Lecture 4-2: Statistical Properties of OLS

Goal: Explain the statistical properties of the OLS estimators: the assumptions, unbiasedness, variance, and the Gauss–Markov theorem.

- Statistical properties of OLS
  - Linear model setup
  - OLS assumptions I–V
  - Sampling distributions
  - Unbiasedness
  - Variance and estimation
  - Gauss–Markov theorem

Worksheet

1. (*Unbiasedness of the slope*) Under Assumptions I–IV (including $E[u|X] = 0$), show $E[\hat{\beta}_1] = \beta_1$.

2. (*Variance of the slope*) Under Assumptions I–V (including homoskedasticity, $\text{Var}(u_i \mid X) = \sigma_u^2$), derive $\text{Var}(\hat{\beta}_1 \mid X) = \dfrac{\sigma_u^2}{\sum_{i=1}^{n}(x_i - \bar{x})^2}$.