JASP Manual

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Department of Psychology
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Table of Contents

Welcome to JASP!

The following manual is intended to guide you through running various statistical analyses. We have provided step-by-step instructions on how to run each test along with pictures for you to reference.

What is JASP?

JASP stands for Jeffreys' Amazing Statistical Program, after the Bayesian pioneer Sir Harold Jeffreys. It is a new, intuitive substitute for statistical programs, like SPSS. Unlike other programs commonly used in research labs, colleges, and universities, JASP is completely free. It is an open-source program supported by the University of Amsterdam, developed with the user in mind. Gone are the days of entering in code to run a program. JASP utilizes a point-and-click user interface to make analysis fun and easy.

What functions can JASP perform?

JASP offers both classical and Bayesian analysis procedures. A complete list of the functionality is included below:

Analysis	**Classical**	**Bayesian**
ANOVA	✓	✓
ANCOVA	✓	✓
Binomial Test	✓	✓
Multinomial Test	✓	
Contingency Tables (Chi-squared included)	✓	✓
Correlation: Pearson, Spearman, Kendall	✓	✓
Exploratory Factor Analysis (EFA)	✓	
Linear Regression	✓	✓
Log-Linear Regression	✓	✓
Logistic Regression	✓	
Principal Component Analysis (PCA)	✓	
Repeated Measures ANOVA	✓	✓
Reliability Analyses: α, γδ, and ω	✓	
Structural Equation Modeling (SEM)	✓	
Summary Statistics		✓
T-Tests: Independent, Paired, One-Sample	✓	✓

It's important to remember that as an open-source program, JASP is constantly evolving based on the needs of its users. If you see an analysis is missing, their website offers a link to submit a feature request: https://jasp-stats.org/feature-requests-bug-reports/.

Another important feature to point out is all of the output tables are in APA format. This makes it easy to copy and paste tables directly from your JASP output.

What are some of the limitations?

As a result of the program constantly increasing its repertoire of analyses, it’s important to check the JASP website for updated software. Also remember to consider the version your class or instructor is using when you download the software. **IMPORTANT: JASP does not offer automatic system updates.**

You cannot directly import data from excel. In order to import your data, you must save your file as a .csv file, then open the file in JASP. Step-by-step directions are provided for you reference.

Frequently Asked Questions (FAQ):

How do I cite JASP?

JASP Team (2018). JASP (Version 0.9)[Computer software].

And the BibTeX entry :
@MISC{JASP2017,
AUTHOR = {{JASP Team}},
TITLE = {{JASP (Version 0.8.4)[Computer software]}},
YEAR = {2017},
URL = {https://jasp-stats.org/}

What programming language is JASP written in?

JASP is written in C++, R, and javascript.

What do the symbols in the corner of variable boxes represent?

These symbols tell you what type of variable (scale, ordinal, or categorical) can go in the particular category.

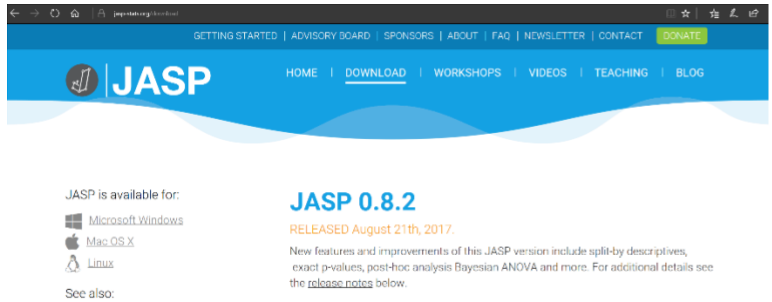
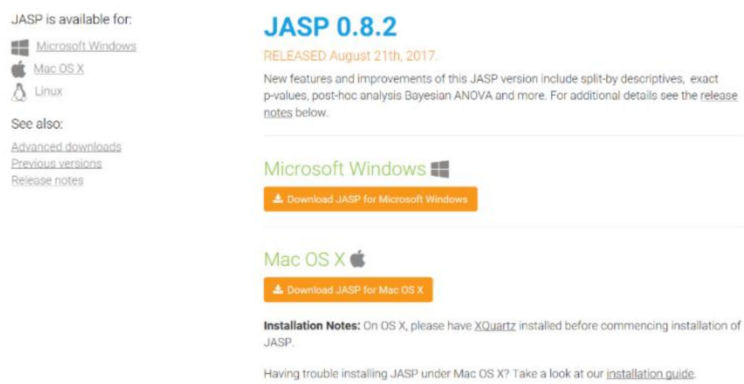
Is there anything JASP cannot do at this point?

