

## GV903-7-FY Advanced Research Methods 2021 – 2022

### Lecturer and Module Supervisor

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### Module Administrator

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Module available for Study Abroad students:    **Yes**                      No    ☒

**ASSESSMENT:** This module is assessed by 100% coursework

### INSTANT DEADLINE CHECKER

**Must be submitted by 09:45am on the day of the lecture**

Assignment Title	Release Date	Due Date	Coursework Weighting	Feedback Due
Assignment 1	Week 5	Week 7	25%	Week 10
Assignment 2	Week 10	Week 12	25%	Week 17
Assignment 3	Week 18	Week 20	25%	Week 23
Assignment 4	Week 24	Week 26	25%	Week 30

### TOP READS

Wooldridge, Jeffrey. 2016. *Introductory Econometrics: A Modern Approach*.

Long, J. Scott 1997. *Regression models for categorical and limited dependent variables*.

Ward, Michael D. and John S. Ahlquist. 2018. *Maximum Likelihood for Social Science*.

### MODULE DESCRIPTION

This module presents quantitative methods essential to test hypotheses. The first part of the course focuses on hypothesis testing, hypothesis testing using least squares, and some classic violations of the Gauss-Markov conditions. We will cover cross-sectional and longitudinal models for continuous dependent variables. This first part will also cover the basics of programming, data management, and data visualisation in the statistical computing environment R as well as the preparation of

documents with statistical contents using LaTeX and knitr, but the main focus of the module is on statistical theory.

The second part of the module focuses on more advanced models ubiquitous in political science based on maximum likelihood estimation and other estimation techniques, starting with the generalised linear model and its various outcome distributions (models for binary, ordered, categorical, count, and event history data) and ending with advanced topics like inferential network analysis and topics in causal inference. This second part will again focus mainly on statistical theory but also cover many political science applications and their implementation using R.

The models and methods are approached substantively, mathematically, and computationally. Throughout the module, students will also familiarise themselves with the interpretation and presentation of empirical evidence in political science. The module will be particularly useful for students who aim to pursue careers in academia or in research-intensive environments, for example think tanks, research-related government posts, data science, or survey analytics.

### **Module Aims:**

The module will enable students to...

- understand and apply the logic of hypothesis testing in a variety of political science contexts.
- understand and interpret statistical analyses in published political science research.
- master the mathematics behind ordinary least squares, maximum likelihood estimation, generalised linear models, and related regression models and estimation techniques.
- translate theories into empirical models.
- conduct their own basic and advanced regression analyses using empirical datasets, both manually and with software, commensurate with analyses published in leading political science journals.
- assess the goodness of fit of empirical models.
- understand which statistical model to employ in a given situation and to what extent the assumptions of each candidate model are met.
- effectively present quantitative results using R, LaTeX, and knitr.

### **Learning Outcomes:**

After completing this module, students will...

- formulate theories in ways that are amenable to multiple hypothesis testing and be able to choose an appropriate statistical model commensurate with their theory.
- understand, and be able to improve upon, statistical analyses and their interpretations in leading political science journals.
- have practical experience with conducting high-quality quantitative political science research as well as with the implementation of basic and advanced

regression models, both using ready-made functions/packages in R and manually/from scratch.

- master the mathematics and statistical theory underlying hypothesis testing, ordinary least squares, maximum likelihood estimation, generalised linear models, time series analysis, panel and multilevel models, event-history analysis, and similar techniques.
- know how to handle complex data structures and implement appropriate models, including temporal, spatial, and hierarchical dependence.
- understand the assumptions underlying a variety of statistical models and be able to diagnose violations of these assumptions.
- be able to present statistical results effectively.

### Key Skills:

Mathematics, including algebra, linear algebra, and calculus. Statistics, including probability. Econometrics.

## ASSESSMENT

This module is assessed by 100% coursework, which consists of problem sets.

