POSC 3410-001: Quantitative Methods in Political Science

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Course Description

Both students and scholars alike are in political science as a result of their keen interest in politics. However, there is an increasing gap between how political science is applied by scholars and how it is understood by students. This class will aim to bridge that gap by introducing students to the *science* of political science. We will start with the basics, discussing concepts and variables before advancing toward regression. The course will conclude with very basic introductions to some advanced topics like non-normal responses, Bayesian inference, and post-estimation simulation. The overall goal of this class is to prepare students for upper division courses where peer-reviewed journal articles with multiple regressions and/or formal models are prominent.

Course Objectives

1. Understand concepts and how we operationalize abstract concepts for the sake of testing.
2. Delineate variables among various types, like nominal, ordinal and interval.
3. Put together a formal research design to address questions of interest in the study of politics.
4. Express why the logic of control is vital to any good research design.
5. Understand important elements of data, like central tendency and spread.
6. Become familiar with advanced topics like non-normal responses, Bayesian thinking, and post-estimation simulation.
7. Learn the `R` programming language, which should be a major addition to a résumé for students who want a career in data analysis or are thinking about graduate school in political science.

Course Policies

This section of the syllabus details multiple policies that will be implemented in this class through the semester, some of which may have been required for the university for accreditation purposes or compliance with various federal, state, and university policies. Be advised that continued enrollment in this class constitutes acceptance of the terms outlined in this document.

Recommended Books

Kellstedt, Paul M., and Guy D. Whitten. 2013. *The Fundamentals of Political Science Research*. 2nd ed. New York, NY: Cambridge University Press.

Pollock, Philip H. 2016. *The Essentials of Political Analysis*. 5th ed. Washington DC: CQ Press.

I assign these books because I believe they are useful. You should look into them if you'd like! Yet, quantitative methods is a unique subset of political science pedagogy where you could truly teach yourself if you had a working internet connection. Unlike other topics/fields in the discipline, political scientists who teach students about research design and methodology are apt to share their notes, lectures slides, and discuss stuff on Twitter. Coding-related inquiries are even more abundant on a place like Stack Overflow. You could truly "just Google" your way through the semester if you were diligent. In light of the extraordinary situation of teaching students during a viral pandemic, I intend to help you by giving ample clarification of what we will be discussing in a week if you wanted to take to Google or Stack Overflow to teach yourself these topics around my instruction. My feelings would not be hurt.

Contact Policy

Clemson University requires us to include our office phone numbers. Most of us do not have office phones. The phone number for the Department of Political Science is 864-656-3233. If, for some reason, a student needs to call me and leave a message, the department's phone number is the best means to do that (short of releasing my personal cellphone number, which I will not do).

Clemson University offers two different email services. In my case, I can be reached by email at svmille@clemson.edu and svmille@g.clemson.edu. I have a *strong* preference for the former and not the latter. I am quicker to respond when reached directly at svmille@clemson.edu because the university's Gmail service has more restrictive SMTP protocols. Students can also contact me through Canvas though Canvas log-in procedures are a hassle, especially when working remotely. Any of these three methods—an email to svmille@clemson.edu, an email to svmille@g.clemson.edu, or Canvas—are adequate to send a message to me but a simple email to svmille@clemson.edu will make it easier for me to respond to you.[1]

Prerequisites

This class does not appear to have any formal prerequisites.

Required Materials

Successful completion of the course requires ownership or reliable access to a computer and some kind of word processing program for writing the paper.

[1] Do not be surprised when I use Canvas for classwide emails. Basically, I prefer Canvas for sending classwide email but still prefer a direct email to svmille@clemson.edu for one-on-one correspondence.

Required Technical Skills

This class assumes some level of access to a computer, and ideally ownership of a personal computer. Students who either do not own a personal computer—or perhaps may have theirs stolen or made inoperational during the semester—should let me know about this. The student should also contact ithelp@clemson.edu or visit CCIT's website with inquiries about university computers that may have access to the R programming language.

The class has a minimal Canvas component as well. Students who do not feel comfortable with Canvas should contact ithelp@clemson.edu or visit CCIT's website.

I assign problem sets that require a rudimentary knowledge of the R programming language. Students should download this free software programming language at cran.r-project.org and install it on their personal computer. Binaries are available for Windows and Mac (even Linux, if that is the weapon of choice for the student).

