

Lecture 22: Chapter 6

Section 6D: Statistical Inference

Statistical Significance

Definition 1. A set of measurements or observations in a statistical study is said to be **statistically significant** if it is unlikely to have occurred by chance.

Example 1. Let's say BYU won the division 1 NCAA championship for basketball in the upcoming season. Is this statistically significant?

We now seek to eliminate ambiguity by quantifying statistical significance.

Definition 2. If the probability of an observed difference occurring by chance is x in 100 or less, the difference is statistically significant at the $x/100$ level.

Definition 3. If the probability of an observed difference occurring by chance is 5 in 100 (0.05) or less, the difference is statistically significant at the 0.05 level.

Margin of Error and Confidence Intervals

Definition 4. Suppose you draw a single sample of size n from a large population and measure its sample proportion. The **margin of error** for 95% confidence is

$$\text{margin of error} \approx \frac{1}{\sqrt{n}}$$

The 95% **confidence interval** is found by subtracting and adding the margin of error from the sample proportion. You can be 95% confident that the true population proportion lies within this interval. The margin of error decreases as the sample size increases.

Example 2. Find the margin of error and 95% confidence interval for the following surveys.

- a. A survey of 1300 people finds 65% are going to college next year.
- b. A survey of 58392 people finds 94% enjoy mathematics.

Hypothesis Testing

People often make statistical claims in the world. How can we know if such claims are valid? **Hypothesis testing** provides a way.

Definition 5. The **null hypothesis** claims a specific value for a population parameter. It takes the form

$$\text{null hypothesis : } \text{population parameter} = \text{claimed value}$$

Definition 6. The **alternative hypothesis** is the claim that is accepted if the null hypothesis is rejected.

Example 3. Sam believes he can run 21 mph whereas his friends claims his true maximum attainable speed is less than 18 mph. What are the null and alternative hypotheses?

To Reject or Not

The following is the method for determining whether or not to reject or keep a null hypothesis:

We decide the outcome of a hypothesis test by comparing the actual sample result (mean or proportion) to the result expected if the null hypothesis is true.

1) If the chance of a sample result at least as extreme as the observed result is less than 1 in 100, the test is significant at the 0.01 level. The test offers strong evidence for rejecting the null hypothesis and accepting the alternative hypothesis.

2) If the chance of a sample result at least as extreme as the observed result is less than 1 in 20, the test is significant at the 0.05 level. The test offers moderate evidence for rejection the null hypothesis.

3) If the chance of a sample result at least as extreme as the observed result is greater than 1 in 20, the test is not significant. The test does not provide sufficient grounds for rejecting the null hypothesis.

Example 4. Assume that a manufacturer of cereal purports that each box he sells contains 1.54 pounds of cereal on average. After randomly sampling 318 boxes of cereal, you determine the average amount to be 1.32 pounds. You determine if the manufacturer's claim is true, the probability of attaining an average of 1.32 pounds for your sample is .012. Formulate the null and alternative hypotheses and state whether the sample provides evidence for rejecting or keeping the null hypothesis.