

## How many variables?

### One Variable

### Two Variables

#### Categorical

#### One-Sample z-test for proportion

To test whether a population proportion is different than some hypothesized value.

#### Hypothesis Test:

$H_0: p = p_0$   
 $H_a: p \neq p_0$  or  $><$

$$z = \frac{\hat{p} - p_0}{\sqrt{\frac{p_0(1-p_0)}{n}}}$$

p-value = normalcdf(lower, upper, 0, 1)

#### Quantitative

#### One-Sample t-test for mean

To test whether there is a difference between a population mean and some hypothesized value.

#### Hypothesis Test:

$H_0: \mu = \mu_0$   
 $H_a: \mu \neq \mu_0$  or  $><$

$$t = \frac{\bar{x} - \mu_0}{\frac{s}{\sqrt{n}}}$$

p-value = tcdf(lower, upper, df)

#### Both Categorical

#### Two-Sample Proportion

To test whether two population proportions differ.

#### Hypothesis Test:

$H_0: p_1 = p_2$   
 $H_a: p_1 \neq p_2$  or  $><$

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

Where  $\hat{p} = \frac{x_1 + x_2}{n_1 + n_2}$

p-value = normalcdf(lower, upper, 0, 1)

#### Chi-Square

Used to test for a relationship in population between two categorical variables

#### Hypothesis Test:

$H_0$ : There is no relationship in population between Var 1 & Var 2  
 $H_a$ : There is a relationship in population between Var 1 & Var 2

$$X^2 = \sum \frac{(\text{observed} - \text{expected})^2}{\text{expected}}$$

p-value =  $X^2$ cdf(lower, upper, df)

#### One of Each

#### Two-Sample t-test

To test for a difference in two independent population means

#### Hypothesis Test:

$H_0: \mu_1 = \mu_2$   
 $H_a: \mu_1 = \mu_2$  or  $><$

$$t = \frac{\bar{x}_1 - \bar{x}_2}{\sqrt{\left(\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}\right)}}$$

p-value = tcdf(lower, upper, df)

#### ANOVA F-test

To test whether at least one group mean differs from the others

#### Hypothesis Test:

$H_0: \mu_1 = \mu_2 = \mu_3 \dots \mu_i$   
 $H_a$ : at least one  $\mu_i$  different from others

$$F = \frac{MSB}{MSE}$$

p-value = Fcdf(lower, upper, df<sub>1</sub>, df<sub>2</sub>)

#### Both Quantitative

#### Paired t-test

To test whether there is an average difference between two dependent (paired) populations

#### Hypothesis Test:

$H_0: \mu_d = 0$   
 $H_a: \mu_d \neq 0$  or  $><$

$$t = \frac{\bar{x}_d}{\frac{s_d}{\sqrt{n}}}$$

Where  $s_d = \sqrt{\frac{\sum(d_i - \bar{d})^2}{n-1}}$

p-value = tcdf(lower, upper, df)

#### Simple Linear Regression

To test for a linear relationship in population between two quantitative variables

#### Population Regression Model:

$$Y = \beta_0 + \beta_1 X_1 + \varepsilon$$

#### Overall F-test:

$$F = \frac{MSB}{MSE}$$

p-value = Fcdf(lower, upper, df<sub>1</sub>, df<sub>2</sub>)