- The R scripts I provide are designed to work on the student's computer with minimal maintenance. I will make this clear in each particular script.
- I *strongly* encourage students to contact me to learn about the language. I will assume that not discussing R with me means the student is fluent with the software.
- Consider getting a graphical user interface (GUI) front-end for R to learn it better. I recommend RStudio, available for free at www.rstudio.com. Do note there is a paid option of Rstudio that you *do* ***not*** *want.* The paid version is for servers. You want the basic open source integrated development environment (IDE). *This is* ***free***. Do not pay for anything related to R or Rstudio since you do not need whatever product is available for purchase.
- Your homework must be typed in either a Word processor or, preferably, LaTeX.

I published a beginner's guide to using R in 2014 when I first started to teach this version of the course that forced students to use the R programming language. I have since streamlined the R requirements for this class, making that guide somewhat dated. You will need to install the following packages, which I illustrate here with the R commands to install them.

```
install.packages("devtools") # for potential loading off remote packages
install.packages("tidyverse") # for most things workflow
# ^ This is a huge installation. It should take a while.
install.packages("stevedata") # for toy data sets to use in-class
install.packages("stevemisc") # for some helper functions
```

Do note you will need to install these packages just once, but you will need to "load" the package with the `library()` command in every R session you start. I will make this clear in each lab script.

This class also includes readings every week that can be obtained from the university's library service. I assume students know how to do this. Students who do not know how to use the library's service to retrieve electronic copies of journal articles should contact ithelp@clemson.edu or visit CCIT's website for assistance. I also include the following guide below for using Google Scholar for this purpose.

- Set Up Google Scholar to Find Class Readings on Your Syllabus

Major Assessment/Grading Activities

- **15%** of your grade will be determined by your attendance and participation in class. See the "grading policies" section of the syllabus for more information.
- **20%** of your grade will be determined by a midterm on **Thursday, Feb. 24** during normal class hours. This would at least be what I would do if there was no ongoing pandemic. In all likelihood, this will amount to an online exam that is due through *Turnitin* before what would be the end of the normal class session on this day. I will communicate this in greater detail as the time approaches.
- **25%** of your grade will be determined by five problem sets (i.e. homework) due periodically through the semester. Check the course schedule and class calendar later in the syllabus. The paper prospectus will be graded as an additional problem set as well. These are all due at the start of the class session on their respective due dates. Submissions will almost assuredly be online through *Turnitin*, though I will also accept in-class submissions as well.
- **15%** of your grade will be determined by a research design paper that applies quantitative methodology to a social science question of interest. I provide more information about this paper in a supplemental document on the course website. This research design is due **before Saturday, April 23, 10:00 a.m.** It must be submitted via *Turnitin* on the course's Canvas module.[2]
- **25%** of your grade will be determined by a final exam. This will be on **Thursday, May 5, 8:00-10:30 a.m.** However, the pandemic means this will almost assuredly be an online exam that is due through *Turnitin* at this time. I will communicate this in greater detail as the time approaches.

Grading Scale

The grading scale for this class is fairly boilerplate and students should be able to infer it on their own. Here it is for clarity.

Table 1: The Grading Scale for This Class

Letter	Percentage
A	90-100+
B	80-89
C	70-79
D	60-69
F	0-59

Grading Policies

The following section of the syllabus will outline the various grading policies associated with the course. I'll summarize a few here. First, students can expect that the turnaround on exams and the paper should be about 10 days, or thereabouts. Enrollment in these classes is capped at 50 and a 10-day turnaround would allow

[2] A paper submitted at ten hours, zero minutes, and zero seconds is *late* by this interpretation.

me to average about five exams/papers a day. This is a reasonable workload for me and allows me to offer comprehensive feedback where appropriate. Second, do not expect me to round up grades. I round down, not up, and will not bend an 89.5 (a B) to a 90 (an A). Further, be advised that I have a reputation of being a harsh grader, especially on exams. I prioritize precision in language in order to fully communicate to me that you understood the question/prompt I gave you. I will start deducting points on things like exam answers and written papers when students are vague or noncommittal in their answers or text. Finally, be advised that graded material are weighted, and that the final grade for the semester reflects these weighted material, even if this may not be evident on Canvas.