Assessment	Weight
Four (4) Assignments	25% each
Total	100%

Problem Sets: The assignments consist of mathematical problem sets. Each problem set assigns a relative weight to each task and these weights add up to 100%. Since the tasks are mathematical, it is possible to obtain 0% in the assignment as well as 100%. Note that the assessment does not award fractions of percentages; in other words, if a question is worth 20%, the only per cent awarded for that question is either 20% or 0%.

The grades reflect the relative weights of the tasks and therefore the minimum grade is 0 and the maximum grade is 100.

PLEASE NOTE THAT THIS IS A QUANTITATIVE MODULE DESIGNED FOR GOVERNMENT STUDENTS AND, ALTHOUGH IT IS POSSIBLE TO OBTAIN A GRADE OF 100, THE COURSEWORK IS IN FACT VERY CHALLENGING.

## MODULE STRUCTURE AND TEACHING

This module will be delivered with (i) a weekly pre-recorded lecture and (ii) a weekly seminar. The pre-recorded lecture will consist of one or more items of prepared content that students can access electronically and must study before the seminar. The seminar will be held face-to-face (and online if necessary) and will consist of one 50-minute session per week in which exercises and students' questions will be discussed. Students are expected to carefully read the literature on the reading list

before consuming the pre-recorded lecture contents. Practical exercises will be provided on a weekly basis to prepare for the four assignments, sometimes as part of the pre-recorded lecture and sometimes separately or both. Students are expected to complete these exercises before the weekly seminar. A module forum will be available on Moodle; all students are expected to participate in the discussions on the forum by asking and answering questions.

<b>Week</b>	<b>Autumn Term</b>
Week 2	Introduction to Advanced Research Methods
Week 3	Fundamentals of Mathematics and Probability; Random Variables, Distributions, and Expectations
Week 4	Fundamentals of Mathematical Statistics and Matrix Algebra
Week 5	The Linear Regression Model – Estimation and Inference
Week 6	The Linear Regression Model – Specification, Interpretation, and Prediction
Week 7	The Linear Regression Model – Heteroskedasticity
Week 8	Time Series Analysis
Week 9	Panel and Multilevel Data
Week 10	Instrumental Variables and Systems of Equations
Week 11	Maximum Likelihood Estimation
<b>Week</b>	<b>Spring Term</b>
Week 16	Binary Dependent Variables
Week 17	The Generalized Linear Model; Bootstrapping and Permutations
Week 18	Ordinal Dependent Variables
Week 19	Nominal Dependent Variables
Week 20	Limited Dependent Variables
Week 21	Counts and Proportions
Week 22	Duration Models
Week 23	Network Models
Week 24	Causal Inference and Matching

Week 25	Missing Data and Imputation
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## COURSEWORK SUBMISSION

### How to submit your essay using FASER

You will be able to access the online submission system via your myEssex portal or via <https://FASER.essex.ac.uk>. FASER allows you to store your work-in-progress. This facility provides you with an ideal place to keep partially completed copies of your work and ensures that no work, even drafts, is lost. If you have problems uploading your coursework, you should contact [ltt@essex.ac.uk](mailto:ltt@essex.ac.uk). You may find it helpful to look at the FASER guide <http://www.essex.ac.uk/it/elearning/faser/default.aspx>. If you have any questions about FASER, please contact your administrator or refer to the handbook.

**Under NO circumstances is your coursework to be emailed to the administrators or the lecturer. This will NOT be counted as a submission.**

### Extenuating circumstances for late submission of coursework

The university has guidelines on what is acceptable as extenuating circumstances for later submission of coursework. If you need to make a claim, you should upload your coursework to FASER and submit a late submission of coursework form which can be found here: <http://www.essex.ac.uk/students/exams-and-coursework/late-submission.aspx>. This must be done within seven days of the deadline. FASER closes for all deadlines after seven days. The Late Submissions committee will decide whether your work should be marked and you will be notified of the outcome.

If you experience significant longer-term extenuating circumstances that prevent you from submitting your work either by the deadline or within seven days of the deadline, you should submit an Extenuating Circumstances Form for the Board of Examiners to consider at the end of the year <http://www.essex.ac.uk/students/exams-and-coursework/ext-circ.aspx>.

