAB (although I provide a brief discussion at the end of this document of a few issues that may be relevant for the relative novice). MATLAB has a tutorial package for the complete novice. For the reader using a different software package (e.g. Gauss or Ox), the programs on this website cannot be used directly. However, most relevant computer languages are quite similar to one another, so I hope that even non-MATLAB users will be able to get something out of my programs. For instance, Gauss and MATLAB are very similar so that a line by line translation of my code into Gauss would be fairly easy --- and also instructional since it would force the reader to go through and understand the code.

The experienced MATLAB user may wish to proceed directly at this point to the programs and data sets. I believe they are fairly self-explanatory. I have tried to use informative names for the programs (e.g. chapter9a.m does the first empirical illustration in Chapter 9, chapter9b.m does the second empirical illustration in Chapter 9, etc.). In addition all of the programs begin with brief descriptions of what they do and are commented throughout with descriptions of what key commands do. The scripts (also called functions or subroutines) called by many programs (e.g. to do random number generation) also have informative names (e.g. tdis_rnd.pdf takes random draws from the t distribution) and are thoroughly commented. As noted in these comments, many of these are taken from Jim LeSage's Econometrics Toolbox (www.spatial-econometrics.com). I would like to thank Jim for letting me use these scripts on my website. His website includes much more material which the Bayesian reader might find interesting.

Brief Description of Files on the Website

Chapters 1 and 12 do not contain any empirical illustrations and, hence, there is no material on this website relating to them.

Chapter 2

ch2data.m Artificially simulates a data set, ch2data.out, for use with chapter2.m (so this program must be run before chapter2.m)

chapter2.m does the empirical illustration in Section 2.7 (univariate Normal linear regression model with natural conjugate prior)

ch2post.m is a script called by chapter2.m which performs most of the posterior calculations.

Chapter 3

HPRICE.TXT data set containing house price data.

chapter3.m does most of empirical illustration in Section 3.9 (Normal linear regression model with natural conjugate prior)

ch3post.m is a script called by chapter3.m which performs most of the posterior calculations.

chapter3a.m does empirical work of Section 3.9 which involves Monte Carlo integration (see Table 3.4, page 54 of book)

Chapter 4

The empirical illustrations in this chapter use the house price data (HPRICE.TXT)

chapter4a.m does the empirical illustration of Section 4.2.7 (Normal linear regression model with independent Normal-Gamma prior analyzed using Gibbs sampling).

chapter4b.m does the empirical illustration of Section 4.3.6 (Normal linear regression model subject to inequality constraints analyzed using importance sampling).

Chapter 5

ch5data.out is the data set used for the empirical illustrations.

ch5mode.m All programs require the posterior mode and Hessian. These are calculated in ch5mode.m (and output to files called postmode.out and postvar.out). This program must be run before the others.

ch5post.m is a script which is called by ch5mode.m

chapter5a.m does part of the empirical illustration of Section 5.9 (Bayesian analysis of the nonlinear regression model using independence chain Metropolis-Hastings algorithm)

ch5aw.m is a script which calculates the weight in the acceptance probability for chapter5a.m

chapter5b.m does part of the empirical illustration of Section 5.9 (using Random walk chain Metropolis-Hastings algorithm and evaluating posterior predictive p-values)

ch5bw.m is a script which calculates the weight in the acceptance probability for chapter5b.m

ch5ppred.m is a script called by chapter5b relating to posterior predictive p-value calculations.

chapter5c.m does part of the empirical illustration of Section 5.9 focusing on Gelfand-Dey method (using Random walk chain Metropolis-Hastings algorithm of chapter5b.m augmented to become Metropolis-within-Gibbs algorithm, see pages 110-112)

ch5cw.m is a script which calculates the weight in the acceptance probability for chapter5c.m

ch5mlike.m is a script which uses output from other programs to calculate the Bayes factor comparing the linear to nonlinear regression models using the method of Gelfand and Dey.

