POLI:7002:0001 Bayesian Statistics
Wednesday 1:30-4:20 pm
103 Schaeffer Hall
Spring 2017

Course Information

Instructor: Elizabeth Menninga
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Course Description

This course covers the theoretical and applied foundations of Bayesian statistical analysis First, we will begin with discussing the Bayesian approach and how it differs from Frequentist analyses, learning how to estimate simple Bayesian models. Second, we will discuss model checking, assessment, and comparison, with an emphasis on computational approaches. Third, the course will cover Bayesian stochastic simulation (Markov chain Monte Carlo) in depth with an orientation towards deriving important properties of the Gibbs sampler and the Metropolis Hastings algorithms. Extensions and hybrids will be discussed. The fourth section will focus on applications of Bayesian statistics in social science data analysis. The topics could include Bayesian Hierarchical models for cross-sections and panel data, factor analysis models, IRT and other measurement models, and latent space models. Throughout the course, estimation with modern programming software (R and Jags) will be emphasized.

Class meetings will typically have two of the following three components: (1) lecture on the main technical points of the weekly reading (often statistical/mathematical), (2) computational demonstration using software such as packages in R, (3) discussion of theoretical and substantive applications. Initial readings are listed in the schedule below, although additional articles may be added. I will make any changes well in advance of the class meeting and notify you of changes or additions by email. When working with statistical software in class, I strongly encourage you to bring your laptops so you can write (and annotate) your own code.

Prerequisites

While there are no formal requirements, students should feel comfortable learning mathematical statistics. It is assumed that students have a background in linear and generalized linear models. Some knowledge of R is useful, but not mandatory. Tutorials and sample code will be shared for students with more limited R background.

Course Materials

In this course, we will use a variety of in-print and on-line resources. The following book is required:

- Gill, J. (2014). *Bayesian Methods: A Social and Behavioral Sciences Approach*, 3rd edition. Chapman & Hall/CRC.

Any other readings assigned will be available through the UIowa library or on the class ICON site.

Software

We will be using statistical software in this course as we learn how to implement/interpret different analyses. R is a free, open-source program. Instructions for downloading R and setting up R are available on the course website. We will also be using Jags (and the package R2Jags) to specify more complex models. This software is also free and a guide for installing it is on ICON.

In addition to the resources on ICON, the Political Science Department has a Collaboratory on the 3rd floor of Schaeffer Hall. The Collab is staffed with a Technology TA who can help you with data/computing/R challenges. Desmond's office hours are 8:00-noon Monday through Friday. I strongly encourage you to take advantage of this resource if you find R challenging or frustrating.

Course Requirements and Grading

Your grade for the course will be determined by performance in four areas: class participation, problem sets, an article critique, and a final paper/presentation. Homework and papers are due at the time specified. Any late assignments will have points deducted at the rate of 10% of the total available points per calendar day unless arrangements are made *prior* to the due date.

Course Grade Breakdown:

- Participation: 15%
- Problem Sets: 25%
- Article Critique: 10%
- Paper & Presentation: 50%

Participation:

Everyone is expected to keep up with the readings and actively participate in discussion. You cannot participate if you are not present. Therefore attendance is expected. Please contact me as soon as possible if you must be absent. Evaluation of your participation will be based on: evidence that you are well-prepared for class and have read assigned material; intelligent, respectful contributions to discussion, especially questions and comments that advance the conversation; asking relevant questions during lecture/software demonstrations; and actively engaging your colleagues during workshops and presentations by asking thoughtful (constructive) questions.

Problem Sets:

There will be a few assignments throughout the semester ($\sim$5). These problem sets will focus on executing topics discussed in class. Often they will require a computing component as well as discussion or interpretation. These assignments will typically be due two weeks after they are posted to ICON. You are welcome to work together on these assignments, but you are each expected to write up and turn in your own answers.

Answer keys will be posted when an assignment is returned. Once the answer key is posted, late homework will no longer be accepted.

