

## Tutorial 18: Independent Samples t-test

### Description

In this tutorial we will learn how to conduct an independent samples t-test. This test is used when we have two independent samples of data and we want to compare the means of both samples. Let's say we want to test whether the means are equal or different, then our hypotheses will be a two-tailed test represented as:

$$H_0: \mu_A = \mu_B, \text{ or } \mu_A - \mu_B = 0$$

$$H_a: \mu_A \neq \mu_B, \text{ or } \mu_A - \mu_B \neq 0 \text{ (note: the alternative hypothesis } H_a \text{ can also be denoted as } H_1)$$

This table outlines all the possible hypotheses that can be tested by an independent samples t test:

Two-tailed test	One-tailed test	One-tailed test
$H_0: \mu_A = \mu_B, \mu_A - \mu_B = 0$ $H_a: \mu_A \neq \mu_B, \mu_A - \mu_B \neq 0$	$H_0: \mu_A \leq \mu_B, \mu_A - \mu_B \leq 0$ $H_a: \mu_A > \mu_B, \mu_A - \mu_B > 0$	$H_0: \mu_A \geq \mu_B, \mu_A - \mu_B \geq 0$ $H_a: \mu_A < \mu_B, \mu_A - \mu_B < 0$

**Note:** we are using the datafile ARMF2020\_wave1andwave2.omv

For this tutorial we will examine the question whether there is a difference or not in the political leanings (pol\_continuum) of those who reported English as their native language compared to those who did not (Eng). Therefore our dependent variable is the variable measuring political leanings (pol\_continuum) and the independent variable is English as a native language (Eng), which will divide our data for pol\_continuum into two independent samples (one for those report English as their native language and a second group of those who say English is not their native language) . pol\_continuum asked participants to rate themselves on the following scale:

- Strongly Conservative (1)
- Somewhat Conservative (2)
- Slightly Conservative (3)
- Neither Conservative nor Liberal (4)
- Slightly Liberal (5)
- Somewhat Liberal (6)
- Strongly Liberal (7)

Eng asked participants the following: Is English your native or first language?

- Yes (0)
- No (1)

The two independent samples are:

A: Those with English as their native language (responded yes), and

B: Those who said English was NOT their native language (responded no).

$$H_0: \mu_{yes} = \mu_{no} \text{ or } \mu_{yes} - \mu_{no} = 0$$

$$H_a: \mu_{yes} \neq \mu_{no} \text{ or } \mu_{yes} - \mu_{no} \neq 0$$

**Data structure (Two Groups of Scores with Each Score a Measurement of the Same Variable)**

Subsample of data being tested

Eng	pol_continuum
No	6
No	7
No	4
No	6
No	6
Yes	6
Yes	4
Yes	4
Yes	7
Yes	7

**Note.** *t tests in Jamovi will only work with ordinal or continuous variables. If your variable is identified as nominal Jamovi will not allow you to select it for a t test. So before beginning please make sure that the variable you are interested in is ordinal (integer) or continuous.*

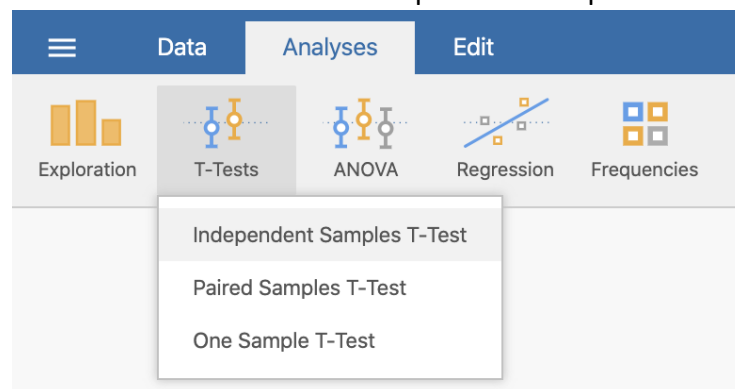
## Content

1. Selecting the test and variables
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4. APA Format describing the findings

