

Hypothesis Testing

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Today's Blueprint

Last Class

- Sampling
 - The basics of sampling
 - Types of samples

Today's Class

- Hypothesis Testing
 - The General Idea
 - Error in Hypothesis Testing

The Big Picture...

The Big Picture

- Using a sample to learn about a population is a process known as *inferential statistics*

The Big Picture

- Two ways to learn about a population (one can make *statistical inferences* using):
 - Confidence intervals (inductive approach)
 - Hypothesis testing (deductive approach)
- For this class, we will focus on #2

The General Idea of Hypothesis Testing

The General Idea

- Hypothesis Testing:
 - Allows us to use sample data to *test a claim* about a population, such as testing whether a population proportion or population mean equals some number
 - *Example:* Is the true average amount that students spent weekly on alcohol \$20?

The General Idea

- The Steps Involved in Hypothesis Testing:
 - Make an initial assumption
 - Collect evidence (data)
 - Based on the available evidence, decide whether or not the initial assumption is reasonable

The General Idea

- It is either *likely* or *unlikely* that we would collect the evidence we did *given the initial assumption*
 - *Note:* “Likely” or “unlikely” is measured by calculating a probability ☺

The General Idea

- If it is *likely*, then:
 - We “*do not reject*” our initial assumption.
 - Why? Because there is not enough evidence to do otherwise

The General Idea

- If it is *unlikely*, then:
 - Either our initial assumption is correct and we experienced an unusual event
 - Or our initial assumption is incorrect

The General Idea

- In statistics, if it is unlikely, then we decide to “*reject*” our initial assumption

The General Idea

- First, state 2 hypotheses, the *null hypothesis* (“ H_0 ”) and the *alternative hypothesis* (“ H_A ”)
 - H_0 : Defendant is not guilty
 - H_A : Defendant is guilty

The General Idea

- An Aside: Telling them apart (FYI)
 - The *null hypothesis* always represents the status quo (*i.e.* the hypothesis that requires no change in current behavior)
 - The *alternative hypothesis* is the conclusion that the researcher is trying to make

The General Idea

- Then, collect evidence:
 - In a criminal trial, evidence can be finger prints, DNA samples, ransom notes, etc
 - In statistics, the *data* are the evidence

The General Idea

- Next, make initial assumption
 - Defendant is innocent until proven guilty
 - In statistics, we always *assume the null hypothesis is true*

The General Idea

- Finally, make a decision based on the available evidence

The General Idea

- If there is sufficient evidence (“beyond a reasonable doubt”), *reject the null hypothesis*
 - (Behave as if defendant is guilty)

The General Idea

- If there is not enough evidence, *do not reject the null hypothesis*.
 - (Behave as if defendant is not guilty)

Errors in Hypothesis Testing

Errors in Hypothesis Testing

- Error and the Notion of Indirect Proof:
- Neither decision entails proving the null hypothesis or the alternative hypothesis

Errors in Hypothesis Testing

- We merely state there is enough evidence to behave one way or the other

Errors in Hypothesis Testing

- This is also always true in statistics!
- No matter what decision we make, *there is always a chance we made an error*

Errors in Hypothesis Testing

- *Why?*
 - Because the entire population is not measured directly in statistical hypothesis testing.
 - Statistical tests can never prove if the null is true or false

Errors in Hypothesis Testing

- Types of Errors:

- The null hypothesis can either be true or false, and in both cases, it can be rejected or retained (accepted)

Errors in Hypothesis Testing

- Therefore, you can be either right or wrong about your decision to accept or reject a true or false hypothesis

Insert Table Describing Type I and Type II Errors Here

Errors in Hypothesis Testing

- *Type 1 Errors*: The Null hypothesis is rejected when it is true
- *Type 2 Errors*: The null hypothesis is not rejected when it is false

Errors in Hypothesis Testing

- There is always a chance of making one of these errors
- Therefore, the goal is to minimize the chance of making one of these errors

Reference

- FYI:
 - Levin, Jack and James Alan Fox. 2003. Elementary Statistics In Social Research, 9th Edition. Boston, MA: Pearson Education Group, Inc.
 - Frankfort-Nachmias, Chava and David Nachmias. 1996. Research Methods in the Social Sciences, 5th Edition. New York, NY: St. Martin Press.