Article Critique:

For the weeks denoted with an asterisk on the schedule, students can sign up to write a critique/response to the applied readings. Students will sign up on the first day of class for their topic, and the schedule will be posted to ICON. Students can critique the article(s) listed on the syllabus, or if they find different article(s) suitable for the topic they may critique those instead (with permission of the instructor). The critique should consider both the strengths and weaknesses of the article(s) in question. Be sure to address the role of Bayesian analysis in the articles(s). This role can be theoretical, substantive, or methodological (or often all three). Questions to ask as you read (and answer in your

critiques) include: Is the complexity of Bayes worth it? What does this framework add to the literature? Do we learn something we couldn't have learned otherwise? Are the authors transparent in their decisions (priors/convergence/etc) or are you left with questions?

The critiques should be 2-4 pages (longer is not necessarily better). On the week of your critique, be prepared to (briefly) share your thoughts with the class as your critique will serve as a kick start for class discussion.

Paper/Presentation:

Write a paper and make sure it includes Bayesian methods. The best papers will be ready to present at a conference or (ideally) publish. The paper should be no more than 25 pages (not including Appendices if you have convergence tests or other diagnostics you need to report). All papers are expected to be formatted professionally (please double-space). The focus of the paper can be substantive (using techniques we learned in class to address an unanswered question in your field), methodological (developing a new network technique), or anything in between.

On the last day of class you will give a conference-style presentation to the class (12-15 minutes), followed by 10-15 minutes for questions and comments. I will invite some faculty to attend these presentations. I expect these presentations to be of professional quality. You should think about the type of presentation you would like to give of your paper at APSA the year you are on the job market.

You are strongly encouraged to help each other with the papers and presentations, talk over ideas, and edit for each other. You are expected to turn in a paper that represents solo-authored original research unless given explicit permission otherwise.

Mid-Semester Paper Deadlines:

Paper Topic & Initial Bibliography: Bring a proposal for your paper to class on February 15. Describe the research question, the contribution you're making to the literature, and how Bayesian analysis will enhance the project (this should be no longer than 2 pages). Attach an initial bibliography of at least 10 sources with 1 or 2 sentence summaries of how the source relates to your research question. Five of these sources should explicitly incorporate Bayes *if at all possible*. In addition to looking for sources within the specific substantive literature, also consider work in other literatures that use similar approaches to the one you intend to use. If you cannot find relevant Bayes sources, indicate where you looked/what literatures you looked at. This proposal will count for 5% of your final paper/presentation grade.

Data Selection & Research Design: Bring a brief description of the data you will use to explore your research question as well as the type of analyses you intend to run on the data to class on March 15. This description should be 2-3 pages (incorporate brief descriptions of how you will operationalize the main concepts, whether the data is already in useable form or will require restructuring, etc). If you have updated or modified your topic since the last deadline, you should briefly include a description of the new topic and contribution as well (in this case you can run longer than 3 pages). This assignment will be 5% of your final paper/presentation grade.

Paper Workshop: On April 19 in place of a typical class, we will hold a paper workshop. Details on the workshop design will be announced as the date nears; for now know that a draft of your paper will be due on April 12. You will provide/receive written comments to/from a few of your colleagues. The draft itself will not be graded, take advantage of this opportunity to incorporate good feedback. The quality of the comments you provide your peers, however, will count for 5% of your final participation grade. Failure to submit a draft will result in your inability to participate in the workshop (and, therefore, a grade of 0 for your comments). The more complete and polished the draft the more useful your colleagues comments will be. I strongly encourage you to take this deadline seriously.

Important Dates

- Critiques: Varies by student. See schedule on ICON.
- Paper Topic & Initial Bibliography: Feb. 15, beginning of class
- Data Selection & Research Design: March 15, beginning of class
- Paper Draft: April 12, beginning of class
- Paper Due: Monday, May 8, 5pm

Grading Scale

The grading scale for the course is as follows. Note that grades of A+ are reserved for exceptional circumstances when a student demonstrates exceptional intellectual capacity and rigorous scholarship.

Letter Grade	Percentage
A+	99-100
A	93-98
A-	90-92
B+	87-89
B	83-86
B-	80-82
C+	77-79
C	73-76
C-	70-72
D+	67-69
D	63-66
D-	60-62
F	59 or below

Other Expectations

Technology: Please turn your mobile phones off or to silent mode before class. Laptops are permitted for class purposes only. If you are using your laptops for notes or readings, sign out of everything else so you can focus on mastering the material at hand. There are days in which we will be using statistical software in class. I will give you advanced warning (typically through e-mail) so you can bring your laptops on those days if you wish.

