KEY COMPONENTS

Population Distribution

Y

Sample

Draw a random sample from population:

$Y_1, \ldots, Y_n$

Statistic

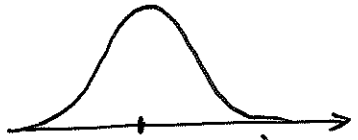
One number summary of the sample:

$T(Y_1, \ldots, Y_n)$

e.g. $\bar{Y}$

Sampling Distribution

Distribution of the statistic over all possible random samples.



$T(Y_1, \ldots, Y_n)$

SO FAR we have been working left to right $\Longrightarrow$

We know (or assume) the population dist. + Know sample size, n + Know the sampling mechanism + Pick a statistic $\Longrightarrow$ (derive, simulate, approximate) Know (almost know) the sampling dist.

Relate properties to population properties

INFERENCE goes right to left $\Longleftarrow$

Make a statement about the population $\Longleftarrow$ We have one sample: $y_1, \ldots, y_n$ + We calculate a statistic with the sample $\Longleftarrow$

HOW? Use $\Longrightarrow$ relationship between pop. dist and sampling dist. to guide us

Your turn: Is the sample mean a good estimate of the population mean?

$\theta = \mu \qquad \hat{\theta} = \bar{Y}$

- Is it unbiased?

$$E(\bar{Y}) - \mu \overset{?}{=} 0$$

Yes $E[\bar{Y}] = \mu \implies$ linearity of expectation

- What is its mean squared error?

$$MSE(\bar{Y}) = \underbrace{Bias(\bar{Y})^2}_{0} + Var(\bar{Y}) = \frac{\sigma^2}{n} \implies \text{properties of } Var(\ )$$

- Is it consistent?

$$\bar{Y} \xrightarrow{p} \mu \qquad \text{WLLN}$$

Hypotheses

Null Hypothesis H_0: specified value (or range of values) for the **parameter** of interest "uninteresting results"

Alternative Hypothesis H_A (or H_1): A differnt specified value or range of values for the parameter of interest (often NEGATION of null) "interesting results"

Two sided versus one-sided One sided $\theta > a$ Two sided $\theta \neq c$ or $\theta < a$ or $\theta > b$

Example : μ = population mean hours spent preparing for class

H_0 : $\mu = 30$

H_A : $\mu \neq 30$

H_0 : $\bar{Y}$ NO!

hypotheses are always about population parameters

Possible outcomes

State of truth

Outcomes of test

	H_0 is true	H_A is true
Reject Null	Incorrect	Correct
Fail to reject Null	Correct	Incorrect

Like H_0, H_A are exhaustive

H_0 & H_A are complementary