# 14.750x: Political Economy and Economic Development

## Module 1 Problem Set

**R Exercise. There are 10 parts to the following question.**

1. R is not technically needed to solve this Problem Set since the questions may be solved analytically. However, make sure you are also able to do them in R in order to be ready for the rest of the course.

   In R, create a dataset (data.frame) with 100 observations. Add the following elements and use them to answer the questions below.

   (a) Create a variable $t$ containing numbers from 1 to 100 (sequentially). What is the mean of t? Report your answer to the nearest one decimal place (for example: 10.7).

   (b) Create a variable we will call $\alpha$, which has value 3 for all 100 observations. What is the variance of $\alpha$? Report your answer as an integer value.

   (c) Create another variable, $\epsilon_t$ , a random normal variable with mean 0 and standard deviation 1. Then create $x_t$, a random uniform variable over [0,1]. $E[x_t]$ refers to the "expectation", "expected value" or "mean" of $x_t$.What is $E[x_t]$? Report your answer rounded to the nearest one decimal point (for example 10.7).

   (d) What is the variance of $x_t$? Hint: the variance of a random uniform variable over $[a, b]$ is equal to $\frac{1}{12}(b-a)^2$. Enter as a ratio of two integers (for example $\frac{3}{4}$).

   (e) Create an outcome variable $y_t$ defined as $y_t = \alpha + \beta x_t + \epsilon_t$ where $\beta = 2$. What is $E[y_t]$? Report your answer as an integer value.

   (f) Estimate $\widehat{\beta}$. Suppose the standard OLS 95% confidence interval of $\widehat{\beta}$ is $(1.61, 3.04)$ (Note that your confidence interval will depend on the exact draws of $\epsilon_t$, and so it might be slightly different).

   True or False: We can reject the hypothesis that $\beta = 1$ with 95% confidence.

   i. True
   ii. False

   (g) Create $v_t$ as a random normal variable with mean 0 and standard deviation 1. Create a new variable $\epsilon_t$ (replace the old variable $\epsilon_t$), a random normal variable with mean 0 and standard deviation 1. Generate $q_t$ as $q_t = x_t + 2x_t^3 + v_t$.

   What is $E[q_t]$? Hint: $E[X^n]$ of a random uniform variable between 0 and 1 is $\frac{1}{n+1}$.

Please report your answer as an integer value.

(h) Generate outcome variable $z_t$ defined as $z_t = \alpha + \beta x_t + \gamma q_t + \epsilon_t$, where $\beta = 2$, $\gamma = 3$. What is $E[z_t]$? Report your answer as an integer value.

(i) Estimate $\widehat{\beta}$ from the (misspecified) model:

$$z_t = \alpha + \beta x_t + u_t$$

Assume that the standard OLS 95% confidence interval is (5.832,10.014). Which point estimate derives this confidence interval? Hint: The confidence intervals are symmetric around the point estimate. Use three places after the decimal point.

(j) Now suppose that the point estimate is 7.8 and the standard error is 1.04. In this instance, what is the upper bound of the standard OLS 95% confidence interval (recall the critical value for a standard OLS 95% confidence interval is 1.96)? Use two places after the decimal point