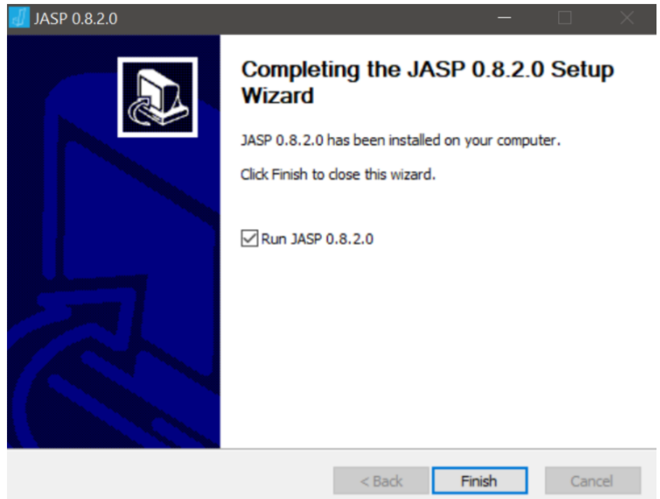
At present, JASP does not have a sufficient system for producing histograms. It is better to utilize excel for this feature. JASP also does not run a MANOVA or MANCOVA.

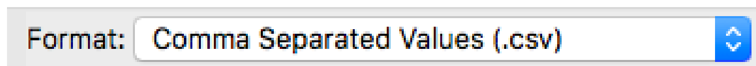
How do I save my output?

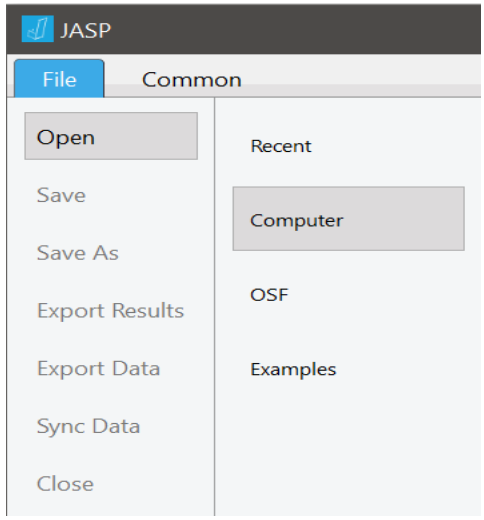
There are a few different options. (1) You can save your output in JASP. Simply, select File > Save and select a destination. (2) You can export your data. At the moment, JASP only allows you to export the output as an HTML file, meaning you can only open it in a web browser. However, you are still able to print this page normally. (3) You can copy and paste your output from JASP into word. Simply, click the downward arrow next to the analysis test name and select copy, then paste your output into Word or PowerPoint.

Introduction to JASP

Step	Action	Result
Downloading JASP		
1.	Open web browser (recommended: Google Chrome) and type in https://jasp-stats.org/download/	
2.	Select your OS (whether Windows or MAC) and click "Download." If you have a Linux processor, continue to the download instructions listed on the webpage.	
3.	As the file downloads, open file, and select "YES" to run the installation, and then click "Next" and "I Agree."	

<table>
<tr><th>Step</th><th>Action</th><th>Result</th></tr>
<tr><td>4.</td><td>Select “Finish”</td><td>
</td></tr>
<tr><td colspan="3">Importing Data Into JASP</td></tr>
<tr><td>1.</td><td>In order to analyze data in JASP, the file must be in CSV format.

