

# Five Step Hypothesis Testing For Dependent T-test

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# Hypothesis Testing

The steps taken to decide whether or not the results of a study support a hypothesis or theory.

Hypothesis: a prediction intended to be tested in a research study.

May be based off of:

- ⇒ Informal observation
- ⇒ Related results of previous studies
- ⇒ Broder theory about topic of study

A theory is a set of principles that attempt to explain an important psychological process.



## Step 1

Restate the question as a research hypothesis and a null hypothesis about the populations.

## Step 2

Determine the characteristics of the comparison distribution.

## Step 3

Determine cutoff sample score on comparison distribution at which the null hypothesis should be rejected.

## Step 4

Determine sample score on comparison distribution.

## Step 5

Decide whether to reject the null hypothesis.

## Example problem using a dependent t-test:

Research indicates that the color red increases men's attraction to women (Elliott & Niesta, 2008). In the original study, men were shown women's photographs presented on either a white or a red background. Photographs presented on red were rated significantly more attractive than the same photographs mounted on white. In a similar study, a researcher prepares a set of 30 women's photographs, with 15 mounted on a white background and 15 mounted on red. One picture is identified as the test photograph and appears twice in the set, once on white and once on red. Each male participant looks through the entire set of photographs and rates the attractiveness of each woman on a 10-point scale. The following table summarizes the ratings of the test photograph for a sample of  $n=9$  men.

| Participant | White background | Red background |
|-------------|------------------|----------------|
| A           | 4                | 7              |
| B           | 6                | 7              |
| C           | 5                | 8              |
| D           | 5                | 9              |
| E           | 6                | 9              |
| F           | 4                | 7              |
| G           | 3                | 9              |
| H           | 8                | 9              |
| I           | 6                | 9              |

Are the ratings for the test photograph significantly different when it is presented on a red background compared to a white background? Use a two-tailed test with  $\alpha = .01$ .

**Step 1:** Restate the question as a research hypothesis and a null hypothesis about the populations.

Research Question: Are men more likely to rate higher on a scale of 10 if a picture of a woman is presented on a red background opposed to a white background?

Research Hypothesis: Pictures of woman presented to men on a red background are going to increase the attractiveness rating opposed to pictures presented on a white background.

Null Hypothesis: There will be no difference in attractiveness rating of pictures presented on a red background compared to pictures presented on a white background.

Population 1: Pictures that are presented on a red background

Population 2: Pictures that are presented on a white background

Null Hypothesis is always the opposite of the research hypothesis.

We do the study thinking that the null is true.

**Step 2:** Determine the characteristics of the comparison distribution.

In this step, you need to define the information needed to compare the two populations. That includes:

Comparison Distribution:  
the data or population you compare the sample to.

- ⇒ Mean
- ⇒ Variance
- ⇒ Standard Deviation

For a dependent t-test, you are comparing two scores that came from one individual so you have to find these things in relation to the difference of those two scores.

- A. Find the difference scores: White background scores—red background scores.
- B. Find the mean of the difference scores
- C. Subtract the mean from each difference score. This makes deviation scores.
- D. Square each deviation score and find the sum.

**Mean of White Back. = 5.22**

**Mean of Red Back. = 8.22**

**Mean of Difference Scores = -3**

**Sum of Squared Deviation Scores = 18**

| -3                          | 0                            | 0                        |  |
|-----------------------------|------------------------------|--------------------------|--|
| -1                          | 2                            | 4                        |  |
| -3                          | 0                            | 0                        |  |
| -4                          | -1                           | 1                        |  |
| -3                          | 0                            | 0                        |  |
| -3                          | 0                            | 0                        |  |
| -6                          | -3                           | 9                        |  |
| -1                          | 2                            | 4                        |  |
| -3                          | 0                            | 0                        |  |
| <b>Difference of Scores</b> | <b>Difference Scores + M</b> | <b>Squared Deviation</b> |  |

Since the variance is unknown, we have to find the estimated population variance of difference scores using this formula:  $S^2 = \frac{\Sigma(X-M)^2}{(N-1)} = \frac{SS}{df}$

$$S^2 = 18/8 = 2.25$$

$df$  = Degrees of Freedom:  $N-1$

Then using the estimated population variance, we find the variance of the distribution of means of difference scores using this formula:

$$S_M^2 = \frac{S^2}{N} \quad S_M^2 = \frac{2.25}{9} = .25$$

Lastly, we have to find the standard deviation of the distribution of means of difference scores using this formula:

$$S_M = \sqrt{S_M^2} \quad S_M = \sqrt{.25} = .50$$

**Step 3:** Determine cutoff sample score on comparison distribution at which the null hypothesis should be rejected.

This example problem is using a two-tailed test at the .01 significance level. To find the cutoff score, we have to use the chart for finding cutoff scores and find our degree of freedom which is 8. Then we slide across the chart for the column that shows .01 significance for a two-tailed test.

Cutoff Score = 3.356

**Step 4:** Determine sample score on comparison distribution.

For this step we need to use the formula to find a t score.

$$t = \frac{M - \mu}{S_M} \quad t = \frac{8.22 - 5.22}{.50} = 6$$

**Step 5:** Decide whether to reject the null hypothesis.

This step includes two parts: the APA statement and implications.

The APA statement is when you state whether you are rejecting the null hypothesis and stating the information.

The implications tells us to whom and why the results are important.

APA Statement: We rejected the null hypothesis because the t-score of 6 exceeded the cut-off score of 3.356. There is a statistically significant difference between the attractiveness rating on pictures that were presented on a red background (M=8.22 SD=.972) and pictures that were presented on a white background (M=5.22 SD=1.481).  $t(16) = 6, p < .01$ .