### Extensions

PGT students may apply for an extension if they have a deadline approaching that they know they will not be able to meet. ONLY the Graduate Director has authority to grant extensions. Extensions are only approved IN ADVANCE of the deadline. Students must apply to the Graduate Director, via the Graduate Administrator, using the Extension form available on Moodle or from the Graduate Administrator. You MUST provide a reason for the request and EVIDENCE that supports your application.

### Plagiarism

Plagiarism is a very serious academic offence and whether done wittingly or unwittingly it is your responsibility. **Ignorance is no excuse!** The result of plagiarism could mean receiving a mark of zero for the piece of coursework. In some cases, the rules of assessment are such that a mark of zero for a single piece of coursework could mean that you will fail your degree. If it is a very serious case, you could be required to withdraw from the University. It is important that you understand

right from the start of your studies what good academic practice is and adhere to it throughout your studies.

The Department will randomly select coursework for plagiarism checks and lecturers are very good at spotting work that is not your own. **Plagiarism gets you nowhere; DON'T DO IT!**

Following the guidance on referencing correctly will help you avoid plagiarism.

Please familiarise yourself with the University's policy on academic offences:  
<http://www.essex.ac.uk/about/governance/policies/academic-offences.aspx>.

## READING

### Basic Readings

Wooldridge, Jeffrey M. 2016. *Introductory Econometrics: A Modern Approach*. Sixth Edition. Boston: Cengage Learning.

Greene, William. 2012. *Econometric Analysis*. Seventh Edition. International Edition. Harlow: Pearson/Prentice Hall.

Long, J. Scott. 1997. *Regression Models for Categorical and Limited Dependent Variables*. Thousand Oaks, CA: Sage.

Ward, Michael D. and John S. Ahlquist. 2018. *Maximum Likelihood for Social Science*. Cambridge University Press.

King, Gary. 1998. *Unifying Political Methodology: The Likelihood Theory of Statistical Inference*. Cambridge University Press.

The Wooldridge textbook is the core reading for the first semester. Greene is (mostly) optional and can be consulted for a more in-depth understanding if required. In the second semester, the textbooks by Long, Ward/Ahlquist, and King are the main resources. In both semesters, there are additional resources on the weekly course plan. In each session, essential and optional readings are denoted as such. The optional readings are strongly recommended, but the focus should be on the essential readings.

## Autumn Term 2021

### WEEK 2

#### Introduction to Advanced Research Methods

Bueno de Mesquita, Bruce. 2014. *Principles of International Politics*. 5th Edition. Los Angeles: Sage/CQ Press. [Please read Chapter 1, "Evaluating Arguments about International Politics"]

Torfs, Paul and Claudia Brauer. 2014. A (Very) Short Introduction to R. <https://cran.r-project.org/doc/contrib/Torfs+Brauer-Short-R-Intro.pdf>

Cottrell, Allin. 1995. A Short Introduction to LaTeX. [http://ricardo.ecn.wfu.edu/~cottrell/ecn297/latex\\_tut.pdf](http://ricardo.ecn.wfu.edu/~cottrell/ecn297/latex_tut.pdf)

Thunder, David. 2004. Back to Basics: Twelve Rules for Writing a Publishable Article. *PS: Political Science & Politics* 37(3): 493-495.

Gandrud, Christopher. 2020. *Reproducible Research with R and RStudio*. 3<sup>rd</sup> Edition. Boca Raton: Chapman and Hall/CRC Press. [Please use as background reading when needed throughout the year.]

Monogan III, James E. 2015. *Political Analysis Using R*. Cham: Springer. [Please use as background reading when needed throughout the year.]

Leifeld, Philip. 2013. texreg: Conversion of Statistical Model Output in R to LaTeX and HTML Tables. *Journal of Statistical Software* 55(8): 1-24. [Optional. Please read when needed throughout the year.]