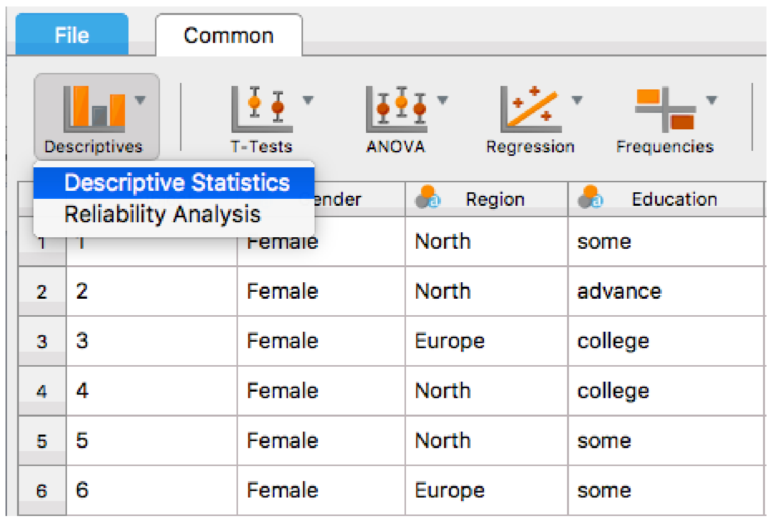
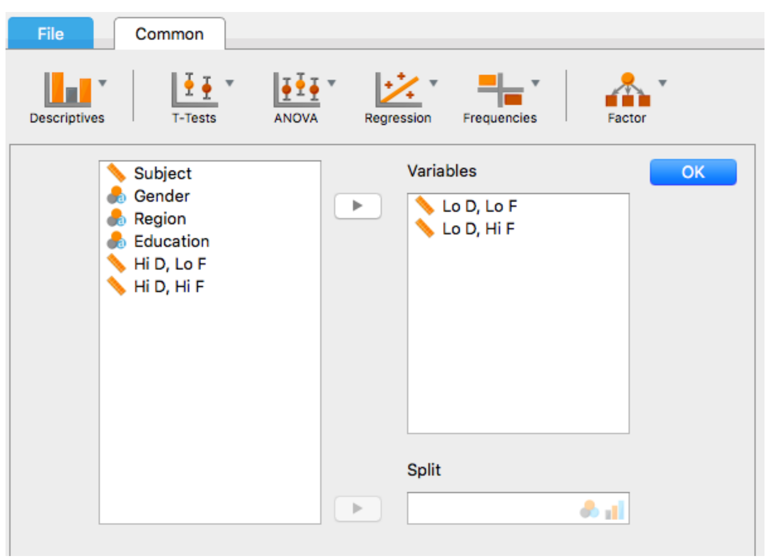
To convert an Excel, or spreadsheet File into a CSV extension file, click “File,” “Save As” and “CSV” and save the file somewhere on your computer.</td><td>
</td></tr>
<tr><td>2.</td><td>The top row in your excel file will become your variable names once the file is opened in JASP.</td><td>
<table>
<tr><th>Diet</th><th>Crackers</th><th>Calories</th></tr>
<tr><td>1</td><td>1</td><td>850</td></tr>
<tr><td>1</td><td>1</td><td>875</td></tr>
<tr><td>1</td><td>1</td><td>825</td></tr>
</table>
<table>
<tr><th></th><th>Diet</th><th>Crackers</th><th>Calories</th></tr>
<tr><td>1</td><td>1</td><td>1</td><td>850</td></tr>
<tr><td>2</td><td>1</td><td>1</td><td>875</td></tr>
<tr><td>3</td><td>1</td><td>1</td><td>825</td></tr>
</table>
</td></tr>
</table>

Step	Action	Result
3.	To import into JASP, open JASP select “File,” “Open,” and “Computer” and select the saved CSV File. For this manual, will we be using the Examples that JASP includes. To follow along, this is where we would click “Examples” and select the appropriate file for the test we are conducting.	
4.	Once the file is open, the data should appear in the “Common” tab.	

End of procedure

Descriptive Statistics

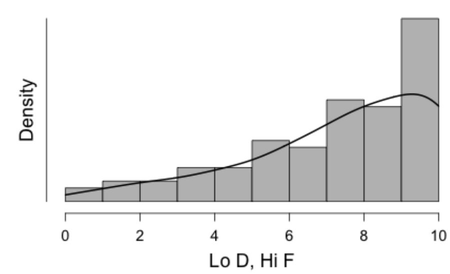
Descriptive statistics and reliability tell us basic features about our data. Descriptive statistics can give us things such as measures of central tendency and measures of dispersion to describe the data. Reliability refers to a scale's ability to consistently measure a variable.