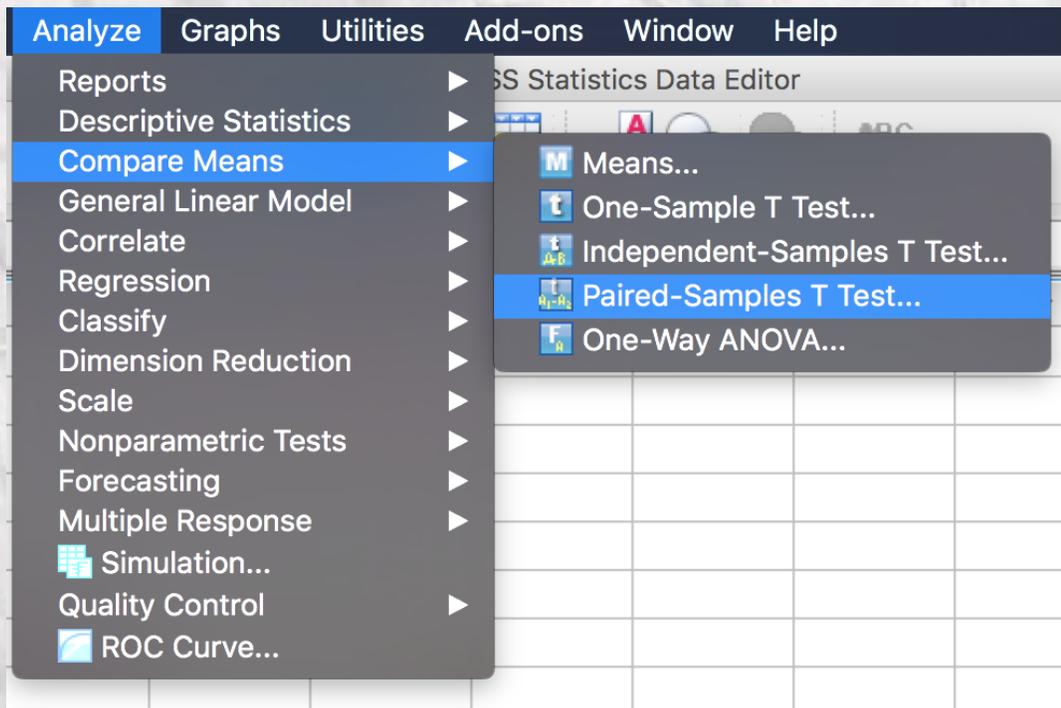
Implications: Women who participate in dating apps and websites might want to consider putting their profile picture on a red background to increase their attractiveness level to potential dates.

Using SPSS:

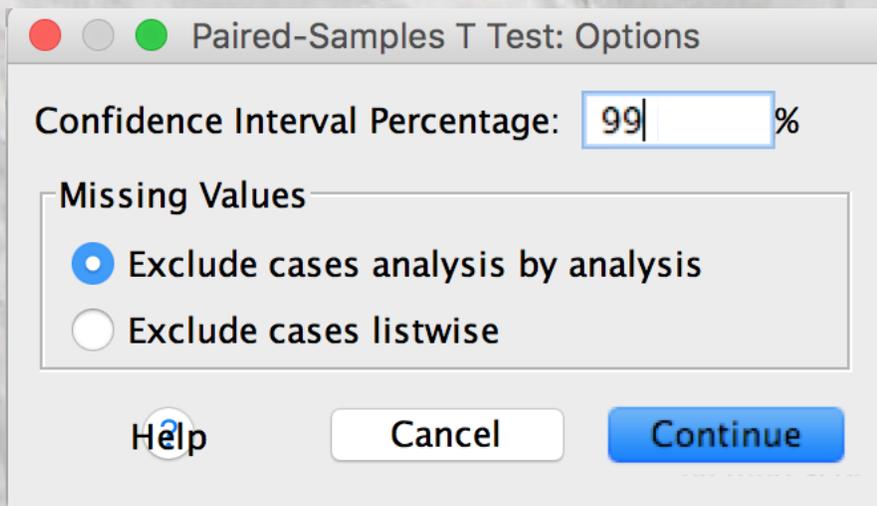
1. Enter data and make sure to label the two variables and identify them as scale.

|       |         |   |   |  |      |      |   |       |       |       |
|-------|---------|---|---|--|------|------|---|-------|-------|-------|
| White | Numeric | 8 | 2 |  | None | None | 8 | Right | Scale | Input |
| Red   | Numeric | 8 | 2 |  | None | None | 8 | Right | Scale | Input |

2. Then click analyze and paired t-test.



3. Make sure your significance level is set correctly.



## 4. Hit okay and analyze your results.

```
T-TEST PAIRS=Red WITH White (PAIRED)  
/CRITERIA=CI(.9900)  
/MISSING=ANALYSIS.
```

### → T-Test

|            | Mean   | N | Std. Deviation | Std. Error Mean |
|------------|--------|---|----------------|-----------------|
| Pair 1 Red | 8.2222 | 9 | .97183         | .32394          |
| White      | 5.2222 | 9 | 1.48137        | .49379          |

|                    | N | Correlation | Sig. |
|--------------------|---|-------------|------|
| Pair 1 Red & White | 9 | .309        | .419 |

|        |             | Paired Differences |                |                 |   | t       | df    | Sig. (2-tailed) |       |
|--------|-------------|--------------------|----------------|-----------------|---|---------|-------|-----------------|-------|
|        |             | Mean               | Std. Deviation | Std. Error Mean | 99% Confidence Interval of the Difference |         |       |                 |       |
|        |             |                    |                |                 | Lower                                     |         |       |                 | Upper |
| Pair 1 | Red - White | 3.00000            | 1.50000        | .50000          | 1.32231                                   | 4.67769 | 6.000 | 8               | .000  |