

## PLSC 503: “Multivariate Analysis for Political Research”

### Exercise Three

February 17, 2018

#### 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

#### Exercise

Using either the linear algebra functions in R or the `mata`/`matrix` commands in Stata, do the following:

1. Estimate the  $\hat{\beta}$ s 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 your results by entering the data into R (or Stata, etc.) and using the `lm` (or `regress`, etc.) command.

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

This homework is worth 50 points, and will be due in electronic form (PDF format) at or before **5:00 p.m. EST on Friday, February 23, 2018**.