### WEEK 3

#### Fundamentals of Mathematics and Probability; Random Variables, Distributions, and Expectations

Wooldridge 2016. [Please read the following two chapters: Appendix A, "Basic Mathematical Tools"; Appendix B, "Fundamentals of Probability"]

Wackerly, Dennis, William Mendenhall and Richard L. Scheaffer. 2014. *Mathematical Statistics with Applications*. Cengage Learning. [Please read the following two chapters: Chapter 3, "Discrete Random Variables and Their Probability Distributions"; Chapter 4, "Continuous Variables and Their Probability Distributions".]

Greene 2012. [Optional. You can read the following chapter for a better in-depth understanding: Appendix B, "Probability and Distribution Theory".]

Moore, Will H. and David A. Siegel. 2013. *A Mathematics Course for Political and Social Research*. Princeton University Press. [Optional. You can use this book to read up on mathematical foundations if you struggle with the other readings.]

Gill, Jeff. 2006. *Essential Mathematics for Political and Social Research*. Cambridge: Cambridge University Press. [Optional. You can use this book to read up on mathematical foundations if you struggle with the other readings.]

## **WEEK 4**

### **Fundamentals of Mathematical Statistics and Matrix Algebra**

Wooldridge 2016. [Please read the following two chapters: Appendix C, "Fundamentals of Mathematical Statistics"; Appendix D, "Summary of Matrix Algebra".]

Greene 2012. [Optional. Read the following two chapters if you require a more in-depth understanding: Appendix C, "Estimation and Inference"; Appendix A, "Matrix Algebra".]

Moore, Will H. and David A. Siegel. 2013. *A Mathematics Course for Political and Social Research*. Princeton University Press. [Optional. You can use this book to read up on mathematical foundations if you struggle with the other readings.]

Gill, Jeff. 2006. *Essential Mathematics for Political and Social Research*. Cambridge: Cambridge University Press. [Optional. You can use this book to read up on mathematical foundations if you struggle with the other readings.]

## **WEEK 5**

### **The Linear Regression Model – Estimation and Inference**

Wooldridge 2016. [Please read the following chapters: Chapter 2.1, "Definition of the Simple Regression Model"; Chapter 2.2, "Deriving the Ordinary Least Squares Estimates"; Chapter 3, "Multiple Regression Analysis: Estimation". Chapter 4, "Multiple Regression Analysis: Inference"]

Long 1997. [Please read Chapter 2: "Continuous Outcomes: The Linear Regression Model".]

Greene 2012. [Optional. For a more in-depth understanding, read the following chapters: Chapter 2, "The Linear Regression Model"; Chapter 3, "Least Squares"; Chapter 4, "The Least Squares Estimator".]

## **WEEK 6**

### **The Linear Regression Model –Specification, Interpretation, and Prediction**

Long 1997. [Please read Chapter 2: "Continuous Outcomes: The Linear Regression Model".]



Wooldridge 2016. [Please read the following chapters: Chapter 5, "Multiple Regression Analysis: OLS Asymptotics"; Chapter 6, "Multiple Regression Analysis: Further Issues"; Chapter 7, "Multiple Regression Analysis with Qualitative Information: Binary (or Dummy) Variables".]

Brambor, Thomas, William Roberts Clark, and Matt Golder. 2006. Understanding Interaction Models: Improving Empirical Analyses. *Political Analysis* 14(1): 63-82.

King, Gary, Michael Tomz, and Jason Wittenberg. 2000. Making the Most of Statistical Analyses: Improving Interpretation and Presentation. *American Journal of Political Science* 44 (2): 341-355.

King, Gary. 1986. How Not to Lie With Statistics: Avoiding Common Mistakes in Quantitative Political Science. *American Journal of Political Science* 30 (3): 666-687. [Optional.]

Greene 2012. [Optional. You can read the following chapters for a more in-depth understanding: Chapter 5, "Hypothesis Tests and Model Selection"; Chapter 6, "Functional Form and Structural Change".]