<table>
<tr><th>Step</th><th>Action</th><th>Result</th></tr>
<tr><td colspan="3">Descriptive Statistics</td></tr>
<tr><td colspan="3">We will use Descriptive Statistics to discover basic information about our data. This can be used to simply get an idea about the data or to compare groups as follow-up information to an omnibus test.
We will be using the example data set "Bugs."</td></tr>
<tr><td>1.</td><td>Click "Descriptives" at the top left-hand corner and "Descriptive Statistics" from the drop-down menu.</td><td>
</td></tr>
<tr><td>2.</td><td>Add the variables you are interested in to Variables. We can add a single variable or as many as we wish. When comparing two variables, JASP will provide us with common descriptive information for the variables.
Explore other options given in the menu space to include any other descriptive information you would like. For the sake of information purposes, all possible characteristics are included in the example.
When you have made your selections, click "OK."</td><td>
</td></tr>
</table>

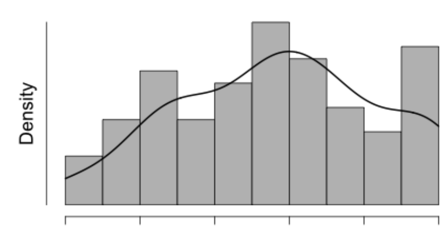
<table>
<tr><th>Step</th><th>Action</th><th>Result</th></tr>
<tr>
<td>3.</td>
<td>Your results will be displayed in the right-hand space.

Among other things, this provides information about measures of central tendency, measures of dispersion, and the normal curve.</td>
<td>
Descriptives

Descriptive Statistics
<table>
<tr><th></th><th>Lo D, Lo F</th><th>Lo D, Hi F</th></tr>
<tr><td>Valid</td><td>93</td><td>91</td></tr>
<tr><td>Missing</td><td>0</td><td>2</td></tr>
<tr><td>Mean</td><td>5.715</td><td>7.379</td></tr>
<tr><td>Std. Error of Mean</td><td>0.2810</td><td>0.2641</td></tr>
<tr><td>Median</td><td>6.000</td><td>8.000</td></tr>
<tr><td>Mode</td><td>3.000 [a]</td><td>10.00</td></tr>
<tr><td>Std. Deviation</td><td>2.710</td><td>2.519</td></tr>
<tr><td>Variance</td><td>7.345</td><td>6.346</td></tr>
<tr><td>Skewness</td><td>−0.1318</td><td>−0.9472</td></tr>
<tr><td>Std. Error of Skewness</td><td>0.2500</td><td>0.2527</td></tr>
<tr><td>Kurtosis</td><td>−0.7606</td><td>0.1598</td></tr>
<tr><td>Std. Error of Kurtosis</td><td>0.4952</td><td>0.5003</td></tr>
<tr><td>Range</td><td>10.00</td><td>9.500</td></tr>
<tr><td>Minimum</td><td>0.000</td><td>0.5000</td></tr>
<tr><td>Maximum</td><td>10.00</td><td>10.00</td></tr>
<tr><td>Sum</td><td>531.5</td><td>671.5</td></tr>
<tr><td>25th percentile</td><td>3.500</td><td>6.000</td></tr>
<tr><td>50th percentile</td><td>6.000</td><td>8.000</td></tr>
<tr><td>75th percentile</td><td>7.500</td><td>9.500</td></tr>
<tr><td>25th percentile</td><td>3.500</td><td>6.000</td></tr>
<tr><td>50th percentile</td><td>6.000</td><td>8.000</td></tr>
<tr><td>75th percentile</td><td>7.500</td><td>9.500</td></tr>
</table>
[a] More than one mode exists, only the first is reported
</td>
</tr>
<tr>
<td>4.</td>
<td>If you scroll down further in the results section, plots and visuals will also appear such as the example included here.</td>
<td>
Lo D, Hi F

