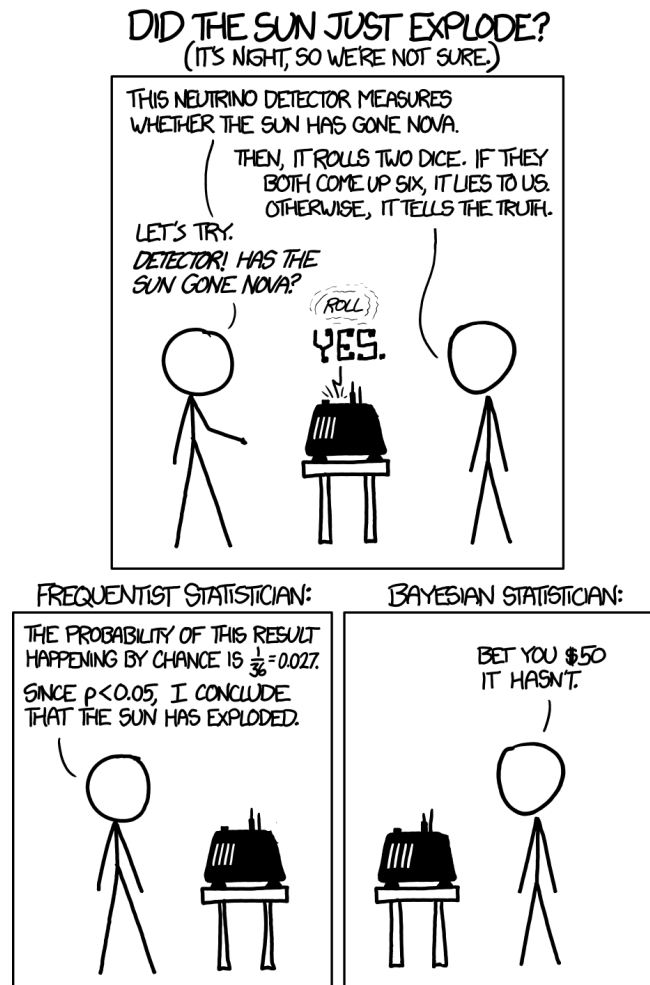


# POLS 8510: APPLIED BAYESIAN MODELING FOR THE SOCIAL SCIENCES

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**Website:** [Perusall](#)

**Time:** MTWThF 2:00pm – 4:45pm  
**Place:** 101D Baldwin Hall



The dominant statistical paradigm in social science is frequentist Null Hypothesis Significance Testing (NHST). You are probably aware of this paradigm. Perhaps because I taught it to you in your first semester as a graduate student. It's the idea that uncertainty comes from *sampling error*, and that we can quantify that uncertainty with a p-value—the probability that our estimate is just the result of an extreme sample drawn from the population.

But there are other sources of uncertainty that we might care about too. Bayesian statistics is how you incorporate those sources of uncertainty into a data analysis, build on prior knowledge, and ultimately, create more satisfying and coherent models of the world. Bayesianism isn't for everyone, but if one of the following three statements describes you, this course might be for you:

1. You're still not sure how you feel about Bayesian statistics. You literally just learned about it by reading the previous paragraph. You feel like statistics is hard enough without adding conjugate priors and Markov Chain Monte Carlos and WAICs and whatever the heck else we're learning about in this class. After this summer, you'll probably go back to being a frequentist. But taking this class will help you become a *better* frequentist, by giving you a fresh perspective on the statistical tools you use.
2. You don't really want to pick sides in the centuries-long war between Bayesians and frequentists. You just have some data you want to analyze, and there are some types of data—e.g. data with a hierarchical structure or lots of missing values—for which Bayesian statistics comes in handy. You're not going to “convert to Bayesianism”. You're not a religious person, at least not when it comes to statistical paradigms. You're a statistical mercenary, or perhaps a data science ninja, willing to use whatever tools are appropriate to your dataset and research question. This class will provide you an introduction to those tools, and teach you how to use them responsibly.
3. You know, deep down, that something is wrong with the way we do statistics. What you know you can't explain, but you feel it. It's there, a splinter in your mind, telling you that everything you've been taught is a pleasant lie designed to launder the irreducible chaos of our universe into tidy journal articles with tidy regression tables with cute little stars that say “It's okay.  $p < 0.05$ . We did science.” Take this course, and I show you how deep the rabbit hole goes.