Absences, Attendance, and Participation Policy

Pre-pandemic attendance policies for my class would otherwise greatly emphasize the importance of attending class and attending lectures. To be fair, these are still important. Every semester from Fall 2014 to Fall 2019, I would collect attendance records from all my classes and regress the student's final grade on the percentage of classes they attended. Generally, the relationship here is quite strong. All else equal, each missed class coincided with an estimated decrease of about 5 percentage points in a student's final grade, adjusting for the given attendance/participation policy of the class. It is still in your interest to attend class as I think sitting down and dedicating your time and energy to the lecture will improve your educational experience. Please make it a point to do this to the best of your abilities.

However, this is very much a new educational reality the pandemic has brought. Every class session, I will disseminate a roll sheet and ask you to initial your name next to it. This is for record-keeping, and to meet various university reporting requirements.[3] There is no formal attendance policy here, other than "please try to attend." There is no formal participation policy either, other than "please try to participate." In practice, the percentage of the grade associated with attendance and participation is now just a cushion to account for my peculiarities as a grader. Please make this class experience a positive one for you, and please feel empowered to attend, ask, and engage it allows an escape from an otherwise grisly, shared reality.

Late Work and Make-up Policy

The formal policy here is, all else equal, there are **NO** make-ups for missed exams or work that does not meet a set deadline given in the syllabus. This otherwise rigid policy will collide with the reality of higher education during a viral pandemic. With this in mind, it is imperative on the student to be proactive in monitoring their health and any illnesses they may contract. The university is trying to help us (instructors) with a tool that tells us which of you (students) are unable to attend class in person. An email from Provost Bob Jones on 5 January 2022 said this tool should be ready by the second week of classes. Until then, students should continue to notify us (instructors) of absences they can anticipate. Ultimately, the nature of the pandemic and the policies the university is adapting around it make it important that the student be proactive here. Communicate with the university and, where appropriate, instructors about your health status. If you feel you might have COVID-19, please get tested and do not expose me or your classmates.

As a matter of making up lost work or exams, please communicate with the university about documenting absences, illnesses, and isolation/quarantine (I/Q) periods. I will try to accommodate with an appropriate

[3] Any professor at Clemson who gives a failing grade to a student must report the date of last recorded attendance with the failing grade. It is also not uncommon for the university to ask professors for wellness checks on various students. Therein, the university asks us to provide the date of last attendance prior to contacting us.

grace period for making up an assignment. I do ask for a measure of promptness from the student. Assuming a student misses the midterm due to an I/Q period, I would ideally like the student to commit to making up the assignment within seven days of when they feel able.

Absences for university-sponsored events may also be accommodated given prior notice and proper documentation. Please be diligent in communicating these matters to me.

University Policies

The following information pertains to university policies that instructors are compelled to make explicit in the syllabus. Some of these policies, prominently about accessibility and Title IX, are federally mandated. These policies have the desired effect of informing the student about various university policies that may not otherwise be apparent while protecting *both* the student and instructor from potential grievances. Large parts of this section may be copy-pasted from templates provided by the Office of Teaching Effectiveness and Innovation (OETI) in order to ensure maximum compliance with various federal, state, and university policies. Again, continued enrollment in this class constitutes awareness and acceptance of the terms outlined in this document.

Academic Integrity Policy

As members of the Clemson University community, we have inherited Thomas Green Clemson's vision of this institution as a "high seminary of learning." Fundamental to this vision is a mutual commitment to truthfulness, honor, and responsibility, without which we cannot earn the trust and respect of others. Furthermore, we recognize that academic dishonesty detracts from the value of a Clemson degree. Therefore, we shall not tolerate lying, cheating, or stealing in any form.

All infractions of academic dishonesty by undergraduates must be reported to Undergraduate Studies for resolution through that office. In cases of plagiarism instructors may use the Plagiarism Resolution Form.

See the Undergraduate Academic Integrity Policy website for additional information and the current catalog for the policy.

For graduate students, see the current graduate student handbook for all policies.

Academic Grievances Policy

Undergraduate students are advised to contact the Ombuds' Office prior to filing an academic grievance. If the undergraduate academic ombudsman agrees that a grievable issue has occurred, students can contact Undergraduate Studies (656-3022) for assistance filing official paperwork within 30 days of the semester following the awarding of a disputed grade.