Email: Email is a useful way to ask quick questions. However, replying to complicated questions is highly inefficient for both you and me. If you want to talk about something you don't understand, come by my office hours. In general, while I respond to student emails, I prefer to talk in person. Come see me during office hours!

Ask Questions! Often if you have a question one of your classmates does too. Relevant questions are strongly encouraged.

Administrative Home
The College of Liberal Arts and Sciences is the administrative home of this course and governs matters such as the add/drop deadlines, the second-grade-only option, and other related issues. Different colleges may have different policies. Questions may be addressed to 120 Schaeffer Hall, or see the CLAS Academic Policies Handbook at `http://clas.uiowa.edu/students/handbook`.

Electronic Communication
University policy specifies that students are responsible for all official correspondences sent to their University of Iowa e-mail address (@uiowa.edu). Faculty and students should use this account for correspondences (Operations Manual, III.15.2, k.11).

Accommodations for Disabilities
The University of Iowa is committed to providing an educational experience that is accessible to all students. A student may request academic accommodations for a disability (which include but are not limited to mental health, attention, learning, vision, and physical or health-related conditions). A student seeking academic accommodations should first register with Student Disability Services and then meet with the course instructor privately in the instructor's office to make particular arrangements. Reasonable accommodations are established through an interactive process between the student, instructor, and SDS. See `http://sds.studentlife.uiowa.edu/` for more information.

Academic Honesty
All CLAS students or students taking classes offered by CLAS have, in essence, agreed to the College's Code of Academic Honesty: "I pledge to do my own academic work and to excel to the best of my abilities, upholding the IOWA Challenge. I promise not to lie about my academic work, to cheat, or to steal the words or ideas of others; nor will I help fellow students to violate the Code of Academic Honesty." Any student committing academic misconduct is reported to the College and placed on disciplinary probation or may be suspended or expelled (CLAS Academic Policies Handbook).

CLAS Final Examination Policies
The final examination schedule for each class is announced by the Registrar generally by the fifth week of classes. Final exams are offered only during the official final examination period. No exams of any kind are allowed during the last week of classes. All students should plan on being at the UI through the final examination period. Once the Registrar has announced the date, time, and location of each final exam, the complete schedule will be published on the Registrar's web site and will be shared with instructors and students. It is the student's responsibility to know the date, time, and place of a final exam.

Making a Suggestion or a Complaint
Students with a suggestion or complaint should first visit with the instructor (and the course supervisor), and then with the departmental DEO. (Wenfang Tang, 335-2358) Complaints must be made within six months of the incident (CLAS Academic Policies Handbook).

Understanding Sexual Harassment
Sexual harassment subverts the mission of the University and threatens the well-being of students, faculty, and staff. All members of the UI community have a responsibility to uphold this mission and to contribute to a safe environment that enhances learning. Incidents of sexual harassment should be reported immediately. See the UI Comprehensive Guide on Sexual Harassment for assistance, definitions, and the full University policy.

Reacting Safely to Severe Weather
In severe weather, class members should seek appropriate shelter immediately, leaving the classroom if necessary. The class will continue if possible when the event is over. For more information on Hawk Alert and the siren warning system, visit the Department of Public Safety website.

Course Outline[1]

Bayesian Statistics

Week 1: January 18. What is Bayes? Why Bayes?

Articles:

- Greenland et al. (2016). "Statistical tests, P values, confidence intervals, and power: a guide to misinterpretations" *European Journal of Epidemiology*
- Gross, J. (2015). "Testing What Matters (If You Must Test at All): A Context-Driven Approach to Substantive and Statistical Significance" *American Journal of Political Science*
- Nuzzo, R. (2014). "Scientific Method: Statistical Errors" *Nature*
- Wasserstein, R. & Lazar, N. (2016). "The ASA's Statement on p-Values: Context, Process, and Purpose" *The American Statistician*

Text:

- **Gill, Ch. 1**

Supplemental:

- Buckley, J. (2004) "Simple Bayesian Inference for Qualitative Political Research" *Political Analysis*
- Efron, B. (1986). "Why Isnt Everyone a Bayesian?" *American Statistician*, 40(1):1-5
- Gelman, A. (2008). "Objections to Bayesian Statistics" *Bayesian Analysis*
- Lindley. (2000). "The Philosophy of Statistics" *The Statistician*
- Senn, S. (2003). "Bayesian, Likelihood, and Frequentist Approaches to Statistics" *Applied Clinical Trials*, 12(8):35-38.
- Siegfried, T. (2010). "Odds are, its wrong: Science Fails to Face the Shortcomings of Statistics" *Science News*, 177(7):26-29.
- Western, B. and Jackman, S. (1994). "Bayesian Inference for Comparative Research". *American Political Science Review*, 88(2):412-423.

