Hypothesis Testing

Two Sample Proportions

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Much of the material will be the two-sample version of hypothesis testing of a single proportion.

Test Statistic and p-Value

The test statistic for two sample proportions is given by

$$t = \frac{(\hat{p}_1 - \hat{p}_2) - (p_1 - p_2)}{\sqrt{\frac{\hat{p}_1(1-\hat{p}_1)}{n_1} + \frac{\hat{p}_2(1-\hat{p}_2)}{n_2}}}$$

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The p-value is found in the same manner as other sections.

Just For Pools and Giggles

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The test statistic then becomes

$$t = \frac{(\hat{p}_1 - \hat{p}_2) - (p_1 - p_2)}{\sqrt{\hat{p}(1 - \hat{p})\left(\frac{1}{n_1} + \frac{1}{n_2}\right)}}$$

Confidence Intervals

The $1 - \alpha$ confidence interval is calculated as

$$(\hat{p}_1 - \hat{p}_2) \pm z_{\alpha/2}\sqrt{\frac{\hat{p}_1(1-\hat{p}_1)}{n_1} + \frac{\hat{p}_2(1-\hat{p}_2)}{n_2}}$$

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Remember, if our confidence interval contains the claimed difference in population proportions, we do not reject the null hypothesis.

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- Each sample size is large enough so that the differences in sampling proportions is approximately normal
  - Good to go if $n_1\hat{p}_1$, $n_1(1-\hat{p}_1)$, $n_2\hat{p}_2$, and $n_2(1-\hat{p}_2)$ are each greater than 5.

Example 1

A poll of 450 registered voters is taken and 43% of them would vote for the incumbent candidate. A week later a poll of 300 different registered voters is taken and 41% of them would vote for the incumbent candidate.

At the $\alpha = 0.05$ significance level, test the claim that the proportions of all registered voters would vote for the incumbent candidate is now different.

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$H_0: p_1 = p_2$
$H_A: p_1 \neq p_2$

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$H_0 : \; p_{\text{men}} = p_{\text{women}}$

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$H_0: \; p_{\text{men}} = p_{\text{women}}$
$H_A: \; p_{\text{men}} > p_{\text{women}}$