Graduate students follow the Graduate Student Handbook (per the catalog, "grievances must be filed with the Graduate School within 60 days of the alleged act.")

Notification of Absence

The Notification of Absence module in Canvas allows students to quickly notify instructors (via an email) of an absence from class and provides for the following categories: court attendance, death of immediate family member, illness, illness of family member, injury, military duty, religious observance, scheduled surgery, university function, unscheduled hospitalization, other anticipated absence, or other unanticipated absence. The notification form requires a brief explanation, dates and times. Based on the dates and times indicated, instructors are automatically selected, but students may decide which instructors will receive the notification. This does not serve as an "excuse" from class. It is a request for an excused absence and students are encouraged to discuss the absence with instructors, as the instructor is the only person who can excuse an absence. If students are unable to report the absence by computer, they may reach the Office of Advocacy and Success via 864-656-0935. Students with excessive absences who need academic or medical assistance can also contact the Office of Advocacy and Success.

Inclement Weather or Emergency

Regularly scheduled exams and assignments may need to be adjusted based on unforeseen circumstances. The Faculty Senate Scholastic Policies Committee suggests the following policy, which you may copy into your syllabus: Any exam that was scheduled at the time of a class cancellation due to inclement weather will be given at the next class meeting unless contacted by the instructor. Any assignments due at the time of a class cancellation due to inclement weather will be due at the next class meeting unless contacted by the instructor. Any extension or postponement of assignments or exams must be granted by the instructor via email or Canvas within 24 hours of the weather-related cancellation.

Accessibility Policy

Clemson University values the diversity of our student body as a strength and a critical component of our dynamic community. Students with disabilities or temporary injuries/conditions may require accommodations due to barriers in the structure of facilities, course design, technology used for curricular purposes, or other campus resources. Students who experience a barrier to full access to this class should let the instructor know and make an appointment to meet with a staff member in Student Accessibility Services as soon as possible. You can make an appointment by calling 864-656-6848, by emailing studentaccess@lists.clemson.edu, or by visiting Suite 239 in the Academic Success Center building. Appointments are strongly encouraged – drop-ins will be seen if at all possible, but there could be a significant wait due to scheduled appointments. Students who have accommodations are strongly encouraged to request, obtain and send these to their instructors through their AIM portal as early in the semester as possible so that accommodations can be made in a timely manner. It is the student's responsibility to follow this process *each* semester and the student, not the instructor, must take the lead on initiating this process.

You can access further information at the Student Accessibility website. Other information is at the university's Accessibility Portal.

Title IX Policy

Clemson University is committed to a policy of equal opportunity for all persons and does not discriminate on the basis of race, color, religion, sex, sexual orientation, gender, pregnancy, national origin, age, disability,

veteran's status, genetic information or protected activity in employment, educational programs and activities, admissions and financial aid. This includes a prohibition against sexual harassment and sexual violence as mandated by Title IX of the Education Amendments of 1972. This Title IX policy is located on the Campus Life website. Ms. Alesia Smith is the Clemson University Title IX Coordinator, and the Executive Director of Equity Compliance. Her office is located at 223 Brackett Hall, 864.656.0620. Remember, email is not a fully secured method of communication and should not be used to discuss Title IX issues.

Emergency Preparedness and Procedures

Emergency procedures have been posted in all buildings and on all elevators. Students should be reminded to review these procedures for their own safety. All students and employees should be familiar with guidelines from the Clemson Police Department. Visit here for information about safety.

Clemson University is committed to providing a safe campus environment for students, faculty, staff, and visitors. As members of the community, we encourage you to take the following actions to be better prepared in case of an emergency:

1. Ensure you are signed up for emergency alerts
2. Download the Rave Guardian app to your phone
3. Learn what you can do to prepare yourself in the event of an active threat

