

PLSC 503: “Multivariate Analysis for Political Research”

Exercise Two

February 6, 2020

Introduction

In this exercise, you’ll use linear/matrix algebra software – that is, the matrix algebra operators in R (and/or Stata’s `mata` or `matrix` commands) – to estimate a linear regression, and then cross-check those results using `lm` or `regress`. The point is to demonstrate both a basic grasp of the software and your understanding of the matrix-algebra representation of the classical linear regression model. The data consist of the following:

Observation	Y	X_1	X_2	X_3
1	39	0.3	8	0
2	-18	0.1	111	1
3	13	0.7	79	1
4	19	1.1	13	1
5	6	0	91	0
6	-2	0.1	43	1
7	15	1.5	52	0
8	-11	0	98	1
9	17	0.9	22	0
10	3	0.2	106	1

Exercise

Using the linear algebra functions in R (or, e.g., the `mata`/`matrix` commands in Stata), do the following:

1. Estimate the $\hat{\beta}$ s and their variances and covariances $\widehat{\text{Var}}(\hat{\beta})$ for the OLS equation:

$$Y_i = \beta_0 + \beta_1 X_{1i} + \beta_2 X_{2i} + \beta_3 X_{3i} + u_i.$$

2. Calculate the predicted \hat{Y}_i s, and the estimated residuals (the \hat{u}_i s).
3. Calculate the estimated root mean squared error (RMSE), the R^2 , and the R^2_{adj} .
4. Calculate the standard errors of the estimated $\hat{\beta}$ s, as well as their covariances.
5. Calculate a t -test for the hypothesis that $\beta_2 = 0$.
6. Calculate an F -test for the joint hypothesis that $\beta_1 = \beta_2 = \beta_3 = 0$.
7. Calculate an F -test for the hypothesis that $\beta_1 = \beta_3$.
8. Check all your results, using `lm`, etc.

Be sure to include *all* code that you used to complete the various steps above.

This assignment is due Thursday, February 13, 2020 at 5:00 p.m. EDT. You can submit your homework by emailing copies **both** to Dr. Zorn (zorn@psu.edu) and Mr. Kim (txk290@psu.edu). In addition to your responses to the items above, please include all code used to fit models, conduct diagnostics, generate plots, and so forth. This assignment is worth 50 possible points.