EPSY 5261 : Introductory Statistical Methods

Day 12

Hypothesis Testing for Comparing Two Proportions

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 for comparing groups
  - Describe a parametric approach to hypothesis testing for comparing two proportions
  - List the assumptions for using the z-distribution to test for a difference in proportions

Recall: Variable Types

- We have been working with quantitative data
  - The population mean ($\hat{p}$) has been our parameter of interest
- Sometimes we have two groups that we want to compare (this could be an additional categorical variable)
  - The parameter of interest is now $p_{group1} - p_{group2}$

Hypothesis Testing

- Purpose: to test a claim about a population parameter
- One Group
  - *RQ: Is the proportion of people who vote democrat different than 0.5?*
- *Two Groups*
  - *RQ: Is there a difference in the proportion of people that vote democrats between those that live in rural and urban areas?*

Steps of Hypothesis Testing

1. Formulate a **research question**
2. Write your **hypotheses**
3. Find **Distribution** of 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

Assumptions

- $n_1\hat{p}_1 > 10$ and $n_1(1-\hat{p}_1)$ AND
- $n_2\hat{p}_2 > 10$ and $n_2(1-\hat{p}_2)$
  - For difference in means: conditions must be met for <u>both</u> groups
- If these are not met, better to use a randomization test

Type I and Type II Errors

- When we conduct a test - we come to a conclusion based on your p-value
  - Reject the null hypothesis OR not reject the null hypothesis
- However, this conclusion could be "incorrect"
- One of two things could have happened based on our p-value:
  - 1. We got a low p-value and rejected the null hypothesis but *we should not have based on the true population parameter*
  - 2. We got a high p-value and we did not reject the null hypothesis but *we should have based on the true population parameter*

Type I and Type II Errors

Type I: We say there is a significant result, when there really is NOT.

Type II: We say there is NOT a significant result, when there really IS.

Decision	TRUTH	
	H_0 is true	H_0 is false
We reject H_0	Incorrect: Type I error	Correct decision! ☺
We fail to reject H_0	Correct decision! ☺	Incorrect: Type II error

Example: Marijuana Users Executive Functioning

- H_0: $\mu_u - \mu_n = 0$
- H_a: $\mu_u - \mu_n \neq 0$
- Decision: We rejected the null hypothesis
  - Type I: Test concludes that there is a difference in average response time between marijuana users and non-users, when in reality there is none.

In the activity: At $\alpha = .05$: We rejected the null – hopefully we were right, but we could have made a Type I error.

Example: Drug trial - Type I

- H_0: $\mu_u - \mu_n = 0$
- H_a: $\mu_u - \mu_n \neq 0$
- Decision: We rejected the null hypothesis
  - Type I: Test concludes that there is a difference in average response time between marijuana users and non-users, when in reality there is none.

In the activity: At $\alpha = .05$: We rejected the null – hopefully we were right, but we could have made a Type I error.

Example: Drug trial - Type II

- H_0: Drug does not work better than placebo
- Ha: Drug does work better than placebo
- Type 2: conclude drug does NOT work, but it does
  - Consequence: Potentially beneficial drug does not get sold!
  - Producer risk - producers missing out on an opportunity
  - Consumers also missing out on effective treatment

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Use R Studio

- Use the z-distribution to help us get our estimate for the variability
- Use functions in R Studio to also give us our p-value
- We will explore the entire hypothesis test process and consider type I and type II errors in today's activity!

Testing for a Difference in Proportions Hypothesis Testing Activity

Summary

- 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
- We can use a z-distribution to help us conduct our test when we have categorical data