Problem set is due Thursday, Mar. 21st in class.

1. Using your data set, run a regression with a substantively interesting interaction term in it. Fully interpret and test this regression specification. Include a substantive discussion of why you expect an interaction term to be present, a substantive discussion of the results, and graphs that show the hypothesized effects. Turn in your R code with your write-up.

2. Consider the simple regression model

$$y = \beta_0 + \beta_1 + u$$

and let z be a binary instrument for x.

(a) Show that the IV estimator can be written as

$$\hat{\beta}_1 = \frac{\bar{y}_1 - \bar{y}_0}{\bar{x}_1 - \bar{x}_0}$$

where the "not" subscript indicates the sample averages over the part of the sample with $z_i = 0$, and the "one" subscript indicates the sample averages over the part of the same with $z_i = 1$.

(b) What is the interpretation of $\hat{\beta}_1$ if x is also binary?

3. Consider the individual effects model

$$y_{it} = \alpha_i + \mathbf{x}'_{it}\boldsymbol{\beta} + u_{it},\ t = 1, 2$$

and the first-differences model

$$y_{it} - y_{i,t-1} = (\alpha_i - \alpha_i) + (\mathbf{x}_{it} - \mathbf{x}_{i,t-1})'\boldsymbol{\beta} + (u_{it} - u_{i,t-1})$$

and show that the estimates of $\boldsymbol{\beta}$ are numerically identical. Show that the error variance estimates are numerically identical.

4. Simulate a model with three independent variables, one of which is measured with random error. When you estimate the model, do the results conform to expectations for the variable measured with error? How about for the other variables?