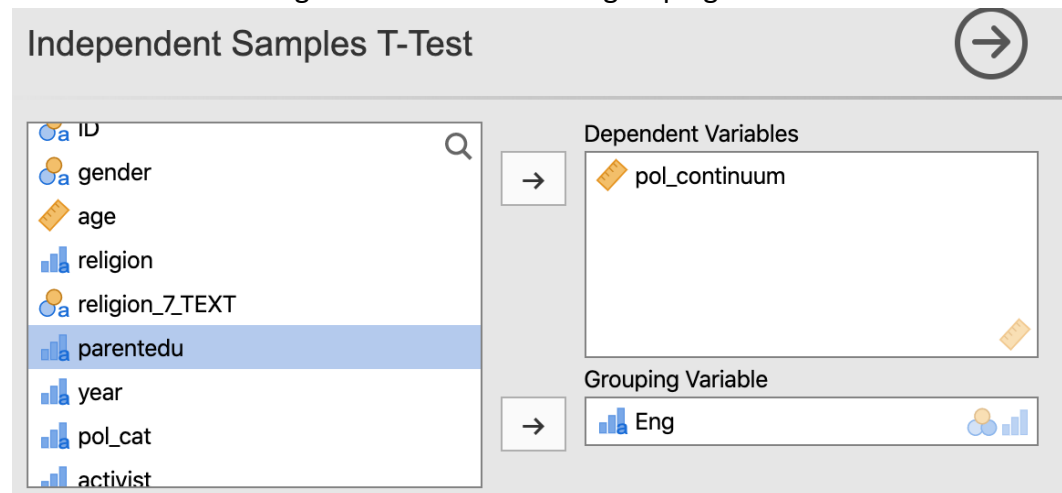
## STEPS

### 1. Selecting the test and variables

- a. Open Jamovi datafile for this dataset.
- b. Go to the 'Analyses' tab.
- c. Click on T-Tests and select 'Independent Samples T Test'.



- d. Select the variable 'pol\_continuum' and move it into the 'Dependent variable window'.
- e. Select the variable 'Eng' and move it into the 'grouping variable':



### 2. Selecting the statistics

- a. Below the variable windows you may specify the hypothesis you are testing and select the statistics you want reported in the output window on the right.
- b. First select the hypothesis by going to the Hypothesis section and selecting Group 1  $\neq$  Group 2, this selection is the alternative hypothesis we would expect

for our two tailed hypothesis:

$$H_0: \mu_{yes} = \mu_{no}$$

$$H_a: \mu_{yes} \neq \mu_{no}$$

**Note.** if you were conducting a one-tailed test you would select one of the other two options: Group 1 <Group 2, or Group 1 >Group 2

- c. Then select any additional statistics you would like reported, typically these include:
  - i. Effect size - this gives you Cohen's d
  - ii. Descriptives - this gives you the sample size, mean, median, standard deviation, and standard error
- d. Then under the 'Assumptions' section select 'Homogeneity test', this tests whether the variances for the two groups are similar/homogeneous or not.

Tests	Additional Statistics
<input checked="" type="checkbox"/> Student's	<input type="checkbox"/> Mean difference
<input type="checkbox"/> Bayes factor	<input type="checkbox"/> Confidence interval 95 %
Prior 0.707	<input checked="" type="checkbox"/> Effect size
<input type="checkbox"/> Welch's	<input type="checkbox"/> Confidence interval 95 %
<input type="checkbox"/> Mann-Whitney U	<input checked="" type="checkbox"/> Descriptives
	<input type="checkbox"/> Descriptives plots
Hypothesis	Assumption Checks
<input checked="" type="radio"/> Group 1 ≠ Group 2	<input checked="" type="checkbox"/> Homogeneity test
<input type="radio"/> Group 1 > Group 2	<input type="checkbox"/> Normality test
<input type="radio"/> Group 1 < Group 2	<input type="checkbox"/> Q-Q plot
Missing values	
<input checked="" type="radio"/> Exclude cases analysis by analysis	
<input type="radio"/> Exclude cases listwise	