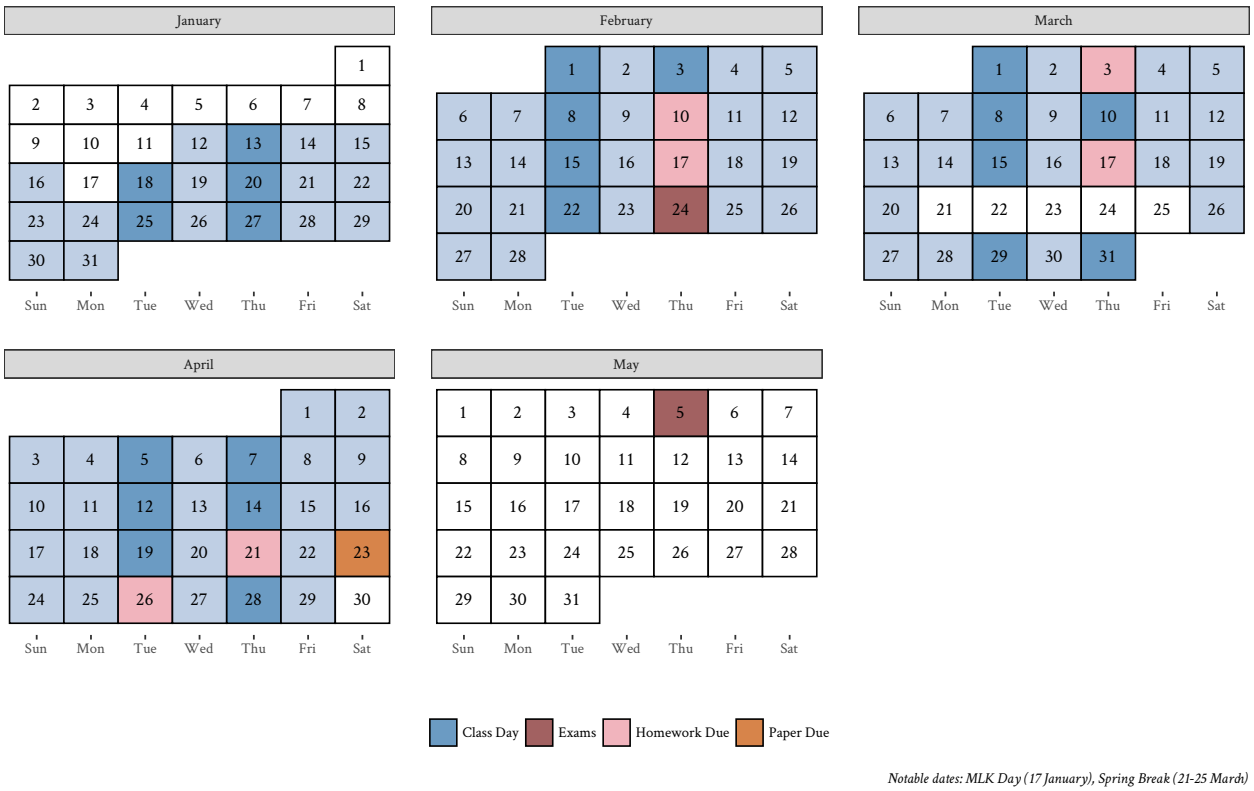

Figure 1: A Calendar for POSC 3410 (Quantitative Methods in Political Science, Spring 2022)

Class Schedule

Important: class readings are subject to change, contingent on mitigating circumstances and the progress we make as a class. Students should attend lectures, check their e-mail, and follow the course website to keep track of any changes to the schedule. Weeks corresponding with midterms will have the exams on Thursday preceded by an in-class review on Tuesday. The calendar below outlines the plan and highlights important dates for the semester. Dates within the semester that correspond with university holidays or in which the professor will be out of town are whitened out. Do note I have tried to accommodate students who, given the circumstances, wish to preserve money and follow the material through lecture and outside reading. Each week is heavily annotated with the week's topics. Students should search keywords to read more as they like.

Week 01, 01/10 - 01/14: Syllabus Day

Read *all* associated documents on course website.

