Gov 2001: Problem Set 6
Assessment Problem

Due Wednesday, March 23 by 6pm

Instructions

You should submit your answers and R code to the problems below using the Quizzes section on Canvas.

Remember that you should treat this assessment problem as you would treat a final exam. You are not allowed to discuss the problem with classmates, the teaching staff, or any other people. You also may not post questions about the assessment problem to the Canvas discussion boards.

You may consult any readings, notes, or R code from the class, and you can also use the internet as a resource, but remember that all answers and code must be entirely your own.

Also don't forget that you only have one opportunity to submit your answers to the assessment problem on Canvas. Be sure you check your work before you click the submit button.

Remember that the purpose of these assessment problems is for you to get an honest sense of how well you understand the content from the class. If you struggle with an assessment problem one week, you should spend the following week being sure that you catch up on the topics you didn't understand.

Problem 1

The negative binomial distribution is a discrete probability distribution that represents the number of successes in n i.i.d. Bernoulli trials that occur before a fixed number of failures (usually denoted as r). One particular parameterization of the Negative Binomial is often referred to as Negbin II. In this model $E(y_i|x_i) = \lambda_i$ and $Var(y_i|x_i) = \lambda_i + \frac{\lambda_i^2}{\theta}$. The variance here is a quadratic function of the mean, instead of a linear function. The pdf for NegBin II is:

$$NegBinII(\lambda_i, \theta) = \frac{\Gamma(\theta + y_i)}{y_i!\Gamma(\theta)} \frac{\lambda_i^{y_i}\theta^{\theta}}{(\lambda_i + \theta)^{(\theta+y_i)}}$$

Where $\Gamma(a) = (a-1)!$. You can calculate this in R using the `gamma()` function.

For this problem you will continue to use the data and set-up from Problem 2 in Problem Set 6.

1.A) What are the stochastic and systematic components?

1.B) Write out the log-likelihood function.

1.C) Optimize the model to find the maximum likelihood estimates for β and θ. (Remember that $\lambda > 0$ and $\theta > 0$).

1.D) Generate a histogram of 10,000 predicted values for a democracy (polity2=10), with all other variables held at their mean. Set your seed to 02138. (Hint: you can use rnbinom to draw from NegBin II).

1.E) Based on your simulations, calculate the probability that such a state has one or more revolutions in a given year.

R Code

Please submit all your code for this assignment as a .R file. Your code should be clean, commented, and executable without error.