Week 2: January 25: The Bayesian Prior

Articles:

- Gill, J. and Walker, L. D. (2005). "Elicited Priors for Bayesian Model Specifications in Political Science Research" *Journal of Politics*, 67(3):841-872.
- Seaman, J. W. I., Seaman, J. W. J., and Stamey, J. D. (2012). "Hidden Dangers of Specifying Non-informative Priors" *The American Statistician*, 66(2):77-84.
- Kass, R. E. and Wasserman, L. (1996). "The Selection of Prior Distributions by Formal Rules" *Journal of the American Statistical Association*, 91(435):1343-1370.

Text:

- **Gill, Ch. 4**

[1] I reserve the right to make changes with respect to topics and pacing, but will try to stick to the schedule as much as possible. You will be notified of any changes through e-mail as well as an updated schedule posted to the course website.

Supplemental:

- Kerman, J. (2011). "Neutral noninformative and informative conjugate beta and gamma prior distributions" *Electronic Journal of Statistics*, 5:1450-1470.

Week 3: February 1: Single- and Multivariate Bayesian Models*

Articles:

- Duch, R. M., May, J., and Armstrong, D. A. (2010). "Coalition-directed Voting in Multiparty Democracies" *American Political Science Review*, 104(4):698-719.
- Horiuchi, Y. Imai, K., and Taniguchi, N. (2007). "Designing and Analyzing Randomized Experiments: Application to a Japanese Election Survey Experiment" *American Journal of Political Science*. 51(3):669-687.

Text:

- **Gill, Ch. 2 & 5**

Supplemental:

- Ghosh, S. K., Mukhopadhyay, P., and Lu, J.-C. (2006). "Bayesian analysis of zero-inflated regression models" *Journal of Statistical Planning and Inference*, 136(4):1360-1375.
- Imai, K. and van Dyk, D. A. (2005). "A Bayesian analysis of the multinomial probit model using marginal data augmentation" *Journal of Econometrics*, 124(2):311-334.
- Martin, A. D. (2003). "Bayesian Inference for Heterogeneous Event Counts" *Sociological Methods & Research*, 32(1):30-63.
- Neelon, B. H., OMalley, A. J., and Normand, S.-L. T. (2010). "A Bayesian model for repeated measures zero-inflated count data with application to outpatient psychiatric service use." *Statistical Modelling*, 10(4):421-439.

Week 4: February 8: Posterior Prediction & Assessing Model Quality (aka Diagnostics)

Text:

- **Gill, Ch. 6**

Supplemental:

- Berger et al. (2000). "Bayesian Robustness" in *Robust Bayesian Analysis*
- Greco, Racugno, & Ventura. (2008). "Robust likelihood functions in Bayesian inference" *Journal of Statistical Planning and Inference*
- Lavine. (1991). "Sensitivity in Bayesian Statistics: The Prior and the Likelihood" *Journal of the American Statistical Association*
- Lopes & Tobias. (2011). "Confronting Prior Convictions: On Issues of Prior Sensitivity and Likelihood Robustness in Bayesian Analysis" *Annu. Rev. Econ.*
- Moreno. (2000). "Global Bayesian Robustness for Some Classes of Prior Distributions" in *Robust Bayesian Analysis*
- Shyamalkumar. (2000). "Likelihood Robustness" in *Robust Bayesian Analysis*

- Sivaganesan. (2000). "Global and Local Robustness Approaches: Uses and Limitations" in *Robust Bayesian Analysis*

Week 5: February 15: Model Comparison & Bayesian Hypothesis Testing*

Assignment Due: Paper Topic & Initial Bibliography

Articles:

- Bartels, L. M. (1997). "Specification Uncertainty and Model Averaging". *American Journal of Political Science*, 41(2):641-674.
- Montgomery, J. M. and Nyhan, B. (2010). "Bayesian Model Averaging: Theoretical Developments and Practical Applications". *Political Analysis*, 18(2):245-270.
- Pick one of these two examples:
  - Pepinsky, T. B. (2014). "The Politics of Capital Flight in the Global Economic Crisis". *Economics & Politics*, 26(3):431-456.
  - Warren, T. C. (2014). "Not by the Sword Alone: Soft Power, Mass Media, and the Production of State Sovereignty". *International Organization*, 68(1):111-141.