- A Beginner's Guide to Using R
- Reading a Regression Table: A Guide for Students
- The American Statistical Association's Statement on *p*-values: Context, Process, and Purpose
- Taking Good Notes
- Dos and Dont's of Writing for Students
- Assorted Tips for Students on Writing Research Papers
- Exam Grading Policy

- Writing a Prospectus
- Prospectus Example
- Research Design Paper Instructions
- Fun with Attendance and Grades (i.e. Students Should Attend Class)
- The Educational Power of Discomfort
- Everybody Writes: A Web Content Approach for Students
- Put Your Laptops Away, Kids (Vol. 2)

Week 02, 01/17 - 01/21: Scientific Inquiry and Science as "Model" (KW, chp. 1)

This week will discuss (dare I say) a "standard" interpretation of an empirical approach to political science. This (again, dare I say) "standard" approach treats knowledge as the byproduct of accumulated hypothesis rejections. Therein, theoretical arguments set up empirical hypotheses to be either 1) rejected or 2) potentially consistent with a set of empirical data and the model of it. Do note the hypothesis is not "true"; nothing is "true" the extent to which the full extent of a universe of cases is unknowable. Theoretical arguments instead live to proverbially "die another day." Think of the acquired knowledge of gravity as illustrative here. You can draw a line of rejected models and hypotheses from the ancient Greeks (e.g. Heraclitus, Aristotle) to Stephen Hawking. Even after Hawking, there is still more to explain. **Keywords:** theoretical model, empirical implication of theoretical models (EITM), hypothetico-deductivism (H-D).

Additional (Helpful) Readings

Clarke, Kevin A. 2007. "The Necessity of Being Comparative: Theory Confirmation in Quantitative Political Science." *Comparative Political Studies* 40(7): 886–908.

Clarke, Kevin A., and David M. Primo. 2007. "Modernizing Political Science: A Model-Based Approach." *Perspectives on Politics* 5(4): 741–53.

Granato, Jim, Melody Lo, and M. C. Sunny Wong. 2010. "A Framework for Unifying Formal and Empirical Analysis." *American Journal of Political Science* 54(3): 783–97.

Granato, Jim, and Frank Scioli. 2004. "Puzzles, Proverbs, and Omega Matrices: The Scientific and Social Significance of Empirical Implications of Theoretical Models (EITM)." *Perspectives on Politics* 2(2): 313–23.

Week 03, 01/24 - 01/28: Literature Review and Theory (KW, chp. 2, 3)

Literature reviews are straightforward, but it is easy to overdo them and misdirect energy in them. Think of a literature review in a standard article (i.e. your research design paper) as a roughly eight-paragraph summary of what we know about a research question. At a minimum, they should answer these questions: 1) what do we know about this question, 2) what do we not know, and 3) why should we care? Your treatment of the second will serve as a nice bridge to the theoretical argument. Theoretical arguments are trickier, but think of them as extended syllogisms. If I accept the underlying premises of the argument, I have to accept the hypothesis that comes from them (otherwise I've contradicted myself). **Keywords:** how to do a literature review, writing research reports/theses, from research question to theory to hypothesis.

Knopf, Jeffrey W. 2006. "Doing a Literature Review." *PS: Political Science and Politics* 39(1): 127–32.

Read "How to Do a Literature Review" on my website/blog.

Week 04, 01/31 - 02/04: Defining and Measuring Concepts (P, chp. 1)

Important point: theoretical arguments are abstract but proxies of the components of these arguments are measured concretely. Think of "democracy" as illustrative here. It, like everything in political science, is a word we use a lot but the concept can be interpreted in any number of ways (see also: "corruption", "power"). Our theoretical discussion that links concepts is ultimately in the abstract, but we devise operationalizations of these concepts as measures that purport to capture the concept in question. Do not ever use a term that you can't define, but build your definitions of these concepts toward something you could actually measure. **Keywords:** conceptual definition, operational definition, unit of analysis, ecological fallacy, (measurement) reliability, (measurement) validity, (systematic, random) measurement error, Hawthorne effect, test-restest method, (face, construct) validity.

Additional (Helpful) Readings

Carmines, Edward G., and Richard A. Zaller. 1979. *Reliability and Validity Assessment*. Newbury Park, CA: Sage Publications.

Week 05, 02/07 - 02/11: Measuring and Describing Variables (P, chp. 2; KW, chp. 5)

Problem set #1 due on Thursday.

This will delve more into the statistics side of things. Consider, for example, your measure of "democracy" may be 0 (non-democracy [e.g. China]) or 1 (democracy [e.g. Canada]), but only you (the researcher and the reader) will know that. Your computer program will not care. It just sees numerical measurements that vary and that it can do any number of things to summarize them. Beware, though: your computer is deceptively stupid. It will give you a mean of a categorical measurement if you ask for one. Your job is to be smarter than the computer. As daunting as that sounds, it is more a plea to be careful/mindful of some limitations you have with your data. **Keywords**: constant/variable, nominal/ordinal/interval variable, dummy variable, Likert item, when can you treat an ordinal variable as interval/continuous?, mode/median/mean.

