UNIVERSITY OF
SAN FRANCISCO
CHANGE THE WORLD FROM HERE

Tutorial 20: One Way ANOVA - Analysis of Variance

Description

In this tutorial we will learn how to conduct a One Way Analysis of Variance (ANOVA). This test is used when we have two or more independent samples (two or more groups) of data and we want to compare the means of all samples. Let's say we want to test whether the means are equal or different, then our hypothesis will be a two-tailed test represented as:

$H_0: \mu_A = \mu_B = \mu_C$

$H_a: \mu_A \neq \mu_{B,} \mu_A \neq \mu_{C,} \mu_B \neq \mu_C$ or at least one difference between population means exists.

(note: the alternative hypothesis H_a can also be denoted as H_1)

For this tutorial we will examine the question whether the type of apology (No Apology, Half Apology, Full Apology) given by Kathy who perpetrated a discriminatory act toward Maria influenced how participants interpreted Kathy's warmth.

Note: we are using the datafile ARMF2020_wave1andwave2.omv

Thus the group variable we will use is called:
Apology_cond
Such that :
NO APOLOGY = 1
HALF APOLOGY = 2
FULL APOLOGY = 3

The dependent variable that we are interested in examining is **traits_2** and corresponds to the question: *Thinking about the person who made most of the comments (Kathy), please rate her on the following qualities using this scale ranging 1 (Strongly Disagree) to 7 (Strongly Agree): Warmth*

The three groups are:
1: Those who read the no apology script.
2: Those who read the half apology script.
3: Those who read the full apology script.

$H_0: \mu_1 = \mu_2 = \mu_3$

$H_a: \mu_1 \neq \mu_{2,} \mu_1 \neq \mu_{3,} \mu_2 \neq \mu_3$

Data structure (Three Groups of Scores with Each Score a Measurement of the Same Variable)
This data structure therefore describes a between group design where participants in one of three apology category conditions provide ratings on a continuous (or ordinal-integer in Jamovi) scale.

Subsample of data being tested

Apology_cond	**traits_2**
1	2
1	2
1	3
1	1
2	6
2	6
2	4
2	4
3	7
3	7
3	5
3	6

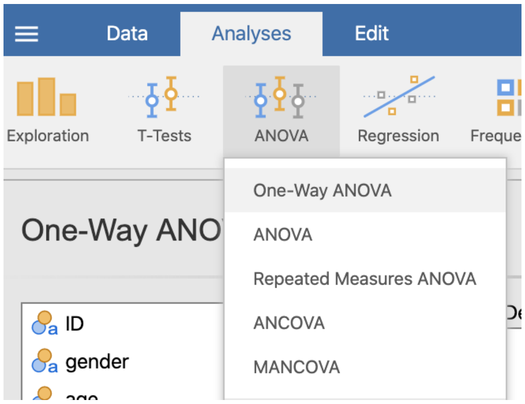
Note. ANOVAs *in Jamovi will only work with ordinal or continuous variables as dependent variables. If your variable is identified as nominal Jamovi will not allow you to select it as a dependent. So before beginning please make sure that the variable you are interested in is ordinal (integer) or continuous.*

Content

1. **Selecting the test and variables**
2. **Selecting the statistics**
3. **Interpreting the results**
4. **APA Format describing the findings**

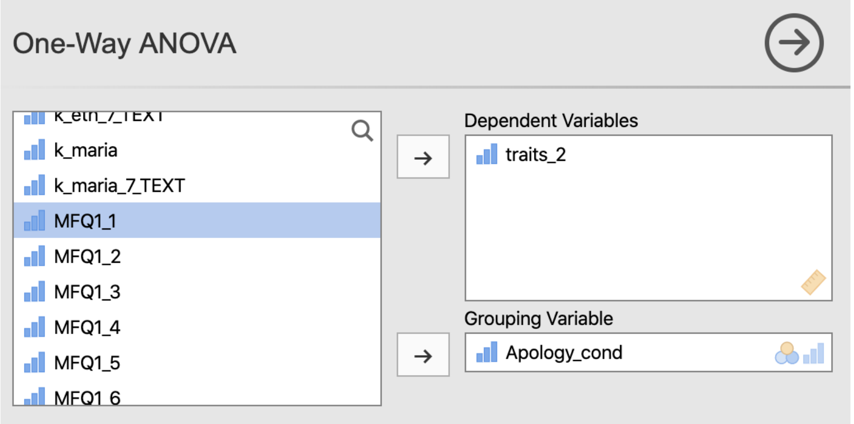
STEPS

1. **Selecting the test and variables**
    a. Open Jamovi datafile for this dataset.
    b. Go to the 'Analyses' tab.
    c. Click on ANOVA and select 'One-Way ANOVA'.



