

EPSY 5261 : Introductory Statistical Methods

Day 7

Introduction to Hypothesis Testing

Learning Goals

- At the end of this lesson, you should be able to...
 - List the steps of a hypothesis test
 - Describe the purpose of a hypothesis test

Test a Claim

- In research we often want to test a claim:
 - Is the true average body temperature really 98.6?
 - Is 10% of the world left-handed?
 - Is a new treatment more effective than an old treatment for a particular disease?

How to test a claim

- To do this we often start by getting a sample from our population of interest
- But do we need to account for?.....

SAMPLING VARIABILITY

Mini Example Scenario

Based on previous research: 10% of people are left-handed

You get a sample of:

6%

9%

20%

Do you think 10% of people are left-handed?

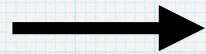
Recap

What did we do on the last slide?:

- Considered the “gold standard”
- Compared our sample to that “gold standard”
- Decided whether our sample “fits” with the “gold standard”
 - Did our sample seem likely if that “gold standard” is true?



Recap



Hypothesis Testing

Hypothesis Testing

Purpose: to test a claim about a population parameter

Steps of Hypothesis Testing

1. Formulate a **research question**
2. Write your **hypotheses**
3. Find **Distribution** Considering the Null Hypothesis
4. **Compare** Sample to the Distribution of Null Hypothesis
5. Get a **p-value**
6. Make a **decision** to reject or fail to reject the p-value
7. Communicate your **conclusion** in context

Example: Research Question

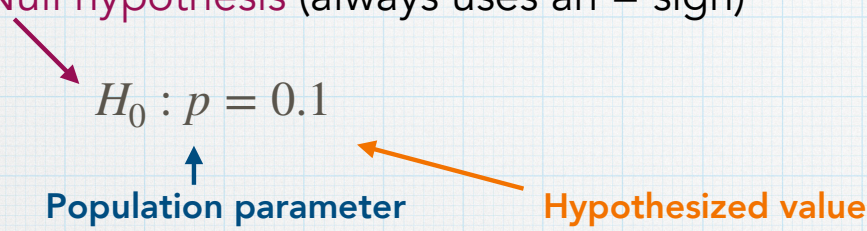
Are more than 10% of people left-handed?

Hypotheses

- Null hypothesis: usually a statement of no effect, no difference, "status quo" (a statement of equality)
 - The "dull" hypothesis
 - The "no change" or "no difference" hypothesis
- Alternative hypothesis: there is an effect or difference (a statement of inequality)
 - The "exciting" hypothesis
 - Aligns with the research question

Example: Hypotheses


- Null hypothesis (always uses an = sign)


$$H_0 : p = 0.1$$

Population parameter

Hypothesized value

- Alternative hypothesis (sign based on the research question)


$$H_0 : p > 0.1$$

Example: Hypotheses

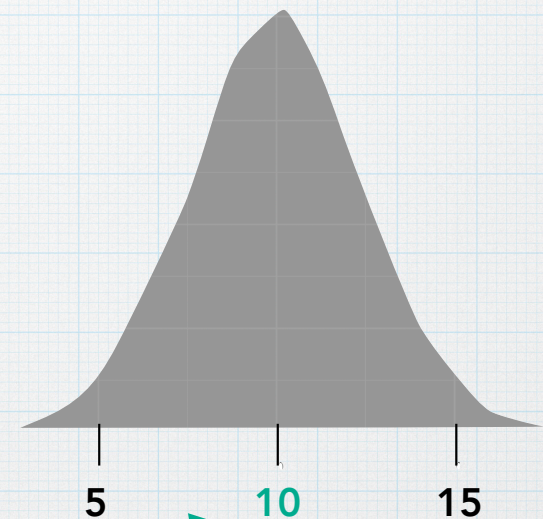
- In other cases the alternative might be:

$$H_a : p \neq 0.1$$

$$H_a : p < 0.1$$

Sampling Distribution

- Obtained by
 - Simulation (next class)
 - Mathematical formula (after next class)
- Allows us to estimate the sampling variability we expect given our sample
- Centered at the null hypothesized value



P-value

- Calculated based on the sampling distribution (based on the null hypothesis)
- Tells us how likely our sample statistic is, given your null hypothesis
- Compared to a *significance level* or *alpha level* (typically 0.05)

Decision

Small p-value



Reject the null hypothesis

α

Big p-value



Do not reject the null hypothesis

Conclusion

- If we REJECT the null hypothesis -> we conclude in favor of the alternative hypothesis (often called "statistical significance" a better term may be "statistical discernibility")
- If we DO NOT REJECT the null hypothesis -> there is NOT enough evidence to reject the null hypothesis

Example Conclusion

- Recall the research question:
 - Are more than 10% of people left-handed?
- Suppose our p-value was 0.3
 - Since this is larger than 0.05 (our alpha value)
- We decide to not reject the null hypothesis
 - We conclude that likely 10% of people are left-handed

Hypothesis Testing Activity

Summary

- There are many steps to the hypothesis test (overview on slide 9)
- Hypothesis tests help us test a claim while taking into account sampling variability
- They provide one form of evidence to help answer a research question