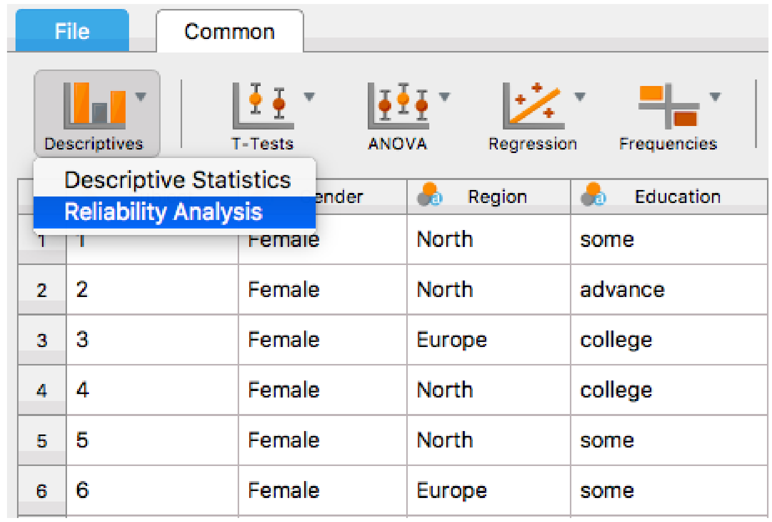


Lo D, Lo F



</td>
</tr>
</table>

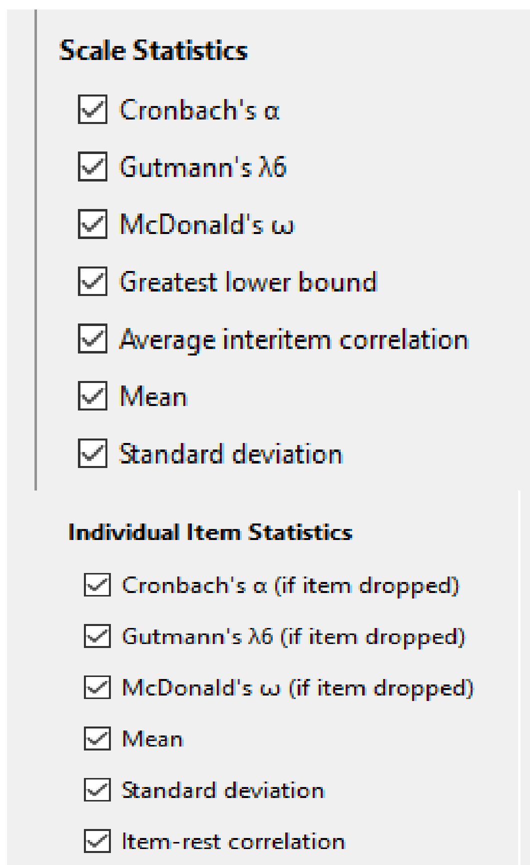
<table>
<tr><td colspan="3">Reliability Analysis</td></tr>
<tr><td colspan="3">We will be using the example data set "Bugs."</td></tr>
<tr><td>1.</td><td>Click “Descriptives” at the top left-hand corner and “Reliability Analysis” from the drop-down menu.</td><td>



</td></tr>
<tr><td>2.</td><td>The Scale Statistics list refers to a series of test statistics that JASP can produce to determine reliability of the measurements for all the variables on the whole. In other words, with higher reliability, results should be consistent under the same conditions.

Individual Item Statistics include the reliability test values (if an item dropped), and the mean, standard deviation and item-rest correlation.

In the Reverse Coding Items area, we can have the scale of the variable reverse (e.g. on a scale from 1-7, 1 becomes 7 and 7 becomes 1, etc.). This will cause the scale and item statistics in the output to change to reflect the changes in the way that the variable is scaled.</td><td>



</td></tr>
</table>

3.	Your results will be displayed in the right-hand space.	(see results below)

Reliability Analysis

Scale Reliability Statistics

	mean	sd	Cronbach's α	Gutmann's λ6	McDonalds' ω	Average interitem correlation
scale	6.547	2.302	0.731	0.577	0.732	0.577

Note. Of the observations, 91 were used, 2 were excluded, and 93 were provided.

