Lecture 1: Parameters & Estimators

Population parameter: property of a random. var

Random var X: $\mu_X = E[X]$, $\sigma_X^2 = V[X]$, $\sigma_X = \sqrt{V[X]}$

μ_X: central tendency; σ_X^2, σ_X: dispersion

Statistic: property of a sample

Sample: N obs of the rand var X

$X_1, X_2, X_3, \cdots, X_N$

"iid" → independent and identically dist

Estimator: statistic that estimates a parameter

Notation: Greek letter → parameter → β, θ

Greek letter w/ a hat → estimator → $\hat{\beta}$, $\hat{\theta}$

Desirable properties of $\hat{\theta}$:

1. Unbiasedness: $E[\hat{\theta}] = \theta$
2. Consistency: as $N \to \infty$, $Pr[|\hat{\theta} - \theta| > \varepsilon] \to 0$ for any ε

   $\hat{\theta} \not\to \theta$
3. Efficiency: $\hat{\theta}$ has the smallest possible $V[\hat{\theta}]$

Let's think about "variance"

- → $V[X]$ = expected squared deviation of X from $E[X]$
- → $V[\hat{\theta}]$ = expected squared deviation of $\hat{\theta}$ from $E[\hat{\theta}]$

Std. deviation: $\sqrt{V[X]}$

Std. error: $\sqrt{V[\hat{\theta}]}$