Week 06, 02/14 - 02/18: Hypotheses and Comparisons (P, chp. 3)

Prospectus due on Thursday.

There will be some back-tracking this week in as much we're going to talk about hypothesis crafting in some detail. We will talk a little bit more about writing theories. More importantly, we're going to talk about making some comparisons with actual data. Everything this will be super basic statements of association the direction of relationships. **Keywords:** (independent, dependent) variable, (positive, negative, zero, curvilinear) relationship, cross-tabulation, mean comparison

Week 07, 02/21 - 02/25: MIDTERM 1

Week 08, 02/28 - 03/04: Probability Theory

Problem set #2 due on Thursday.

I like to have students look "underneath the hood" of statistical inference, between learning about basic relationships and introducing students to regression, and after the first midterm. This first involves an introduction to basic probability and counting rules. It then pivots to a discussion of some important distributions you will see in the social/political world. "Demystification" is the goal here. A lot of inference happens under the assumptions of a normal distribution and I want students to get comfortable with this (even if they started political science thinking it would be math-free). **Keywords**: (joint, conditional) probability, unions, intersections, Bayes' theorem, prosecutor's fallacy, fundamental theorem of counting, ordering and replacement, combination, binomial theorem, Pascal's triangle, binomial mass function, normal density function (Gaussian distribution).

Additional (Helpful) Reading

Lynch, Scott M. 2013. *Using Statistics in Social Research: A Concise Approach* New York, NY: Springer (pp. 57-82) [available on Canvas]

Read "The Normal Distribution, Central Limit Theorem, and Inference from a Sample" on my blog.

Week 09, 03/07 - 03/11: Research Design, Control, and Comparisons (P, chps. 4-5; KW, chp. 4)

Making causal statements (or softer statements of association) requires controlling for what are called "confounders." These are intervening effects that could mitigate the relationship between a predictor and an outcome that a student wants to argue. How much "controlling" you do depend on the nature of the research design. Random assignment creates only random differences between treatment and control, making the treatment the only systematic difference. Research designs where random assignment is not available require more work. **Keywords:** experimental design, random assignment, treatment, control, (lab, field, survey, natural, quasi-) experiment, selection, controlled comparison, (spurious, additive, interactive) relationship.

Week 10, 03/14 - 03/18: Statistical Inference (P, chp. 6)

Problem set #3 due on Thursday.

This is a week on the basics of inferential statistics. In as many words, inferential statistics involves making statements about a population of cases based on a random sample of it. "Classical" inferential statistics then comes in ruling out central tendency values in a population as unlikely given a randomly collected sample. If that sounds familiar, it's because it brings us back to the second week's material: knowledge is accumulated hypothesis rejections. **Keywords:** population, population parameter, (random) sample, census, the 1936 Literary Digest Poll, (response, selection) bias, random sampling error, standard deviation, central limit theorem, standardization, z-score, standard normal distribution, (95-percent) confidence interval, Student's t-distribution, degrees of freedom.

Week 11, 03/21 - 03/25: SPRING BREAK

Week 12, 03/28 - 04/01: Correlation and Linear Regression (P, chp. 8; KW, chps. 8-10)

This week will extend statistical inference into the world of regression. Regression is a tool to model variation in some outcome as a (linear) function of one or more predictors and it is the workhorse of applied inferential statistics. The process of inference is the same, though typically regression modelers reject (or fail to reject) null hypotheses of zero relationship between a predictor and an outcome based on an observed coefficient and standard error. We'll start first with an aside on correlation, which is its own useful tool as well. **Keywords:** correlation, scatterplot, Pearson's *r*, multicollinearity, (multiple) regression, regression coefficient, standard error, prediction error, "ordinary least squares", partial effects, interactive effects.

Additional (Helpful) Reading

Read "What Do We Know About British Attitudes Toward Immigration? A Pedagogical Exercise of Sample Inference and Regression" on my blog.