Text:

- **Gill, Ch. 7**

Supplemental:

- Carlin, B. P. and Chib, S. (1995). "Bayesian Model Choice via Markov Chain Monte Carlo Methods." *Journal of the Royal Statistical Society, Series B* 57, 473-484.
- Etz, A. and Vandekerchkhove, J. (2016). "A Bayesian Perspective on the Reproducibility Project: Psychology" *Plos One*
- Geisser & Eddy. (1979). "A Predictive Approach to Model Selection" *Journal of American Statistical Association*
- Gelman et al. (2014) "Understanding predictive information criteria for Bayesian models" *Statistical Computing*
- Gelman, A. and Rubin, D. B. (1995). "Avoiding Model Selection in Bayesian Social Research". *Sociological Methodology*, 25:165-173.
- Myung and Pitt. (1997). "Applying Occam's Razor in Cognitive Modeling: A Bayesian Approach" *Psychonomic Bulletin & Review*
- Quinn, K. M., Martin, A. D., and Whitford, A. B. (1999). "Voter Choice in Multi-Party Democracies: A Test of Competing Theories and Models". *American Journal of Political Science*, 43(4):1231-1247 (uses Bayes Factors to discriminate between models)
- Raftery, A. E. (1995). "Bayesian Model Selection in Social Research". *Sociological Methodology*, 25:111-163
- Spiegelhalter et al. (2002). "Bayesian measures of model complexity and fit" *J. R. Statist. Soc. B*
- Vanpaemel. (2010). "Prior Sensitivity in Theory Testing: An Apologia for the Bayes Factor" *Journal of Mathematical Psychology*
- Vehtari & Lampinen. (2002). "Bayesian Model Assessment and Comparison Using Cross-Validation Predictive Densities" *Neural Computation*

- Verhagen and Wagenmakers. (2014). "Bayesian Tests to Quantify the Result of a Replication Attempt" *Journal of Experimental Psychology: General*
- Wagenmakers et al. (2010). "Bayesian Hypothesis Testing for Psychologists: A Tutorial on the Savage-Dickey Ratio" *Cognitive Psychology*

Note: February 22: Class Canceled–ISA Conference

Week 6: March 1: Monte Carlo Methods (Understanding MCMC Part I)

Articles:

- Jackman, S. (2000). "Estimation and Inference via Bayesian Simulation: An Introduction to Markov Chain Monte Carlo." *American Journal of Political Science* 44, 375-404.

Text:

- **Gill, Ch. 9**

Supplemental:

- Carsey, T.M. and J.J. Harden: *Monte Carlo Simulation and Resampling Methods for Social Science*. Thousand Oaks, CA: Sage.
- Go, C. & Batzoglou, S. (2008). "What is the expectation maximization algorith?" *Nature Biotechnology*
- Metropolis, N. and Ulam, S. (1949). "The Monte Carlo Method." *Journal of the American Statistical Association* 44, 335-3.
- Peskun, P. H. (1973). "Optimum Monte Carlo Sampling Using Markov Chains." *Biometrika* 60, 607-612.
- Tierney, L. (1994). "Markov Chains for Exploring Posterior Distributions." *Annals of Statistics* 22, 1701-1728.
- Von Hilgers, P. & Langville, A. (N. date). "The Five Greatest Applications of Markov Chains"

Week 7: March 8: Markov Chains (Understanding MCMC Part II)

Text:

- **Gill, Ch. 10**

Supplemental:

