Multiple Proportions

Confidence Interval does not apply

One Categorical Variable (Goodness of Fit)

Parameters: $p_1, p_2, \dots, p_k$
Point estimates: $\hat{p}_1, \hat{p}_2, \dots, \hat{p}_k$

Hypotheses:

$H_0: p_1 = p_{1,0}, p_2 = p_{2,0}, \dots, p_k = p_{k,0}$
H_a: At least one $p_i \neq p_{i,0}$ for $i \in \{1, \dots, k\}$

Test Statistic Random Variable (Assuming H_0)

$$X^2 = \sum_{\text{all cells}} \frac{(\text{observed} - \text{expected})^2}{\text{expected}} \sim \chi^2(df = k-1)$$

Observed Test Statistic

$$x^2_{obs} = \sum_i \frac{(n_{obs,i} - n_{exp,i})^2}{n_{exp,i}}$$

P-value

$P(X^2 \geq x^2_{obs})$

Two Categorical Variables (Test of Independence)

(Assuming # of Rows $R = 2$ & # of Columns k)

Hypotheses

$H_0: p_1 = p_2 = p_3 = \dots = p_k$
H_a: At least one p_i is different for $i \in \{1, \dots, k\}$

Test Statistic Random Variable (Assuming H_0)

$$X^2 = \sum_{\text{all cells}} \frac{(\text{observed} - \text{expected})^2}{\text{expected}} \sim \chi^2(df = k-1)$$

Observed Test Statistic

x^2_{obs}: Replace "observed" w/ values in table & expected with $\frac{(\text{row } i \text{ total}) \times (\text{column } j \text{ total})}{\text{table total}}$

P-value

$P(X^2 \geq x^2_{obs})$