## **WEEK 7**

### **The Linear Regression Model – Heteroskedasticity**

Wooldridge 2016. [Please read the following chapters: Chapter 8, "Heteroskedasticity"; Chapter 9, "More on Specification and Data Issues".]

Greene 2012. Please read Chapter 9, "The Generalized Regression Model and Heteroscedasticity".]

## **WEEK 8**

### **Time Series Analysis**

Wooldridge 2016. [Please read the following chapters: Chapter 10, "Basic Regression Analysis with Time Series Data"; Chapter 11, "Further Issues in Using OLS with Time Series Data"; Chapter 12, "Serial Correlation and Heteroskedasticity in Time Series Regressions". Optionally, read Chapter 18, "Advanced Time Series Topics", for a more in-depth understanding.]

De Boef, Suzanna and Luke Keele. 2008. Taking Time Seriously. *American Journal of Political Science* 52(1): 184-200.

Enders, Walter. 2008. *Applied Econometric Time Series*. Hoboken, NJ: John Wiley & Sons. [Optional. For students who want to gain a more in-depth understanding of time-series analysis.]

Greene 2012. [Optional. For a more in-depth understanding, you can read the following chapters: Chapter 20, "Serial Correlation"; Chapter 21, "Nonstationary Data".]

## **WEEK 9**

### **Panel and Multilevel Data**

Wooldridge 2016. [Please read the following chapters: Chapter 13, "Pooling Cross Sections across Time: Simple Panel Data Methods"; Chapter 14, "Advanced Panel Data Methods".]

Bell, Andrew and Kelvyn Jones. 2015. Explaining Fixed Effects: Random Effects Modeling of Time-Series Cross-Sectional and Panel Data. *Political Science Research and Methods* 3(1): 133-153.

Schmidt-Catran, Alexander W. and Malcolm Fairbrother. 2016. The Random Effects in Multilevel Models: Getting Them Wrong and Getting Them Right. *European Sociological Review* 32(1): 23-38.

Beck, Nathaniel. 2008. *Time-Series Cross-Sectional Methods*. The Oxford Handbook of Political Methodology. Edited by Janet M. Box-Steffensmeier, Henry E. Brady and David Collier. 475-493. [Optional.]

Beck, Nathaniel and Jonathan N. Katz. 1995. What to do (and not to do) with Time-Series Cross-Section Data. *American Political Science Review* 89(3): 634-647. [Optional.]

Beck, Nathaniel and Jonathan N. Katz. 1996. Nuisance vs. Substance: Specifying and Estimating Time-Series-Cross-Section Models. *Political Analysis* 6: 1-36. [Optional.]

Greene 2012. [Optional. For a more in-depth understanding, you can read Chapter 11, "Models for Panel Data".]

## **WEEK 10**

### **Instrumental Variables and Systems of Equations**

Wooldridge 2016. [Please read the following chapters: Chapter 9, "More on Specification and Data Issues"; Chapter 15, "Instrumental Variables Estimation and Two Stage Least Squares"; Chapter 16, "Simultaneous Equations Models".]

Miguel, Edward, Shanker Satyanath and Ernest Sergenti. 2004. Economic Shocks and Civil Conflict: An Instrumental Variables Approach. *Journal of Political Economy* 112(4): 725-753.

Reuveny, Rafael and Quan Li. 2003. The Joint Democracy–Dyadic Conflict Nexus: A Simultaneous Equations Model. *International Studies Quarterly* 47(3): 325-346.

Gawande, Kishore and Hui Li. 2009. Dealing with Weak Instruments: An Application to the Protection for Sale Model. *Political Analysis* 17(3): 236-260. [Optional.]

Jackson, John E. 2002. A Seemingly Unrelated Regression Model for Analyzing Multiparty Elections. *Political Analysis* 10(1): 49-65. [Optional.]

Greene 2012. [Optional. For a more in-depth understanding, you can read the following chapters: Chapter 8, "Endogeneity and Instrumental Variable Estimation"; Chapter 10, "Systems of Equations".]

