

# Final Review – Part 4: 2-Sample Hypothesis Tests

## Basics

- A hypothesis test problem will ask you to test a claim.
- Look for a significance level, not a confidence level.
- Use the 5 step process.
  1. State  $H_0$  &  $H_1$ .
  2. State the level of significance  $\alpha$ .
  3. State which test you are performing.
  4. State the calculated value of the test statistic and P-value from StatCrunch.
  5. Make a decision about  $H_0$ . (Reject  $H_0$  or Fail to Reject  $H_0$ )  
Make a conclusion about  $H_1$ . (There {is/is not} sufficient evidence to conclude that “ $H_1$  is true”.)
- These tests will use 2 samples to compare one population to another.

## Two Proportion Hypothesis Test

- The wording should indicate that we are testing a claim about proportion or percentages, and may involve the idea of “likelihood”.
- The claim should compare the proportion/percentage of one group to another group.
- The sample information provided will be two sets of  $x$  out of  $n$ .
- The data gathered would be categorical, not numerical.
- No standard deviation will be provided.
- StatCrunch steps:  
Stat > Proportions > 2-sample > With Summary  
For each sample enter  $x$  for the number of successes, and  $n$  for the number of observations.  
Enter correct sign in the alternative hypothesis and press compute! for test statistic & P-value.

## Paired Difference Hypothesis Test

- The wording should indicate that we are testing a claim involving two paired groups.
- The claim should compare the mean of one group to another group.
- The sample information provided will be two sets of numerical data.  
Each set will have the same number of values.  
There will be a clear one-to-one relationship between one value in the first group and one value in the second group.
- The data gathered would be numerical, not categorical.
- StatCrunch steps:  
Type data in two separate columns.  
Stat > T-statistics > Paired  
Select the correct columns for sample 1 & sample 2.  
Enter the correct sign in the alternative hypothesis.  
Press compute! to find the test statistic and P-value.

## Two Mean Hypothesis Test

- The wording should indicate that we are testing a claim about means.
- The claim should compare the mean of one group to another group.
- The sample information provided will either be two sets of sample mean/sample standard deviation/ $n$  or two sets of numerical data.
- The data gathered would be numerical, not categorical.
- StatCrunch steps:

### ***Given mean/s.d./n***

Stat > T-statistics > 2-sample > With Summary

For each sample, enter sample mean, standard deviation, size.

Enter the correct sign in the alternative hypothesis.

Press compute! to find the test statistic and P-value.

### ***Given data***

Type data in two separate columns.

Stat > T-statistics > 2-sample > With Data

Enter the correct sign in the alternative hypothesis.

Press compute! to find the test statistic and P-value.

## Examples

1) A random sample of 300 Fresno State students contained 165 females. A random sample of 200 COS students contained 118 females. At the 0.05 level of significance, test the claim that the proportion of Fresno State students that are female is the same as the proportion of COS students that are female.

*“Test the claim that ...” & “0.05 level of significance” → Hypothesis Test Problem*

*Proportions are mentioned in the problem, two sets of  $x$  out of  $n$ , the data are categorical → Hypothesis Test for Two Proportions*

### **ANSWER:**

1. Population #1: Fresno State students

$$H_0: p_1 = p_2$$

$$H_1: p_1 \neq p_2$$

2.  $\alpha = 0.05$

3. Two Proportion Test

4.  $z = -0.88$ , P-value = 0.3766

5. Fail to Reject  $H_0$ .

There is NOT sufficient evidence to conclude that the proportion of Fresno State students that are female is different than the proportion of COS students that are female.

2) Eight students enrolled in an SAT test prep class. Here are their scores before and after the class. At the 0.05 level of significance, test the claim that the test prep class improved the students' scores.

Before	1000	1110	940	900	980	650	1200	1050
After	1090	1150	1000	870	970	900	1400	1130

*“Test the claim that ...” & “0.05 level of significance” → Hypothesis Test Problem*

*The data are numerical, the data are numerical and paired (same student before & after), → Hypothesis Test for Paired Differences*

### **ANSWER:**

1.  $d = \text{Before} - \text{After}$

$$H_0: \mu_d = 0$$

$$H_1: \mu_d < 0$$

2.  $\alpha = 0.05$

3. Paired Difference Test

4.  $t = -2.49$ , P-value = 0.0209

5. Reject  $H_0$ .

There is sufficient evidence to conclude that the test prep class improved the students' scores.

**3)** A sample of 400 Fresno State students had a mean age of 22.3 years old, with a standard deviation of 8.5 years. A random sample of 125 COS students had a mean age of 25.1 years old, with a standard deviation of 10.7 years. At the 0.05 level of significance, test the claim that the mean age of Fresno State students is lower than the mean age of COS students.

*"Test the claim that ..." & "0.05 level of significance" → Hypothesis Test Problem*

*Mean is mentioned in the problem, the data (weights) would be numerical, two sets of sample mean and standard deviation provided → Hypothesis Test for Two Means*

**ANSWER:**

1. Population #1: Fresno State students

$H_0: \mu_1 = \mu_2$

$H_1: \mu_1 < \mu_2$

2.  $\alpha = 0.05$

3. Two Mean Test

4.  $t = -2.67$ , P-value = 0.0041

5. Reject  $H_0$ .

There is sufficient evidence to conclude that the mean age of Fresno State students is lower than the mean age of COS students.