d. Select the variable ‘traits_2’ and move it into the ‘Dependent variable window.

e. Select the variable ‘Apology_cond’ and move it into the ‘grouping variable’:



Dependent Variables: traits_2

Grouping Variable: Apology_cond

2. Selecting the statistics

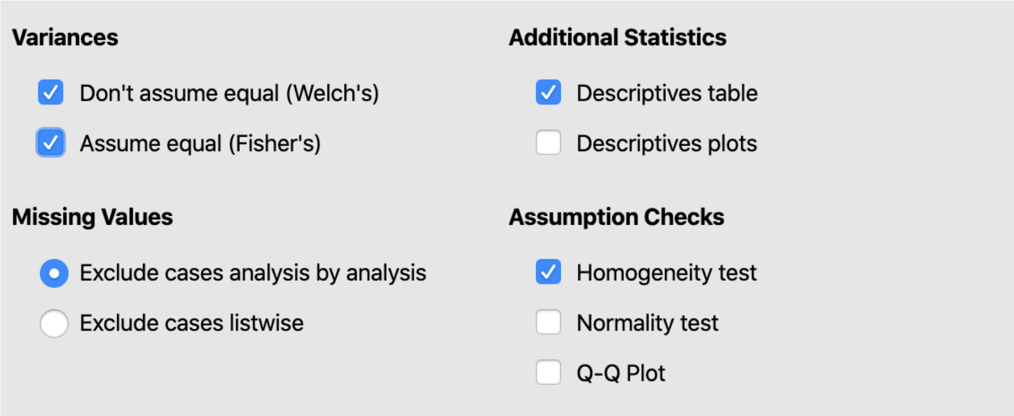
a. Below the variable windows you may specify the statistics you would like Jamovi to carry out.

b. Under ‘Variances’ select both ‘Don’t assume equal (Welch’s)’ and ‘Assume Equal (Fisher’s)’. This will ensure that an F test is carried out when either variances of the three groups are found to be unequal or equal.

c. Then select any additional statistics you would like reported, typically this includes:

   i. Descriptives table - this gives you the sample size, mean, standard deviation, and standard error for each group

d. Then under the ‘Assumption Checks’ section select “Homogeneity test’, this tests whether the variance of the three groups are similar or not.



Variances

- ☑ Don't assume equal (Welch's)
- ☑ Assume equal (Fisher's)

Missing Values

- ● Exclude cases analysis by analysis
- ○ Exclude cases listwise

Additional Statistics

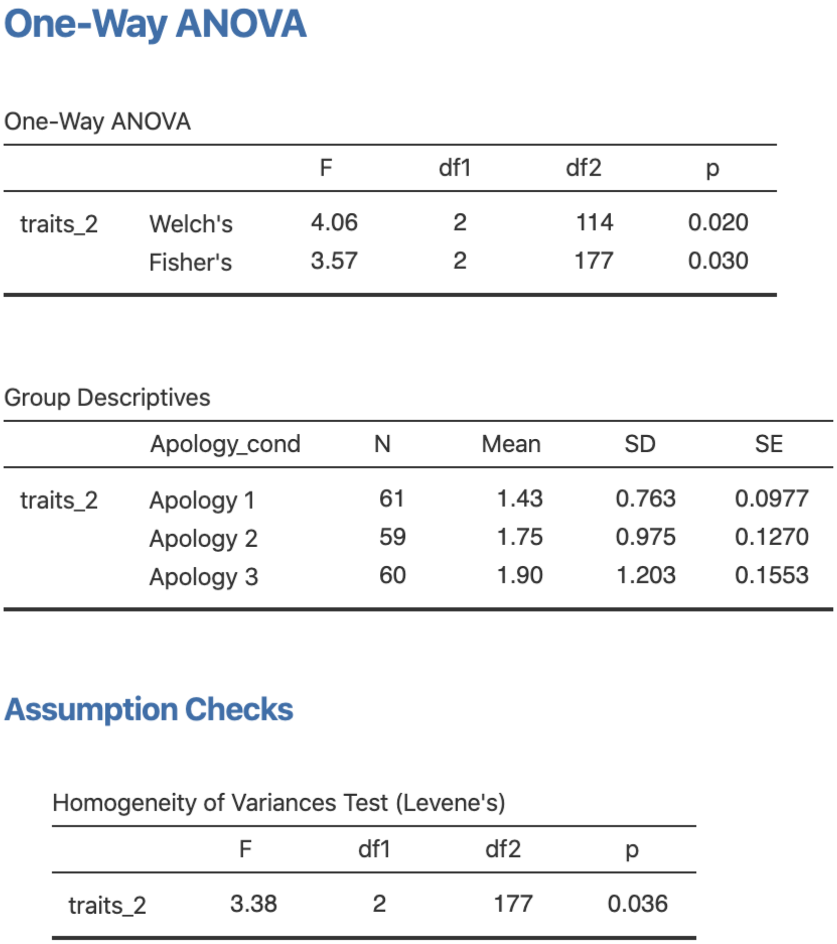
- ☑ Descriptives table
- ☐ Descriptives plots