## **WEEK 11**

### **Maximum Likelihood Estimation**

Myung, Jae. 2003. Tutorial on Maximum Likelihood Estimation. *Journal of Mathematical Psychology* 47(1): 90-100.

Ward and Ahlquist 2018. [Please read the following chapters: Chapter 1, "Introduction to Maximum Likelihood"; Chapter 2, "Theory and Properties of Maximum Likelihood Estimators".]

Elff, Martin. 2015. *Estimation Techniques: Ordinary Least Squares and Maximum Likelihood*. In: The SAGE Handbook of Regression Analysis and Causal Inference. Edited by Henning Best and Christof Wolf. Chapter 2. London: Sage.

King 1998. [Please read Chapter 4, "The Likelihood Model of Inference".]

Greene 2012. [Optionally, for more in-depth preparation, you can read Chapter 14, "Maximum Likelihood Estimation".]

## **Spring Term 2022**

## **WEEK 16**

### **Binary Dependent Variables**

Long 1997. [Please read the following chapters: Chapter 3, "Binary Outcomes: The Linear Probability, Probit, and Logit Models"; Chapter 4, "Hypothesis Testing and Goodness of Fit".]

Ward and Ahlquist 2018. [Please read Chapter 3, "Maximum Likelihood for Binary Outcomes".]

King 1998. [Optionally, you can read Chapter 5, "Discrete Regression Models".]

Greene 2012. [Optional. For more in-depth information, you can read Chapter 17,

"Discrete Choice".]

## **WEEK 17**

### **The Generalized Linear Model; Bootstrapping and Permutations**

Ward and Ahlquist 2018. [Please read the following chapters: Chapter 4, "Implementing MLE"; Chapter 5, "Model Evaluation and Selection"; Chapter 6, "Inference and Interpretation"; Chapter 7, "The Generalized Linear Model".]

Fox, John. 2015. *Applied Regression Analysis and Generalized Linear Models. Third Edition*. London: Sage. [Please read Chapter 15, "Generalized Linear Models".]

## **WEEK 18**

### **Ordinal Dependent Variables**

Long 1997. [Please read Chapter 5, "Ordinal Outcomes: Ordered Logit and Ordered Probit Analysis".]

Ward and Ahlquist 2018. [Please read Chapter 8, "Ordered Categorical Variable Models".]

Greene 2012. [Optional. For an in-depth understanding, you can read the following chapters: Chapter 17, "Discrete Choice"; Chapter 18, "Discrete Choices and Event Counts".]

## **WEEK 19**

### **Nominal Dependent Variables**

Long 1997. [Please read Chapter 6, "Nominal Outcomes: Multinomial Logit and Related Models".]

Ward and Ahlquist 2018. [Please read Chapter 9, "Models for Nominal Data".]

Alvarez, R. Michael and Jonathan Nagler. 1998. When Politics and Models Collide: Estimating Models of Multiparty Elections. *American Journal of Political Science* 42(1): 56-96.

Greene 2012. [Optional. For an in-depth understanding, you can read Chapter 18, "Discrete Choices and Event Counts".]

## **WEEK 20**

### **Limited Dependent Variables**

Wooldridge 2016. [Please read Chapter 17, "Limited Dependent Variable Models and Sample Selection Corrections".]

Long 1997. [Please read Chapter 7: "Limited Outcomes: The Tobit Model".]

Sigelman, Lee and Langche Zeng. 1999. Analyzing Censored and Sample-Selected Data with Tobit and Heckit Models. *Political Analysis* 8(2): 167-182.

Greene 2012. [Optional. For a more in-depth understanding, you can read Chapter 19, "Limited Dependent Variables - Truncation, Censoring, and Sample Selection".]

## **WEEK 21**

### **Counts and Proportions**

Long 1997. [Please read Chapter 8, "Count Outcomes: Regression Models for Counts".]

Ward and Ahlquist 2018. [Please read Chapter 10, "Strategies for Analyzing Count Data".]

Philip, Paolino. 2001. Maximum Likelihood Estimation of Models with Beta-Distributed Dependent Variables. *Political Analysis* 9(4): 325-346.