## Course Prerequisites and Objectives

I will assume that before taking this course you have taken POLS 7012 and 7014 or their equivalents (introduction to statistics and linear regression) and that you are familiar with the basics of the R programming language. Over the next three weeks, we will work through Richard McElreath's delightful textbook [Statistical Rethinking](#). We will read roughly 20 pages per day. Please read and annotate the assigned pages in [Perusall](#) before class so that we can focus on questions and hands-on activities during class time. You will want to bring a laptop equipped with R and RStudio to class every day.

## Assignments & Grading

You will be expected to actively read and mark up the textbook on Perusall (50% of your grade). Each day in class we will work on practice problems, and you will submit individual responses to those exercises as a knitted R report (graded pass/fail, 50% of your grade).

## Office Hours

Since we're meeting for 3 hours every day, I will not hold formal office hours, but I will generally be available before and after class to discuss questions.

## Tentative Course Outline

Moltke the Elder writes that no battle plan survives contact with the enemy. This is doubly true for syllabi. The following outline gives my rough estimate of how quickly we'll work through the material, but we will adjust as necessary.

## Week 1: Foundations

### Day 1: Getting Started

*Setting up R and RStudio, R Bootcamp, Basic Programming, Meditations on Golem Engineering*

### Day 2: The Basic Ingredients

*Marbles, Models, Parallel Universes, Priors, Posteriors, Globe Tossing*

### Day 3: Sampling from Posteriors

*Bayes Theorem, Vampires, Summarizing Distributions from Samples*

### Day 4: The Gaussian Distribution

*How Normal Distributions Got Their Shape, How To Describe Your Model*

## Week 2: Rethinking OLS

### Day 5: The Linear Model

*Quadratic Approximation, Posterior Predictive Distributions, Polynomials, Cherry Blossoms*

### Day 6: Causal Inference

*DAGs, Spurious Associations, Residuals, Multiple Regression*

### Day 7: More Causal Inference

*Handling Categorical Variables, Waffle Houses*

### Day 8: Yet More Causal Inference

*Why You Shouldn't Just Throw Every Variable Into Your Model, Causal Salads, Multicollinearity, Post-Treatment Bias, Collider Bias*

### Day 9: Interactions

*Conditional Associations, An Actual Political Science Application, But Also Manatees*

## Week 3: Generalized Linear Models

### Day 10: MCMC

*Markov Chains, Monte Carlos, and Markov Chain Monte Carlo*

### Day 11: The Generalized Linear Model

*Link Functions, The Exponential Family*

**Day 12: Binomial Regression***Logistic Regression, Prosocial Chimpanzees***Day 13: Multilevel Models***Pooling, Partial Pooling, Tadpoles***Week 4: Special Topics****Day 14: Measurement Error***Return to the Waffle House, Shrinkage***Day 15: Missing Data***Omitted Variable Bias, Missing At Random, Missing Completely At Random, Bayesian Imputation***Mental Health and Wellness Resources**

- If you or someone you know needs assistance, you are encouraged to contact Student Care and Outreach in the Division of Student Affairs at 706-542-7774 or visit <https://sco.uga.edu>. They will help you navigate any difficult circumstances you may be facing by connecting you with the appropriate resources or services.
- UGA has several resources for a student seeking [mental health services](#) or [crisis support](#).
- If you need help managing stress anxiety, relationships, etc., please visit [BeWellUGA](#) for a list of FREE workshops, classes, mentoring, and health coaching led by licensed clinicians and health educators in the University Health Center.
- Additional resources can be accessed through the UGA App.