- Casella, G. and George, E. I. (1992). "Explaining the Gibbs Sampler." *The American Statistician* 46, 167-174.
- Gelfand, A. E. and Smith, A. F. M. (1990). "Sampling-Based Approaches to Calculating Marginal Densities." *Journal of the American Statistical Association* 85: 389-409.
- Geman, S. and Geman, D. (1984). "Stochastic Relaxation, Gibbs Distributions and the Bayesian Restoration of Images." *IEEE Transactions on Pattern Analysis and Machine Intelligence* 6,721- 741.
- Geyer, C. J. (1992). "Practical Markov Chain Monte Carlo." *Statistical Science* 7, 473-511.
- Hastings, W. K. (1970). "Monte Carlo Sampling Methods Using Markov Chains and Their Applications." *Biometrika* 57, 97-109.
- McKeague & Wefelmeyer. (2000)."Markov chain Monte Carlo and Rao-Blackwellization" *Journal of Statistical Planning and Inference*

Note: March 15: Spring Break

Week 8: March 22: Markov Chain Monte Carlo Convergence Diagnostics (Understanding MCMC Part III)

Assignment Due: Data Selection & Research Design

Articles:

- Cowles, M. K., Roberts, G. O., and Rosenthal, J. S. (1999). "Possible Biases Induced by MCMC Convergence Diagnostics." *Journal of Statistical Computation and Simulation* 64, 87-104.

Text:

- **Gill, Ch. 13 & 14**

Supplemental:

- Gallistel. (2009). "The Importance of Proving the Null" *Psychological Review*
- Gelman, A., Rubin, D. B. (1992). "Inference from Iterative Simulation Using Multiple Sequences." *Statistical Science* 7, 457- 511.
- Zellner, A. and Min, C-K. (1995). "Gibbs Sampler Convergence Criteria." *Journal of the American Statistical Association* 90, 921-927.
- Plummer, M., Best, N., Cowles, K., and Vines, K. (2006). "CODA: Convergence Diagnosis and Output Analysis for MCMC". *R News*, 6(1):7-11.

Week 9: March 29: Hierarchical Models*

Articles:

- Beazer, Q. H. and Woo, B. (2016). "IMF Conditionality, Government Partisanship, and the Progress of Economic Reforms". *American Journal of Political Science*, 60(2):304-321.
- Danneman, N. and Ritter, E. H. (2014). "Contagious Rebellion and Preemptive Repression". *Journal of Conflict Resolution*, 58(2):254-279.
- Stegmueller, D. (2013). "How Many Countries for Multilevel Modeling? A Comparison of Frequentist and Bayesian Approaches" *American Journal of Political Science*. 57(3): 748-761.

Text:

- **Gill, Ch. 12**

Supplemental:

- Bell, A. and Jones, K. (2015). "Explaining Fixed Effects: Random Effects Modeling of Time-Series Cross Sectional and Panel Data". *Political Science Research and Methods*, 3(1):133-153.
- Grimmer, J. (2013). "Appropriators not Position Takers: The Distorting Effects of Electoral Incentives on Congressional Representation" *American Journal of Political Science*, 57(3): 624-642.
- Shor, B., Bafumi, J., Keele, L., and Park, D. (2007). "A Bayesian Multilevel Modeling Approach to Time Series Cross-Sectional Data". *Political Analysis*, 15(2):165-181.
- Steenbergen, M. R. and Jones, B. S. (2002). "Modeling Multilevel Data Structures". *American Journal of Political Science*, 46(1):218-237 (for a refresher on multilevel models).
- Stegmueller, D. (2013b). "Modeling Dynamic Preferences: A Bayesian Robust Dynamic Latent Ordered Probit Model". *Political Analysis*, 21(3):314-333.

- Stegmueller, D., et al. (2012). "Support for Redistribution in Western Europe: Assessing the Role of Religion. European" *Sociological Review*, 28(4):482-497.
- Ward, M. D., Siverson, R. M., and Cao, X. (2007). "Disputes, Democracies, and Dependencies: A Reexamination of the Kantian Peace". *American Journal of Political Science*, 51(3):583-601.

Week 10: April 5: Item Response Theory & Other Measurement Models*

Articles:

- Treier, S. and Jackman, S. (2008). "Democracy as a Latent Variable". *American Journal of Political Science*, 52(1):201-217.
- Martin and Quinn. "Dynamic Ideal Point Estimation via Markov Chain Monte Carlo for the U.S. Supreme Court, 1953-1999" *Political Analysis*. 2002:10(2).
- Selin, J. L. (2015). "What Makes an Agency Independent?" *American Journal of Political Science*.