Item Statistics

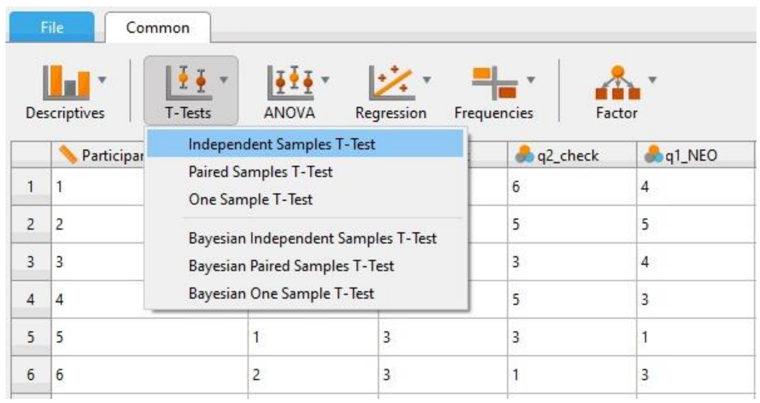
Item Reliability Statistics

				If item dropped		
	mean	sd	item-rest correlation	Cronbach's α	Gutmann's λ6	McDonalds' ω
Lo D, Lo F	5.714	2.666	0.577	0.333	NaN	
Lo D, Hi F	7.379	2.519	0.577	0.577	0.333	

End of procedure

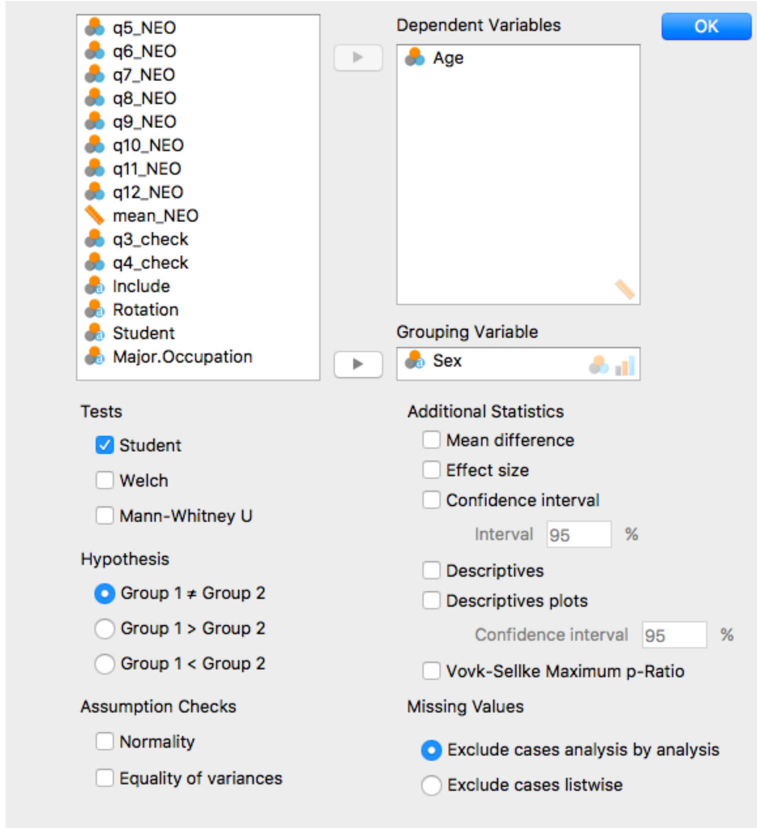
T-Test

A T-test is a parametric test that is used to evaluate the difference between two means. The means can be independent from one another (there are different participants across the two groups) or they can be dependent (the same participants were measured on two occasions). Alternatively, a researcher may only have one mean and he or she would like to test it against a known or hypothesized mean. These three analyses, Independent Samples, Paired Samples, and One Sample, are discussed below.

Step	Action	Result
Independent Samples		
The Independent Samples T-Test allows you to test the null hypothesis that the means of two independent groups are equal. We will be using the example data set "**Kitchen Rolls**." Suppose we wondered if there was a difference in age based on sex. Here, sex gives us two independent groups (male and female).		
1.	Click "T-Tests" at the top left-hand corner and "Independent Samples T-Test" from the drop-down menu.	

<table>
<tr><th>Step</th><th>Action</th><th>Result</th></tr>
<tr><td>2.</td><td>Add your Dependent Variable and Grouping Variable. As mentioned, in this example, we will be using Age as a dependent variable and Sex as a grouping variable. Keep in mind the following constraints:
• The dependent variable must be scale
• The grouping variable must have exactly 2 levels

Check “Student” under Tests and “Group 1 ≠Group 2” under Hypothesis.

