SYLLABUS FOR AAEC6564
"BAYESIAN ECONOMETRIC ANALYSIS"
SPRING 2023

INSTRUCTOR: KLAUS MOELTNER

Contact Information:

office:	Hutcheson 303-B
phone:	(540)231-8249
e-mail:	moeltner@vt.edu

Course Information:

location:	Hutcheson 207
time:	TR 11:00am - 12:15pm
office hours:	TR, 1-2pm or by appointment

PREREQUSITES:
AAEC 5126 or STAT 5304 or STAT 5444 (or talk to me....)

Course Description and Objectives

This course is primarily designed for PhD students in Agricultural and Applied Economics (AAEC) and Economics (ECON) beyond their first year. It should also be suitable as an elective for graduate students in Statistics or related fields (e.g. Computer Science, Engineering) with an interest in applied Bayesian modeling.

The primary objective of the course is to familiarize students with fundamental techniques and methods of Bayesian analysis, such as Monte Carlo Integration, Gibbs Sampling, Metropolis-Hastings algorithm, data augmentation, Bayesian model search and model averaging, and Bayesian nonparametric methods. We will focus on econometric applications where the Bayesian approach brings clear advantages over classical methods, such as estimation under small samples, strong prior information, or model uncertainty. We will use the software package `Matlab` for this purpose. Students will program all algorithms "from scratch" to become familiar with all model components and details. Throughout the course, we will work with "real-world" empirical data sets from various fields of economics.

Textbooks

I will be primarily using my own lecture notes and sample `Matlab` code (posted on Canvas as we move along), but I recommend the following textbooks as useful reference and background sources:

(1) Chan et al. (2020): An applied Bayesian text that is light on theory and heavy on intuition, examples, and practice.
(2) Koop (2003). Similar to Chan et al. (2019), but with more details on methodologies and techniques.
(3) Gelman et al. (2004). A comprehensive, all-around reference for Bayesian methods. Nice appendix with explicit forms for many density functions.

For those of you interested in the statistical origins and fundamentals of Bayesian analysis, I recommend STAT 5444 "Bayesian Statistics", taught by our Statistics Department. Two introductory textbooks used in that course, with focus on statistical foundations of Bayesian methods, are:

(1) Hoff (2009): Very accessible, with detailed derivations.
(2) Berger (2006): Focus on decision theory and Bayes

Software

We will be using Matlab as our statistical programming package and LaTeX for word processing. The full Matlab package can be purchased by current VT students for $37 / year from the IT procurement and licensing solutions office at VT. As an alternative, you will have access to VT's Advanced Research Computing (ARC) cluster system, and use Matlab through their onDemand interface.

Access and installation instructions for both options are given in a separate module on Canvas.

1. Grading and Other Administrative Issues

Grading. There will be 6 problem sets that can be completed in team work. However, everybody needs to hand in an individual version. You can earn up to 20 points for each PS for a total of 120 points. The 6^{th} problem set has to be handed in during the assigned "final exam" time slot for this course on May 5, 2023, between 10:05 am and 12:05 pm.

Student conduct. The Virginia Tech honor system applies to all graded work in this course. For more information, visit http://www.honorsystem.vt.edu

Students with disabilities. Please let me know if you have a documented disability, so we can provide any accommodations you may need.

VT public health guidelines. https://ready.vt.edu/

References

Berger, J. (2006). *Statistical decision theory and Bayesian analysis*, 2nd edn, Springer.

Chan, J., Koop, G., Poirier, D. and Tobias, J. (2019). *Bayesian Econometric Methods*, 2nd edn, Cambridge University Press.

Chan, J., Koop, G., Poirier, D. and Tobias, J. (2020). *Bayesian Econometric Methods*, Cambridge University Press.

Gelman, A., Carlin, J., Stern, H. and Rubin, D. (2004). *Bayesian Data Analysis*, 2nd edn, Chapman & Hall/CRC.

Hoff, P. (2009). *A first course in Bayesian statistical methods*, Springer.

Koop, G. (2003). *Bayesian Econometrics*, Wiley.

Semester Schedule for AAEC6564, Spring 2023
(subject to adjustments)

Week	Dates	Topic	References*	PS's / Exams
		Module 1: Introduction to Bayesian Inference		
1	Jan. 17, 19	Bayesian model components	K. 1, CKPT. 1,2	
2	Jan. 24, 26	Comparison to classical methods / MLE	CKPT. 4	
		Module 2: Gibbs Sampling		
3	Jan. 31, Feb. 2	Convergence plots and diagnostics; Autocorrelation plots	K. 4, CKPT. 12	
4	Feb. 7, 9	Effect of: sample size, priors, starting values, blocking; Monte Carlo Integration		PS1 due Feb. 9
		Module 3: Coverage and Prediction in Bayesian Analysis		
5	Feb. 14, 16	Interval Estimation	CKPT. 5	
6	Feb. 21, 23	Posterior Predictive Densities	CKPT. 7	
		Module 4: Bayesian Model Comparison		
7	Feb. 28**	Bayes Factors; Savage-Dickey Density Ratio	K. 4,6; CKPT. 5,10	PS2 due Feb. 28
8	Mar. 14, 16	Gelfand-Dey method; Chib method	CKPT. 16	
		Module 5: Hierarchical Models, Data Augmentation		
9	Mar. 21, 23	Concepts and tools	K. 7, CKPT. 13	PS3 due Mar. 23
10	Mar. 28, 30	Specific models		
		Module 5: Metropolis-Hastings Methods		
11	Apr. 4, 6	MH with random walk chains	K. 5, CKPT. 12	
12	Apr. 11, 13	MH with tailored proposal densities		PS4 due Apr. 13
		Module 6: Bayesian Model Search and Model Averaging		
13	Apr. 18, 20	MC3 Method	K. 11, CKPT. 16	
14	Apr. 25, 27	SSVS method		PS5 due Apr. 27
		Module 7: Finite Mixture Models		
15	May 2	Multinomial and Dirichlet priors	CKPT. 15	
16	May 5			PS6 due May 5

*K=Koop, CKPT=Chan, Koop, Poirier,Tobias / **Instructor out of town on March 2