### 3. Interpreting the results

- a. Below is the Jamovi output that is produced:

## Independent Samples T-Test

Independent Samples T-Test

		Statistic	df	p	Effect Size	
pol_continuum	Student's t	1.42	178	0.157	Cohen's d	0.257

## Assumptions

Homogeneity of Variances Test (Levene's)

	F	df	df2	p
pol_continuum	1.18	1	178	0.278

Note. A low p-value suggests a violation of the assumption of equal variances

Group Descriptives

		Group	N	Mean	Median	SD	SE
pol_continuum	Yes		141	5.67	6.00	1.31	0.110
	No		39	5.33	6.00	1.38	0.221

- b. Interpreting the independent samples t test
- Provides a t- statistic under 'Statistic'
  - degrees of freedom under 'df'
  - p-value under 'p'
  - provides Cohen's d as the effect size under 'Effect Size'
  - We can conclude if our null hypothesis  $H_0: \mu_{yes} = \mu_{no}$  should be rejected or retained by observing the p-value in the Independent Samples T Test table, if the p-value is less than .05 then we reject the null hypothesis but if p-value is  $>.05$ , in our case  $p = .157$  which is larger than .05 then we retain the null hypothesis and conclude that the two means  $\mu_{yes}$  and  $\mu_{no}$  are approximately the same but definitely not statistically significantly different from one another. So we can conclude that there is no difference in the political leanings of those who report English as their native language and those who do not.
  - Because the means are not statistically different there is no need to interpret Cohen's d.
- c. Interpreting the Homogeneity test
- Jamovi conducts a Levene's F test to test whether there is a difference in the variance in political leanings for each group (yes vs no).
  - To interpret this test observe the p-value again if the p-value is less than

.05 then we can conclude that the variances are statistically different therefore are not homogeneous and the homogeneity of variance assumption is violated. We cannot trust the Student's *t* test results if this is the case. We then must conduct a Welch's *t* test which can be selected under the 'Tests' section.

- iii. If the *p*-value is  $> .05$ , then the assumption holds and the Student's *t* test we have conducted can be trusted. This is the case for our test because  $p = .278$ .

d. Interpreting the descriptives table

- i. The descriptives provide us with the means in political leanings for each sample,  $M_{\text{yes}} = 5.67$  and  $M_{\text{no}} = 5.33$ , and these are the means being compared. While the mean for 'yes' group is bigger than the mean for the 'no' group the test suggests that it is not statistically significantly bigger.

**4. APA format describing the findings:**

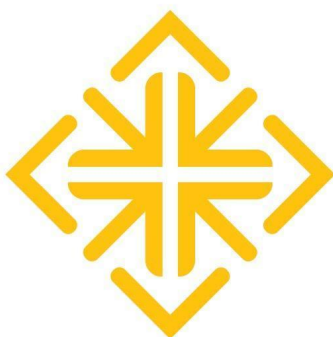
An independent samples *t* test was conducted to examine the political leanings of those who reported English as their native language and those who did not. Findings indicated that political leanings of participants in each group were not statistically different from each other  $t(178) = 1.42, p = .157$ . The mean political rating for those who reported English as their native language was  $M = 5.67, SD = 1.31$ , while those who indicated that English was not their native language had a mean political leaning of  $M = 5.33, SD = 1.38$ .

-----END TUTORIAL-----

**This Jamovi tutorial is a companion to a video tutorial and these materials were developed by:**

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**This tutorial was made possible by an Open Education Resource grant awarded to the first two authors by Gleeson Library, University of San Francisco.**



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