Chapter 6

The house price data (HPRICE.TXT) is used for the first two empirical illustrations in this chapter.

yankees.txt is the Yankees data set used by chapter6c.m and chapter6d.m.

redsox.txt is the Red Sox data set used by chapter6d.m

chapter6a.m does the empirical illustration of Section 6.3.2 (heteroskedasticity of a known form). This program uses Metropolis-within-Gibbs and requires specification of the variance of the candidate generating density. This can either be specified in the code, or produced by ch5mode.m.

ch6aw.m is a script which calculates the weight in the acceptance probability for chapter6a.m.

chapter6b.m does the empirical illustration of Section 6.4.3 (the regression model with Student-t errors).

chapter6c.m does the empirical illustration of Section 6.5.3 (the Normal regression model with autocorrelated data) using the Yankees data.

chapter6d.m does the empirical illustration of Section 6.6.4 (the Seemingly Unrelated regression model) using the Yankees and Red Sox data.

Chapter 7

ch7artdat.m makes artificial data sets from panel data models (including individual effects and random coefficients models)

ch7artdat1.m makes artificial data sets from the stochastic frontier model

chapter7a does part of the Empirical illustration in Section 7.6 (for the pooled model)

chapter7b does part of the Empirical illustration in Section 7.6 (for the individual effects model with non-hierarchical prior)

chapter7c does part of the Empirical illustration in Section 7.6 (for the individual effects model with hierarchical prior)

chapter7d does part of the Empirical illustration in Section 7.6 (for the random coefficients model)

Note: The preceding programs require the user to make an artificial data set (using ch7artdat.m) before running. They also require the user to specify points for evaluating

the marginal likelihood (this is required by the Chib method). The programs are constructed so that you can first run them without calculating the marginal likelihood (by setting imlike=0) in order to create files containing the required point.

chapter7e does the Empirical illustration in Section 7.7.5 (for the stochastic frontier model)

Chapter 8

ch8artdat.m makes the artificial data set for the empirical illustration in Section 8.2.4 (the local level model)

chapter8a.m does part of the empirical illustration in Section 8.2.4

chapter8b.m does part of the empirical illustration in Section 8.2.4

DLIPROD.DAT is the data set used for the empirical illustration in Section 8.3.2 (the industrial production data set).

chapter8c.m does part of the empirical illustration in Section 8.3.2 (the state space model)

djs.m is a script called by chapter8c.m which uses the DeJong-Shephard method for drawing the states.

Chapter 9

ch9artdata.m makes the artificial data set for the empirical illustration of Section 9.3.1 (tobit)

ch9artdatb.m makes the artificial data set for the empirical illustration of Section 9.4.1 (probit)

chapter9a.m does the empirical illustration in Section 9.3.1 (tobit)

chapter9b.m does the empirical illustration in Section 9.4.1 (probit)

chapter9c.m does part of the empirical illustration in Section 9.6.1 (multinomial probit without identification imposed)

chapter9d.m does part of the empirical illustration in Section 9.6.1 (multinomial probit with identification imposed)

cracker.doc contains explanatory material about the cracker data set

cracker.dat is the complete cracker data set

crack.dat is the part of the cracker data set used in the empirical illustration of Section 9.6.1

Chapter 10

ch10artdat.m makes the artificial data set for the empirical illustration on pages 242-243 (the partial linear model)

ch10artdatb.m makes the artificial data set for the empirical illustration on page 251 (the additive version of the partial linear model)

ch10artdatc.m makes the artificial data set for the empirical illustration of Section 10.3.6 (the mixture of Normals model)

chapter10a.m does the empirical illustration on pages 242-243 (the partial linear model)

chapter10b.m does the empirical illustration on page 251 (the additive version of the partial linear model)

chapter10c.m does the empirical illustration on pages 242-243 (the mixture of Normals model)

Chapter 11

growth.dat contains the data used in the empirical illustration of Section 11.2.6.

chapter11.m does the empirical illustration of Section 11.2.6 (Bayesian model averaging)

The website contains the following scripts which are used by many programs in many chapters. The ones with an asterisk are taken from Jim LeSage's Econometrics Toolbox (www.spatial-econometrics.com).

