POLS6382 Quantitative Methods III: Maximum Likelihood Estimation

University of Houston
September 3, 2025

Homework Assignment 1

Instructions

- Answer the following questions and submit your answers and R code in one document. Your document should be prepared using LaTex or R-Markdown.

- Submit your report using the submission link on Canvas.

- Homework 1 is due on Friday (September 19), by noon.

- We will review Homework 1 during the lab session on Wednesday, September 24.

1 Basics of Data Analysis Using R

In this exercise, you will replicate some data analysis functions we learned in Lab 1 using the data file genderequality.dta. This data file includes cross-country survey data from the World Values Surveys Wave 6. You will use the following variables:

`equality`: A continuous scale (factor index) measuring gender equality norms. Positive values refer to more egalitarian views on gender equality and negative values refer to less egalitarian views.

`kidnum`: Number of children a respondent has.

`income`: Family income levels.

`age`: The respondent's age.

`education`: Education attainment.

`female`: The respondent's gender, coded as "1" for female respondents and "0" otherwise.

- **1a.** Use package `tidyverse` to tabulate the sample size, mean, and standard deviation of variable `equality` by country. This variable measures gender equality norms embraced by survey respondents. Discuss the data regarding cross-country comparison in mean equality scores and within-country dispersion of this variable.

- **1b.** Use function "ggplot()" to draw a panel figure to show the bivariate association between `equality` and `kidnum` (the number of children of survey respondents) by country. Discuss what you observe from the visual.

- **1c**. Estimate a linear regression model, regressing variable `equality` on the following variables: `income, education, married, age, female`, and *kidnum*. Output the regression coefficients in a table.

2   Grid Search

The following data show the number of appointments to the United States Supreme Court from 1961 through 1992, by presidential term. Members of the Court serve for life, so presidents get to appoint a new Justice only when one dies or resigns. Given that these are events that occur over a fixed interval of time, it is not unreasonable to suppose that they follow a Poisson distribution.

The Poisson distribution is

$$f(y_i|\lambda) \sim \frac{e^{-\lambda}\lambda^{y_i}}{y_i!}$$

The likelihood is

$$L(\lambda|y_1, y_2, \ldots, y_8) = \frac{e^{-8\lambda}\lambda^{\Sigma y_i}}{\prod y_i!}$$

The data are

Years	Number Appointed
1961-64	2
1965-68	2
1969-72	4
1973-76	1
1977-80	0
1981-84	1
1985-88	3
1989-92	2

- **2a**. Use maximum likelihood estimation via a grid search to estimate the parameter of the Poisson distribution (to 2 decimal points. Graph this likelihood against the parameter estimates.

- **2b**. Use the estimated parameter to estimate the probability that Bill Clinton would have 0, 1, 2, 3, 4, or 5 appointments to the Supreme Court during his first term of office. (He actually made 2 appointments: Ginsburg, 8/10/93; Breyer, 8/3/94.)

3   Outline Your Term Paper Ideas

In this exercise, you will outline ideas for your term paper. By answering the following questions, you will prepare a brief research proposal that guides your research project throughout the semester.

- **3a**. What is the research question? And, why do you focus on this research question?

- **3b**. Propose one or several hypotheses to be tested in the term paper. For each hypothesis, provide three references that support the hypothesis. Make sure that you list the most cited and/or most recent references in the literature.

- **3c**. What is the research and data design that you plan to use in this research project?

- **3d**. What will be the dependent variable, and how do you measure the dependent variable?

- **3e**. What will be the key independent variable(s) based on each of your proposed hypotheses?

- **3f**. Provide a brief data collection plan to demonstrate that your research proposal is viable. If you have collected some pilot data, include some pilot analysis to show the feasibility of your research ideas.