

## Homework 18: ECO220Y

### Problems:

(1) For which of the following is it possible to estimate the parameters using OLS (aka the least squares method)? Explain.

(a)  $\ln(y_i) = \beta_0 + \beta_1 x_i^2 + \varepsilon_i$

(b)  $\ln(y_i) = \beta_0 + \beta_1 x_i^\lambda + \varepsilon_i$

(c)  $y_i = \exp(\beta_0 + \beta_1 x_i + \varepsilon_i)$

(d)  $y_i = \exp(\beta_0 + \beta_1 x_i) + \varepsilon_i$

(e)  $y_i = \beta^2_0 + \beta^2_1 x_i^2 + \varepsilon^2_i$

(f)  $\ln(y_i) = (\beta_0 + \beta_1 x_i^2 + \varepsilon_i)^2$

(g)  $\ln(y_i) = \ln(\beta_0) + \beta_1 \ln(x_i) + \ln(\varepsilon_i)$

(2) Explain why the variable  $term_i$ , which measures a student's average term work marks, is an endogenous variable in the following regression that seeks to explain  $final_i$ , which measures a student's mark on the final examination. Explain a counterfactual situation where  $term_i$  would be an exogenous variable.

$$final_i = \beta_0 + \beta_1 term_i + \varepsilon_i$$

(3) Suppose instead the professor collects data on students' heights and specifies the following model:

$$final_i = \beta_0 + \beta_1 height_i + \varepsilon_i$$

Discuss which of the 6 assumptions of the linear regression model likely would be violated in this case.

(4) There are two competing academic theories regarding the relationship between student course evaluations and the number of years that a professor has been teaching. One theory holds that the most experienced professors will get the highest ratings. The second theory says that the young and energetic, although inexperienced, professors will score highest. What would a scatter diagram of evaluations (Y) and experience (X) look like if the first theory is correct? (Make a rough sketch.) What would the scatter diagram look like if the second theory is right? In either case, why might we anticipate that the data will not lie exactly on a line  $y = \beta_0 + \beta_1 x$ ?

A college dean believes that there is no relationship at all between course evaluations and teaching experience. If the dean is right, what would a scatter diagram of evaluations and years look like?