Greene 2012. [Optional. For more in-depth understanding, you can consult Chapter 18, "Discrete Choices and Event Counts".]

## **WEEK 22**

### **Duration Models**

Ward and Ahlquist 2018. [Please read Chapter 11, "Strategies for Temporal Dependence".]

Box-Steffensmeier, Janet M. and Bradford S. Jones. 1997. Time is of the Essence: Event History Models in Political Science. *American Journal of Political Science* 41: 1414-1461.

Jones, Bradford S. and Regina P. Branton. 2005. Beyond Logit and Probit: Cox Duration Models of Single, Repeating, and Competing Events for State Policy Adoption. *State Politics & Policy Quarterly* 5(4): 420-443.

Box-Steffensmeier, Janet M. and Christopher J. W. Zorn. 2001. Duration Models and Proportional Hazards in Political Science. *American Journal of Political Science* 45(4): 951-67. [Optional.]

Box-Steffensmeier, Janet M. and Christopher Zorn. Duration Models for Repeated Events. *Journal of Politics* 64(4): 1069-1094. [Optional.]

## **WEEK 23**

### **Network Models**

Cranmer, Skyler J., Philip Leifeld, Scott D. McClurg and Meredith Rolfe (2017): Navigating the Range of Statistical Tools for Inferential Network Analysis. *American Journal of Political Science* 61(1): 237-251.

Cranmer, Skyler J. and Bruce A. Desmarais. 2011. Inferential Network Analysis with Exponential Random Graph Models. *Political Analysis* 19: 66-86.

Leifeld, Philip, Skyler J. Cranmer and Bruce A. Desmarais (2018): Temporal Exponential Random Graph Models with btergm: Estimation and Bootstrap Confidence Intervals. *Journal of Statistical Software* 83(6): 1-36.

Malang, Thomas, Laurence Brandenberger and Philip Leifeld (2019): Networks and Social Influence in European Legislative Politics. *British Journal of Political Science* 49(4): 1475-1498.

Leifeld, Philip and Skyler J. Cranmer (2019): A Theoretical and Empirical Comparison of the Temporal Exponential Random Graph Model and the Stochastic Actor-Oriented Model. *Network Science* 7(1): 20-51. [Optional.]

## **WEEK 24**

### **Causal Inference and Matching**

Ho, Daniel E., Kosuke Imai, Gary King and Elizabeth A. Stuart. 2007. Matching as Nonparametric Preprocessing for Reducing Model Dependence in Parametric Causal Inference. *Political Analysis* 15(3): 199-236.

Boyd, Christina L., Lee Epstein and Andrew D. Martin. 2010. Untangling the Causal Effects of Sex on Judging. *American Journal of Political Science* 54(2): 389-411.

Bechtel, Michael M. and Jens Hainmueller. 2011. How Lasting Is Voter Gratitude? An Analysis of the Short- and Long-Term Electoral Returns to Beneficial Policy. *American Journal of Political Science* 55(4): 852- 868.

Sekhon, Jasjeet S. 2009. Opiates for the Matches: Matching Methods for Causal Inference. *Annual Review of Political Science* 12: 487-508. [Optional.]

## **WEEK 25**

### **Missing Data and Imputation**

Ward and Ahlquist 2018. [Please read Chapter 12, "Strategies for Missing Data".]

Azur, Melissa J., Elizabeth A. Stuart, Constantine Frangakis and Philip J. Leaf. 2011. Multiple Imputation by Chained Equations: What is it and How Does it Work? *International Journal of Methods in Psychiatric Research* 20(1): 40-49.

King, Gary, James Honaker, Anne Joseph and Kenneth Scheve. 2001. Analyzing

Incomplete Political Science Data: An Alternative Algorithm for Multiple Imputation. *American Political Science Review* 95(1): 49-69.

Honaker, James and Gary King. 2010. What to Do about Missing Values in Time Series Cross Section Data. *American Journal of Political Science* 54(2): 561-581.

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