

## Homework 2 (Econometrics 1)

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- Deadline: **12/19 (Thu) (23:59 JST)**
- The answers should be submitted through Waseda Moodle.
- The submitted file should be a pdf file. Handwritten answers are accepted as long as they are readable.
- For problems involving programming, show both codes and outputs.
- Working on the problems in a group is **allowed**, provided that the following rules are observed
  - The maximum number of a group is **three**
  - The names of the group members should be clarified
  - Each student should provide their answers in their own words. Copying the other members' work is **not allowed**

**Problem 1** (7 points) Solve Problem 1,3 and 5 in Problem set 2.

**Problem 2** (3 points) Show that under Assumptions 1-3 in the L.6 slides, the variance of  $\hat{\beta}_{n1}$  given  $X_1, \dots, X_n$  is

$$\frac{\sigma^2}{n} \frac{1}{\frac{1}{n} \sum_{i=1}^n (X_i - \bar{X}_n)^2}$$

**Problem 3** (5 points) In this problem, you calculate the OLS estimators using R. Please obtain your own data by using the following code:

```
set.seed(A)
data <- as.data.frame(state.x77)
data <- data[sample(1:50, 40),]
```

where you need to input the last two digits of your student number for A. Here we use the information of the life expectancy as Y and the illiteracy rate as X. Then answer the following problems.

1. We consider the following two models.

**Model 1:**  $Y_i = \beta_0 + X_i\beta_1 + \epsilon_i$

**Model 2:**  $Y_i = X_i\beta_1 + \epsilon_i$

Obtain the OLS estimators for these two models **without using the lm function** and compare the result with those given by the `lm` function. (See p.17 in the Lecture 6 slides.)

2. For the two models, visually compare the distribution of the data and the lines obtained by OLS as we did in p.16 in the Lecture 6 slides. Discuss which result looks more reasonable.
3. Based on the “more reasonable” model you chose, explain what the estimated value of  $\beta_1$  implies about the relationship between the illiteracy rate and the life expectancy.