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**POLI:7002:0001 Bayesian Statistics**  
*Spring 2021*  
Course Outline<sup>1</sup>

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**The Basics of Bayesian Statistics**

**Week 1: January 26 & 28. What is Bayes? Why Bayes?**

**Activities:** Introductions & Welcome to the Course!

**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 Isn’t 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.

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<sup>1</sup>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 manjor changes.

## **Week 2: February 2 & 4: The Bayesian Prior**

**Activities:** Optional Intro to R Workshop during office hours

### **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**

### **Supplemental:**

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

## **Week 3: February 9 & 11: Single- and Multivariate Bayesian Models**

### **Articles:**

- Blais, A., Guntermann, E., and Bodet, M.A. (2017). “Linking Party Preferences and the Composition of Government: A New Standard for Evaluating the Performance of Electoral Democracy.” *Political Science Research and Methods*, 5(2):315331.
- Lee, M. and Murdie, A. (2020). “The Global Diffusion of the #MeToo Movement.” *Politics & Gender*
- Karreth, J. (2018). “The Economic Leverage of International Organizations in Interstate Disputes.” *International Interactions*, 44(3):463490.

### **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 16 & 18: Sensitivity Analysis & Posterior Prediction**

##### **Articles:**

- King, G., Tomz, M., and Wittenberg, J. (2000). “Making the Most of Statistical Analyses: Improving Interpretation and Presentation.” *American Journal of Political Science*, 44(2):347361.

##### **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 23 & 25: Model Comparison & Selection**

**Assignment Due:** Paper Topic & Initial Bibliography (on Thursday); be prepared to share a brief overview of your project with the class

##### **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:**

- Montgomery, J.M., Hollenbach, F.M., and Ward, M.D. 2012. “Improving Predictions Using Ensemble Bayesian Model Averaging.” *Political Analysis*, 20(3):271-291 (if you are interested prediction & forecasting).
- 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 Vandekerckhove, 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.
- 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
- 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*

## Understanding MCMC

### **Week 6: March 2 & 4: Introduction to Simulation-Based Inference**

**Activities: No class on Tuesday March 2**

**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 algorithm?” *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 9 & 11: Introduction to Simulation-Based Inference (Cont.)**

**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*

### **Week 8: March 16 & 18: Convergence Diagnostics**

#### **Articles:**

- Cowles, M.K. and Carlin, B.P. (1996). “Markov Chain Monte Carlo Convergence Diagnostics: A Comparative Review.” *Journal of the American Statistical Association*, 91(434):883904.
- 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 23 & 25: Hierarchical Models**

**Assignment Due:** Data Selection & Research Design on Thursday

#### **Articles:**

- Steenbergen, M.R. and Jones, B.S. 2002. “Modeling Multilevel Data Structures.” *American Journal of Political Science* 46(1):218237 (for a refresher on multilevel models).
- 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.
- Stegmüller, D. (2013). “How Many Countries for Multilevel Modeling? A Comparison of Frequentist and Bayesian Approaches” *American Journal of Political Science*. 57(3): 748-761.

- Helgason, A.F. and Merola, V. 2017. “Employment Insecurity, Incumbent Partisanship, and Voting Behavior in Comparative Perspective.” *Comparative Political Studies* 50(11):1489-1523

**Text:**

- **Gill, Ch. 12**

**Supplemental:**

- Plumper, T. and Troeger, V.E. (2019). “Not so Harmless After All: The Fixed-Effects Model.” *Political Analysis* 27(1):2145 (if you work with TSCS data).
- 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.
- 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.
- 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: March 30 & April 1: 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).
- Williams, R. et al. (2019). “A latent variable approach to measuring and explaining peace agreement strength.” *Political Science Research and Methods*.
- Campbell, S. P., Findley, M. G., and Kikuta, K. (2017). “An Ontology of Peace: Landscapes of Conflict and Cooperation with Application to Colombia.” *International Studies Review* 19(1):92-113

**Supplemental:**

- Kenwick, M. R. (2020). “Self-Reinforcing Civilian Control: A Measurement-Based Analysis of Civil-Military Relations.” *International Studies Quarterly* 64(1):71-84.
- Selin, J. L. (2015). “What Makes an Agency Independent?” *American Journal of Political Science*.

- 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.
- Caughey, D. and Warshaw, C. (2015). “Dynamic Estimation of Latent Opinion Using a Hierarchical Group-Level IRT Model”. *Political Analysis*, 23(2):197-211.
- 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. *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 6 & 8: Missing Data**

### **Articles:**

- King, G. et al. (2001) “Analyzing Incomplete Political Science Data: An Alternative Algorithm for Multiple Imputation.” *American Political Science Review* 95(1): 4969
- Stegmueller, D. (2014) “Religion and Redistributive Voting in Western Europe” *The Journal of Politics* 75(4):1064-1076
- Shih, V. et al. (2012) “Getting Ahead in the Communist Party: Explaining the Advancement of Central Committee Members in China” *American Political Science Review* 106(1)
- Honaker, J. and King, G. (2010) “What to Do about Missing Values in Time-Series Cross-Section Data” *American Journal of Political Science* 54(2)



## **Week 12: April 13 & 15: Bayesian Change Point Analysis**

**Assignment Due:** Paper Draft due on Thursday

### **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 13: April 20 & 22: Paper Workshop**

## **Week 14: April 27 & 29: Bayesian Causal Inference**

### **Articles:**

- 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.
- More TBD

## **Week 15: May 4 & 6: (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*