Economics 311 — Fall 2017
Daily Problem #3 — September 8

Studenmund's equation (2.4) says that

$$\hat{\beta}_1 = \frac{\sum_{i=1}^{N}\left[\left(X_i - \bar{X}\right)\left(Y_i - \bar{Y}\right)\right]}{\sum_{i=1}^{N}\left(X_i - \bar{X}\right)^2}$$

a. If X_i is above average, what will be the sign of $\left(X_i - \bar{X}\right)$?

b. If Y_i is above average, what will be the sign of $\left(Y_i - \bar{Y}\right)$?

c. If both are above average for observation *i*, what is the sign of the product $\left(X_i - \bar{X}\right)\left(Y_i - \bar{Y}\right)$?

d. What happens to your answers to a, b, and c if X_i and Y_i are both below average for observation *i*?

e. What is the sign of $\left(X_i - \bar{X}\right)\left(Y_i - \bar{Y}\right)$ if one variable is above average and the other is below average for observation *i*?

f. Suppose that the relationship between X and Y is positive, so Y tends to be above average for the same observations that X is above average and Y tends to be below average for the same observations that X is below average. Would most of the summands in the numerator of the $\hat{\beta}_1$ expression to be positive or negative? (Are there likely to be more observations that follow the pattern of c and d or more that follow the pattern of d?) What sign would you expect for the numerator, positive or negative?

g. Given that the denominator of the $\hat{\beta}_1$ expression cannot be negative, what sign would you expect for $\hat{\beta}_1$ when the relationship is positive?