

## Section 7.4 - Hypothesis Testing for Proportions

1. Note: By assuming  $H_0$ , we assume that we know  $p$  (and hence  $q$ ). Thus, we can use

$$\sigma_{\hat{p}} = \sqrt{\frac{pq}{n}}, \text{ instead of } \sigma_{\hat{p}} = \sqrt{\frac{\hat{p}\hat{q}}{n}}, \text{ as with confidence intervals. Also, recall } \mu_{\hat{p}} = p.$$

2.  **$z$ -test for a proportion:** Need  $np \geq 5$  and  $nq \geq 5$ .

- Idea: testing a claim (null hypothesis) about  $p$  (test statistic =  $\hat{p}$ ).

- $$z = \frac{\hat{p} - \mu_{\hat{p}}}{\sigma_{\hat{p}}} = \frac{\hat{p} - p}{\sqrt{pq/n}}$$

3. Hypothesis Test for  $p$ . First verify that  $np \geq 5$  and  $nq \geq 5$ .

(a) Describe  $p$  in words.

(b) Identify  $H_0$  and  $H_a$ .

(c) Specify level of significance ( $\alpha$ ).

(d) Assume that  $H_0$  is true.

(e) Sketch the sampling distribution of  $\hat{p}$  (Note if test is left-tailed, right-tailed, or 2-tailed.)

(f) Find the standardized test statistic,  $z$ , and the  $P$ -value.

(g) Compare  $P$ -value to  $\alpha$  to determine whether to reject  $H_0$  or fail to reject  $H_0$ .

(h) Interpret the decision in the context of the original claim, and state your  $P$ -value.

4. Example #1:

A department store decides to examine the proportion of shoppers interested in a boutique format for the store's basement. Of the 250 shoppers surveyed, 175 think it would be a good idea.

(a) Say in words what the population proportion  $p$  is for this situation.

(b) If  $\alpha = 0.05$ , do you have enough evidence to conclude that the majority of shoppers feel that the boutique format is a good idea.

5. Example #2:

A government association claims that 44% of all adults in the United States do volunteer work. You work for a volunteer organization and are asked to test this claim. You find that in a random sample of 1165 adults, 556 do volunteer work. At  $\alpha = 0.05$ , do you have enough evidence to reject the association's claim?

6. Explain to someone who knows no statistics what your  $P$ -value from Example #2 means.

7. Example #3:

An experiment on the side effects of pain relievers assigned arthritis patients to one of several over-the-counter pain medications. Of the 440 patients who took one particular brand of pain reliever, 26 suffered some "adverse symptom."

(a) If 10% of all patients suffer adverse symptoms, what would be the sampling distribution of the proportion with adverse symptoms in a sample of 440 patients?

(b) Does the experiment provide strong evidence that fewer than 10% of patients who take this particular medication have adverse symptoms? (Use a 5% level of significance.)

8. Example #4: USA Today reported that about 47% of the general consumer population in the United States is loyal to the automobile manufacturer of their choice. Suppose that Chevrolet did a study of a random sample of 1006 Chevrolet owners and found that 490 said that they would buy another Chevrolet. Does this indicate that the population proportion of consumers loyal to Chevrolet is more than 47%?" Use  $\alpha = 0.05$ . (Be sure to show ALL the steps of this hypothesis test.)