

# ECON 3161 Homework 1 (Fall 2023)

Due Date: Sept 10th (Sunday), by the end of the day

**Instruction: There are 85 points in total. You can either type or handwrite your answer. Then upload your answer file on canvas. Please clearly number your answers. Incomplete or non-legible answers will only receive partial or no credits. For the first two questions, you can refer to my math review lecture notes or the math refreshers A – C of our reference book.**

1. (24 pts) Let  $X$  be a random variable taking on the values -1 and 2, each with probability 0.5. Answer the following two questions:
  - (i) Find  $E(X)$  and  $E(X^2)$ . (12 points)
  - (ii) Find  $var(X)$  and  $var(X^2)$ . (12 points)
2. (25 pts) Let  $Y_1, Y_2, Y_3$  be independent, identically distributed random variables from a population with mean  $\mu$  and variance  $\sigma^2$ . Let  $\bar{Y} = \frac{1}{3} \sum_{i=1}^3 Y_i$  denote the average of these three random variables. Answer the following questions:
  - (i) What are the expected value and variance of  $\bar{Y}$ ? (10 points)
  - (ii) Now consider a different estimator of  $\mu$ :  $W = \frac{1}{2}(Y_1 + Y_2)$ . Show that  $W$  is an unbiased estimator of  $\mu$ . Find the variance of  $W$ . (10 points)
  - (iii) Based on your answers to parts (i) and (ii), which estimator do you prefer? (5 points)
3. (18 pts) Read section 1-4 on pages 10-14 and section 2-7a on pages 53-54 of our reference book, and watch the video (by clicking the link <https://www.youtube.com/watch?v=iPBV3BIV7jk>), answer the following questions:
  - (i) What does a counterfactual outcome mean? Can you observe a counterfactual outcome in practice? (8 points)
  - (ii) What does ceteris paribus mean? If we collect earnings data from two groups of people (group 1 attended public colleges, group 2 attended private colleges), and compare the earnings between those two groups, will this be a ceteris paribus comparison? Why? (10 points)
4. (18 pts) Read section 2-7a on pages 53-54 of our reference book, and watch the video (by clicking the link <https://www.youtube.com/watch?v=eGRd8jBdNYg>), answer the following questions:
  - (i) What does RCT stand for? What are the advantages and disadvantages of RCTs? (9 points)
  - (ii) In the West Point study, what is the treatment? What is the treatment group? What is the control group? (9 points)