Explore other options given in the menu space. For instance, it may be useful to look at Assumption Checks, as an Independent Samples *t*-Test assumes Normality and Equality of Variance. It is also helpful to select “Effect Size,” under Additional Statistics. When you have made your selections, click “OK.”</td><td>
</td></tr>
<tr><td>3.</td><td>Your results will be displayed in the right-hand space.

In this case, there is no evidence of a significant difference in age between males and females, as our *p*-value is greater than .05.</td><td>T-Test

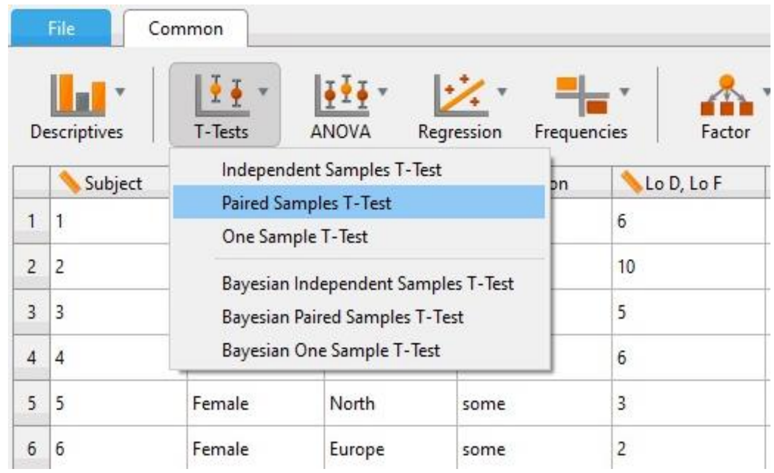
Independent Samples T-Test
<table><tr><th></th><th>t</th><th>df</th><th>p</th></tr><tr><td>Age</td><td>−1.329</td><td>100.0</td><td>0.187</td></tr></table>*Note*. Student's T-Test.</td></tr>
</table>

Paired Samples

The Paired Samples T-Test allows you to test the null hypothesis that the means of two dependent groups are equal.

We will be using the example data set "**Bugs.**"

1. Click "T-Tests" at the top left-hand corner and "Paired Samples T-Test" from the drop-down menu.

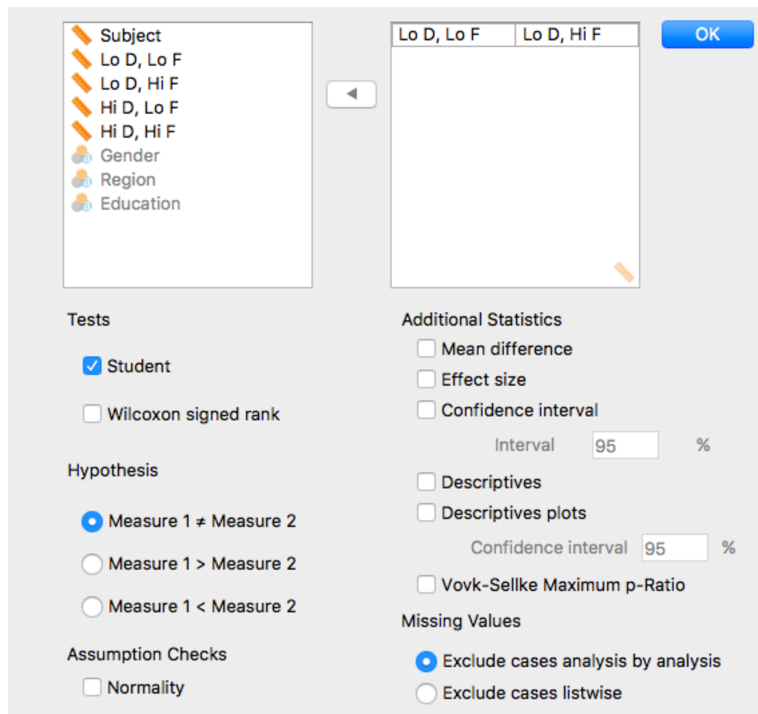


2. Add your conditions to right box. In this example, we will be using Lo D, Lo F and Lo D, Hi F as the levels that we would like to compare. Keep in mind the following constraints:

   - The variable must be scale

   Check "Student" under Tests and "Group 1 ≠Group 2" under Hypothesis.