Week 13, 04/04 - 04/08: Regression (Continued) (P, chp. 9; KW, chp. 11)

Students learn regression around OLS (linear) regression. Do not misunderstand that OLS is the foundation and it has a lot of nice properties. It is just often the wrong model for the data you probably have. In many applications, a researcher may want to explain whether a candidate won or lost, whether someone voted or not, or whether there was a war between two countries in a given year or not. These are binary outcomes in which a phenomenon is either "there" or "not there." This means you will probably want a logistic model. **Keywords:** heteroskedasticity, logistic regression, odds, odds ratio, percentage change in odds, (natural) logarithm, logit.

Week 14, 04/11 - 04/15: Making the Most of Statistical Analysis (KW, chp. 12)

In the real world, regression is a vehicle to storytelling. There is a theoretical argument someone wants to advance with an empirical test to check for whether (a model of) real world phenomena is consistent with the argument (typically through regression). However, the researcher needs to tell this story in a way that is not only accessible to someone like me, but to a lay person as well. From my perspective, this is the most important revolution to come in empirical political science in the 21st century. What I (for lack of better term) call the "quantities of interest" movement, regression modelers use the parameters from their regression model, advances in cheap computing technology, and some various parlor tricks learned along the way to explain complicated model output to intuitive "quantities of interest" that are easily accessible to both the researcher and the lay reader. **Keywords:** standardization by two standard deviations, Andrew Gelman's "divide by 4" rule, multivariate normal distribution, post-estimation simulation.

Required Reading

Gelman, Andrew. 2008. "Scaling Regression Inputs by Dividing by Two Standard Deviations." *Statistics in Medicine* 27(15): 2865–73.

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): 347–61.

Additional (Helpful) Reading

Read "How to Make the Most of Regression: Standardization and Post-Estimation Simulation" on my blog.

Week 15, 04/18 - 04/22: Bayesian Inference

Problem set #4 due on Thursday.

"Classical" statistical inference, at its core, is ruling out counterclaims as unlikely given an observed sample statistic. Stare close enough at this and you will start asking some critical questions about whether we know about a fixed parameter, whether that fixed parameter against which we test is plausible or interesting, whether we can truly make statements of relative frequencies of extreme results, whether we have a truly random sample of data, and whether we can know the population parameter at all. Plus, do you not want to make probabilistic statements of the hypothesis being true? Recall the prosecutor's fallacy means you cannot say that in the "classical" perspective. This is where a Bayesian perspective to interest can be both helpful and more informative. **Keywords**: frequentist/objectivist probability, subjective probability, Bayes' theorem, prior beliefs, posterior probability, data-generating process (DGP).

Required Reading

Western, Bruce, and Simon Jackman. 1994. "Bayesian Inference for Comparative Research." *American Political Science Review* 88(2): 412–23.

Additional (Helpful) Reading

Read "What Explains Union Density? A Replication of an Old Article with the brms Package" on my blog.

Week 16, 04/25 - 04/29: Replication

Problem set #5 due on Tuesday.

Replication is a hobby horse of mine in empirical political science. There is no excuse in the 21st century to not keep track of your work and, like in grade school math, "show your work." Replication is as much a phenomenon as it is a crisis affecting all the social sciences. Therein, replication crises run the gamut from some silly error that can completely undermine an otherwise good-faith analysis to bad-faith analyses and outright data fabrication. This week will focus on just one particular scandal (Reinhart and Rogoff's "Growth in a Time of Debt") and show how a replication crisis can include some good faith silly errors made possible by a click-based workflow and some questionable coding decisions for which it is important to be transparent. No matter, even accidental evil is still evil and we are still very much living in the afterglow of "Growth in a Time of Debt." Just ask Greece, or look around you in the United States.

Required Reading

Herndon, Thomas, Michael Ash, and Robert Pollin. 2014. "Does High Public Debt Consistently Stifle Economic Growth? A Critique of Reinhart and Rogoff." *Cambridge Journal of Economics* 38(2): 257–79.

Reinhart, Carmen M., and Kenneth S. Rogoff. 2010. "Growth in a Time of Debt." *American Economic Review* 100(2): 573–78.

Additional (Helpful) Reading

Read "Revisiting Reinhart and Rogoff, Ten Years Later" on my blog.

Week 17, 05/02 - 05/06: FINAL EXAM