Supplemental:

- Bakker, R. (2009). "Re-measuring Left-Right: A Comparison of SEM and Bayesian Measurement Models for Extracting Left-Right Party Placements". *Electoral Studies*, 28(3):413-421.
- Bakker, R. and Poole, K. T. (2013). "Bayesian Metric Multidimensional Scaling". *Political Analysis*, 21(1):125-140.
- Caughey, D. and Warshaw, C. (2015). "Dynamic Estimation of Latent Opinion Using a Hierarchical Group-Level IRT Model". *Political Analysis*, 23(2):197-211.
- Clinton, J. D. and Jackman, S. (2009). "To Simulate or NOMINATE?" *Legislative Studies Quarterly*, 34(4):593-621.
- Fariss, C. J. (2014). "Respect for Human Rights has Improved Over Time: Modeling the Changing Standard of Accountability". *American Political Science Review*, 108(2):297-318.
- Fox, J.-P. and Glas, C. (2001). "Bayesian Estimation of a Multilevel IRT Model Using Gibbs Sampling". *Psychometrika*, 66(2):271-288.
- Gray, J. and Slapin, J. B. (2012). "How Effective are Preferential Trade Agreements? Ask the Experts". *Review of International Organizations*, 7(3):309-333. (Uses Bayesian Factor Analysis)
- Hollyer, J. R., Rosendorff, B. P., and Vreeland, J. R. (2014). "Measuring Transparency". *Political Analysis*, 22(4):413-434 (Uses Bayesian IRT)
- Imai, Lo, and Olmsted. (2016). "Fast Estimation of Ideal Points with Massive Data" *American Political Science Review*. 110(4). (Uses EM algorithm to estimate ideal points)
- Linzer, D. A. and Staton, J. K. (2015). "A Global Measure of Judicial Independence, 1948-2012". *Journal of Law and Courts*, 3(2):223-256.
- Rosas, G., Shomer, Y., and Haptonstahl, S. R. (2015). "No News Is News: Nonignorable Nonresponse in Roll-Call Data Analysis". *American Journal of Political Science*, 59(2):511-528. (IRT Models & non-response bias)
- Slapin, J. B. and Proksch, S.-O. (2008). "A Scaling Model for Estimating Time-Series Party Positions from Texts". *American Journal of Political Science*, 52(3):705-722.

Week 11: April 12: Bayesian Change Point Analysis*

Assignment Due: Paper Draft uploaded to ICON

Articles:

- Park. (2010). "Structural Change in U.S. Presidents' Use of Force" *American Journal of Political Science*
- Park. (2011). "Changepoint Analysis of Binary and Ordinal Probit Models: An Application to Bank Rate Policy Under the Interwar Gold Standard" *Political Analysis*
- Western & Kleykamp. (2004). "A Bayesian Change Point Model for Historical Time Series Analysis" *Political Analysis*

Text:

- **Gill, Brief Example p. 346**

Supplemental:

- Barry & Hartigan. (1993). "A Bayesian Analysis for Change Point Problems" *Journal of the American Statistical Association*
- Carlin, Gelfand, & Smith. (1992). "Hierarchical Bayesian Analysis of Changepoint Problems" *Applied Statistics*
- Chib. (1998). "Estimation and comparison of multiple change-point models" *Journal of Econometrics*

Week 12: April 19. Paper Workshop

Week 13: April 26. (Dynamic) Latent Space Models

Articles:

- Hoff & Ward. (2004). "Modeling Dependencies in International Relations Networks" *Political Analysis*
- Sewell & Chen. (2016). "Latent Space Approaches to Community Detection in Dynamic Networks" *Bayesian Analysis*

Supplemental:

- Hoff, Raftery, & Handcock. (2002). "Latent Space Approaches to Social Network Analysis" *Journal of the American Statistical Association*
- Sewell & Chen. (2015). "Latent Space Models for Dynamic Networks" *Journal of the American Statistical Association*
- Sewell & Chen. (2016). "Latent space models for dynamic networks with weighted edges" *Social Networks*
- Ward, Ahlquist, & Rozenas. (2013). "Gravity's Rainbow: A dynamic latent space model for the world trade network" *Network Science*

Week 14: May 3. Presentations