

Inference

- ▶ Interested in a **variable** that can (in principle) be measured on everything in a **population**.
- ▶ Focus on a **parameter** θ (e.g. a mean or a proportion) that describes the population distribution of the variable.
- ▶ Not feasible to measure variable on everything in population so select a **sample**, measure the variable on each thing in the sample, and then compute a **statistic** $\hat{\theta}$ for the sample distribution
- ▶ **Inference** is the process of using the statistic value $\hat{\theta}$ to say something about the parameter value θ .
- ▶ need to account for variability in the sampling process
- ▶ two main methods of inference
 - ▶ confidence interval
 - ▶ significance test

Confidence intervals

- ▶ **Confidence interval** $[\hat{\theta} - m, \hat{\theta} + m]$: an interval produced by a method that has a specified probability (often 95%) of returning an interval containing the parameter value θ
- ▶ to compute **margin of error** m , need to know about sampling distribution (i.e., distribution of $\hat{\theta}$ for all possible samples of fixed size)
- ▶ sampling distribution has standard deviation $\sigma_{\hat{\theta}}$
- ▶ for a given confidence level C , margin of error is multiple of $\sigma_{\hat{\theta}}$ needed to have middle C of the sampling distribution

$$m = (\text{multiplier for level } C)(\text{standard deviation for sampling distribution})$$

Significance tests

- ▶ translate question into null and alternative hypotheses:

Null hypothesis: $\theta = \theta_0$

Alternate hypothesis: $\theta \neq \theta_0$

- ▶ determine statistic value $\hat{\theta}$ for a sample
- ▶ use $\hat{\theta}$ to compute **P-value**: probability of getting statistic values at least as far from θ_0 as $\hat{\theta}$ is within the sampling distribution of all possible statistic values
- ▶ use P -value as measure of evidence that $\hat{\theta}$ provides against the null hypothesis
- ▶ can use pre-determined significance level α as guide in decision to reject or accept the null hypothesis