9.2 Significance Tests for a Population Proportion

Learning Objectives:

1. State and check the Random, 10%, and Large Counts conditions for performing a significance test about a population proportion.
2. Perform a significance test about a population proportion.
3. Interpret the power of a test and describe what factors affect the power of a test.
4. Describe the relationship among the probability of a Type 1 error (significance level), the probability of a Type II error, and the power of a test.

Vocabulary: test statistic, one sample z test for a population proportion, power

Read 554–557

What are the three conditions for conducting a significance test for a population proportion? How are these different than the conditions for constructing a confidence interval for a population proportion?

We use a ____________________ to measure how far a sample statistic diverges from the expected/assumed value if the null hypothesis were true. This value is used to find the _______________.

Formula:

Read 557–560

What are the four steps for conducting a significance test? What is required in each step?

1) **STATE**: What _____________________ do you want to test and at what ____________________ _______________? Define any parameters (variables) you use.

2) **PLAN**: Identify the appropriate ____________________________ and check the _____________.

3) **DO**: Draw a picture! If conditions are met, perform the appropriate ______________________.

4) **CONCLUDE**: Make a _____________________ about the hypothesis in ___________________.

What test statistic is used when testing for a population proportion? Is this on the formula sheet?

<u>Alternate Example</u>: *Kissing the right way*
According to an article in the San Gabriel Valley Tribune (February 13, 2003), "Most people are kissing the 'right way.'" That is, according to a study, the majority of couples prefer to tilt their heads to the right when kissing. In the study, a researcher observed a random sample of 124 kissing couples and found that 83/124 of the couples tilted to the right. Is this convincing evidence that couples really do prefer to kiss the right way?

HW page 552 (23, 24, 25–28), page 570 (31, 33, 35, 39)

9.2 Two-sided tests for a proportion

Read 562–564

Alternate Example: *Benford's law and fraud*

When the accounting firm AJL and Associates audits a company's financial records for fraud, they often use a test based on Benford's law. Benford's law states that the distribution of first digits in many real-life sources of data is not uniform. In fact, when there is no fraud, about 30.1% of the numbers in financial records begin with the digit 1. However, if the proportion of first digits that are 1 is significantly different from 0.301 in a random sample of records, AJL and Associates does a much more thorough investigation of the company. Suppose that a random sample of 300 expenses from a company's financial records results in only 68 expenses that begin with the digit 1. Should AJL and Associates do a more thorough investigation of this company?

Can you use confidence intervals to decide between two hypotheses? What is an advantage to using confidence intervals for this purpose? Why don't we always use confidence intervals?

<u>Alternate Example</u>: *Benford's law and fraud*
A 95% confidence interval for the true proportion of expenses that begin with the digit 1 for the company in the previous Alternate Example is (0.180, 0.274). Does the interval provide convincing evidence that the company should be investigated for fraud?

HW page 571 (37, 41–49 odd)

9.2 Type II Errors and the Power of a Test

Can you use your calculator for the Do step? Are there any drawbacks to this method?

Read 565–569

The ____________ of a test against a specific H_a is the probability that the test will reject H_o at a chosen significance level α when the H_a is true.

Will you be expected to calculate the power of a test on the AP exam?

In the potato example, suppose that the true proportion of blemished potatoes is $p = 0.10$. This means that we should reject H_0 because $p = 0.10 > 0.08$.

(a) Will the inspector be more likely to find convincing evidence that $p > 0.08$ if he looks at a small sample of potatoes or a large sample of potatoes? How does sample size affect power?

(b) Will the inspector be more likely to find convincing evidence that $p > 0.08$ if he uses $\alpha = 0.10$ or $\alpha = 0.01$? How does the significance level affect power?

(c) Suppose that a second shipment of potatoes arrives and the proportion of blemished potatoes is $p = 0.50$. Will the inspector be more likely to find convincing evidence that $p > 0.08$ for the first shipment ($p = 0.10$) or the second shipment ($p = 0.50$)? How does "effect size" affect power?

(d) Is there anything else that affects power?

(e) Suppose that the true proportion of blemished potatoes is $p = 0.11$. If $\alpha = 0.05$, the power fo the test is 0.76. Interpret this value.

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(f) What is the probability of a Type II error for this test? Interpret this value.

In the Benford's Law and Fraud example from the previous lesson, we tested the claim that about 30.1% of the numbers in financial records begin with the digit 1. Suppose that $p = 0.25$. That is, 25% of all financial records at this company begin with the digit 1. When $\alpha = 0.05$, the power of the test is 0.58.

(a) Interpret this value.

(b) How can AJL and Associates increase the power of their test?

(c) For what values of p would the power of the test be greater than 0.58, assuming everything else stayed the same?

HW page 572 (51–57 odd, 59–62)