Assumption Checks

- ☑ Homogeneity test
- ☐ Normality test
- ☐ Q-Q Plot

3. Interpreting the results

a. This is the Jamovi output that is produced:



One-Way ANOVA

One-Way ANOVA

		F	df1	df2	p
traits_2	Welch's	4.06	2	114	0.020
	Fisher's	3.57	2	177	0.030

Group Descriptives

	Apology_cond	N	Mean	SD	SE
traits_2	Apology 1	61	1.43	0.763	0.0977
	Apology 2	59	1.75	0.975	0.1270
	Apology 3	60	1.90	1.203	0.1553

Assumption Checks

Homogeneity of Variances Test (Levene's)

	F	df1	df2	p
traits_2	3.38	2	177	0.036

[3]

b. Interpreting the One-Way ANOVA
   i. Provides a F- statistic under 'F'
   ii. Provides the numerator (between-groups) degrees of freedom under 'df1'
   iii. Provides the denominator (error) degrees of freedom under 'df2'

        iv. p-value under ‘p’
        v. Note. One-Way ANOVA output in Jamovi does not report the effect size.
        vi. We can conclude if our null hypothesis H_0: $\mu_1 = \mu_2 = \mu_3$ should be rejected or retained by observing the p-values in the One-way ANOVA table, if the p-value is less than .05 then we reject the null hypothesis but if p-value is >.05, we retain the null hypothesis. In the table we have two p-values. To know which one to focus on you must find out if the Homogeneity of Variance assumption holds or not:
            1. If homogeneity of variance holds then interpret Fisher’s test
            2. If homogeneity of variance does not hold then interpret Welch’s test
            3. To check if the homogeneity of variance assumption holds go to step c.

    Note. In both Welch’s test and Fisher’s test p-values are less than .05 so we can conclude that the mean scores for warmth are statistically significantly different among the three apology groups.

    c. Interpreting the Homogeneity test
        i. Jamovi conducts a Levene’s F test to test where there is a difference in the variance of each group.
        ii. 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 Fisher’s F test in this case. We then must rely on Welch’s F test. In this case the p-value is .036 which is < .05 so we reject the null that variances are the same and conclude that the variances are statistically different. So we must interpret Welch’s F test.

    d. Interpreting the descriptives table
        i. The descriptives provide us with the means for each sample, $M_1 = 1.43$, $M_2 = 1.75$, and $M_3 = 1.90$, and these are the means being compared. While the test tells us that there is a difference between the means it does not tell us where the statistical difference is. We must rely on post-hoc analyses to figure this out. Please visit the next tutorial (tutorial 21).

4. **APA format describing the findings:**
   A one-way ANOVA was conducted to examine the level of warmth attributed to Kathy by participants in each apology group. An effect of the type of apology was found such that $F(2, 114) = 4.06$, $p<.05$. Thus suggesting that type of apology affected the level of warmth attributed to Kathy such, average warmth in the no apology condition was $M = 1.43$, $SD = 0.76$, average warmth in the half apology condition was $M = 1.75$, $SD = 0.97$, and average warmth in the full apology condition was $M = 1.90$, $SD = 1.20$.

---END TUTORIAL---

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

Aline Hitti, Ph.D., University of San Francisco
Saera Khan, Ph.D., University of San Francisco
Sage Stefanick, University of San Francisco
Erica Divinagracia, University of San Francisco
Adolfo Barrales, University of San Francisco

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

UNIVERSITY OF
SAN FRANCISCO

CHANGE THE WORLD FROM HERE