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 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%

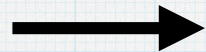9%

20%

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

Recap

What did we do on the last slide?:

- Considered past research; our "gold standard"

- Compared our sample results 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 $\longrightarrow$ Hypothesis Testing

Hypothesis Testing

Purpose: <u>to test a claim</u> about a <u>population parameter</u>

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** based on the p-value

7. Communicate your **conclusion** in context
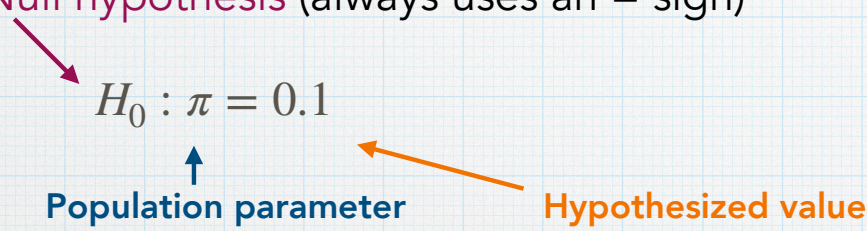
Example: Research Question

Are 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 <u>is</u> an effect or difference (a statement of inequality)

  - The "exciting" hypothesis

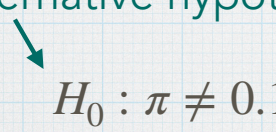 - Aligns with the research question

Example: Hypotheses

- Null hypothesis (always uses an = sign)

$$H_0 : \pi = 0.1$$

Population parameter   **Hypothesized value**

- Alternative hypothesis (sign based on the research question)

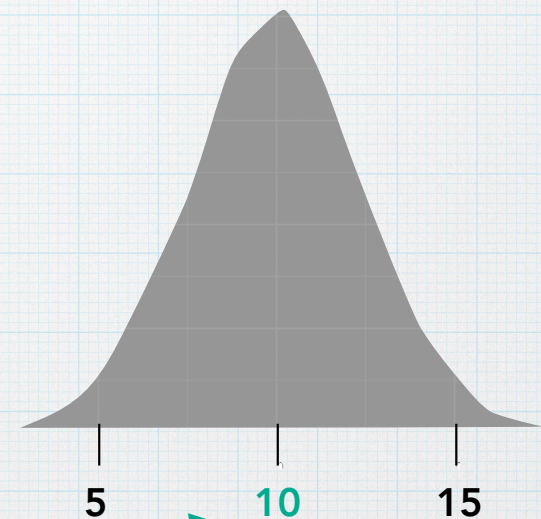$$H_0 : \pi \neq 0.1$$

Example: Hypotheses

- In other cases the alternative might be:

$$H_a : \pi > 0.1$$

$$H_a : \pi < 0.1$$

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

5   10   15

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

α

Small p-value

Big p-value

Reject the null hypothesis

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 <u>DO NOT REJECT</u> the null hypothesis -> there is NOT enough evidence to reject the null hypothesis

Example Conclusion

- Recall the research question:

    - Are 10% of people left-handed?

- Suppose our p-value was 0.3

    - Since this is larger then 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