beta_cdf.m* evaluates the cumulative distribution function for the Beta distribution.
beta_inv.m* evaluates quantiles of the Beta distribution.
beta_pdf.m* evaluates the probability density function for the Beta distribution.
chis_cdf.m* evaluates the c.d.f. for the Chi-squared distribution.
chis_inv.m* evaluates quantiles of the Chi-squared distribution.
chis_rnd.m* generates random draws from the Chi-squared distribution.
dfp_min.m* minimizes a user-specified function using the DFP method.
dirich_rnd.m generates random draws from the Dirichlet distribution.
fdhess.m* computes the Hessian of a user-specified function.
fdis_cdf.m* evaluates the cumulative distribution function for the F distribution.
frpr_min.m* minimizes a user-specified function using the FRPR method.

gamm_cdf.m* evaluates the cumulative distribution function for the Gamma distribution.
gamm_inv.m* evaluates quantiles of the Gamma distribution.
gamm_pdf.m* evaluates the probability density function for the Gamma distribution.
gamm_rnd.m* generates random draws from the Gamma distribution.
gradnt.m* computes the gradient of a user-specified function.
hessian.m* computes the Hessian of a user-specified function.
hpdi.m computes a highest posterior density interval.
is_scalar.m* determines if an argument is a scalar.
linmin.m* minimizes a user-specified function using a line minimzation method.
logwish_pdf.m evaluates the log of the p.d.f. of the Wishart distribution.
momentg.m* computes various MCMC convergence diagnostics.
mprint.m* prints a matrix in formatted form.
multi_rnd.m* generates random draws from the Multinomial distribution.
multnden.m evaluates log of Normal p.d.f.
norden.m evaluates Normal p.d.f. at points on a grid.
normlt_rnd.m* generates random draws from the left-truncated Normal distribution.
normrt_rnd.m* generates random draws from the right-truncated Normal distribution.
normt_rnd.m* generates random draws from the truncated Normal distribution.
norm_cdf.m* evaluates the cumulative distribution function for the Normal distribution.
norm_pdf.m* evaluates the probability density function for the Normal distribution.
norm_rnd.m* generates random draws from the Normal distribution.
pow_min.m* minimizes a user-specified function using the Powell method.
stdn_cdf.m* evaluates the cumulative distribution function for the N(0,1) distribution.
stdn_pdf.m* evaluates the probability density function for the N(0,1) distribution.
tdens.m evaluates the probability density function for the Student-t distribution.
tdensity.m evaluates the p.d.f. of the Student-t distribution at points on a grid.
tdis_cdf.m* evaluates the cumulative distribution function for the t distribution.
tdis_inv.m* evaluates quantiles of the t distribution.
tdis_pdf.m* evaluates the probability density function for the t distribution.
tdis_rnd.m* generates random draws from the t distribution.
tnorm_rnd.m generates random draws from the truncated multivariate Normal.
truncnorm_rnd.m* generates random draws from the left-truncated Normal.
wish_rnd.m generates random draws from the Wishart distribution.

A Few Tips for the Novice MATLAB User

I recommend that the complete novice spend some time going through the tutorial materials that come with MATLAB to develop basic skills before working with the programs on this website.

This website contains numerous programs and scripts (sometimes called subroutines or functions). These are text files containing series of commands (or explanatory comments that are not run by the computer. Lines with explanatory comments begin with a "%"). Programs and subroutines all have "m" suffixes. My programs carry out Bayesian analysis of a particular model (e.g. the Normal linear

regression model). These programs often require tasks which are common to a lot of models. For instance, random number generation from the t distribution is required in many models. Accordingly, code for such things is contained in a separate script. As long as the script is in the same directory/folder as the program being run, the program will automatically find the script. A similar thing applies to data sets. Hence, an easy way of organizing the materials on this website is to download everything (i.e. all programs, scripts and data sets) you want to a particular directory (e.g. c:\bayes). Then, after you start MATLAB, change to the directory where everything is (e.g. type chdir c:\bayes).

As noted above (and in the programs), some of my programs require a preliminary program to be run first (e.g. to artificially simulate a data set or find the posterior mode and Hessian for use in a Metropolis-Hasting algorithm). If a program is not running, make sure you have run the preliminary program first.