   Explore other options given in the menu space. For instance, it may be useful to look at Assumption Checks, as a Paired Samples *t*-Test assumes Normality. It is also helpful to select "Effect Size," under Additional Statistics. When you have made your selections, click "OK."



3. Your results will be displayed in the right-hand space.

In this case, there is evidence of a significant difference between the two conditions, with a *p*-value less than .05.

T-Test

Paired Samples T-Test

			t	df	p
Lo D, Lo F	-	Lo D, Hi F	−6.649	90	< .001

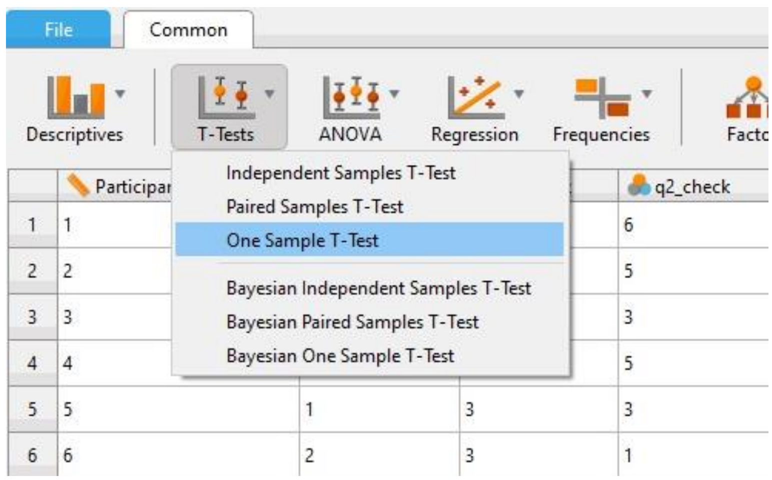
Note. Student's T-Test.

One Sample

The One Sample T-Test allows you to test the mean of a set of data against a known or hypothesized mean.

We will be using the example data set "**Kitchen Rolls**." Suppose we wondered if this group's age differs from the average age of a general population.

1. Click "T-Tests" at the top left-hand corner and "One Sample T-Test" from the drop-down menu.

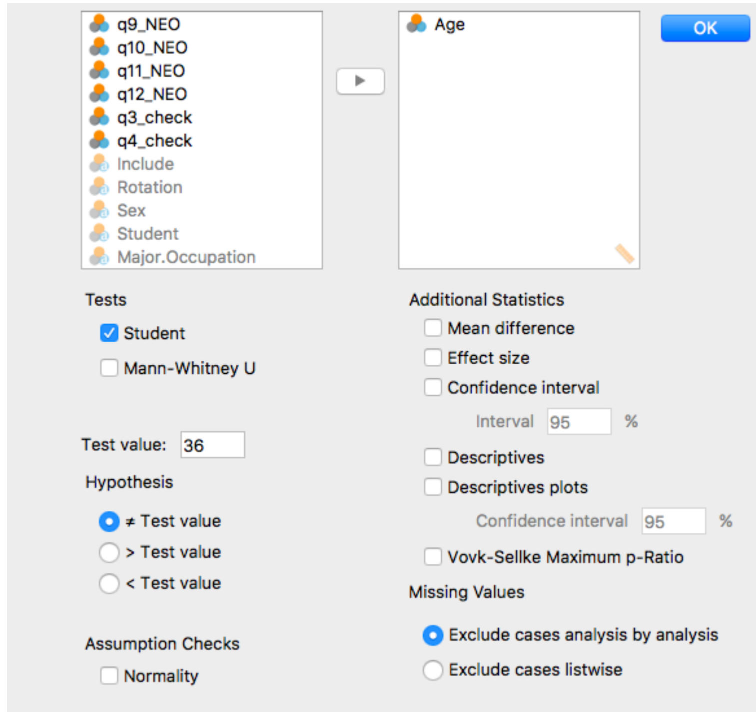


2. Add your dependent variable. As mentioned, in this example, we will be using Age as a dependent variable. Keep in mind the following constraints:

- The dependent variable must be scale

Check “Student” under Tests and “≠ Test Value” under Hypothesis. Under Test Value, input the number that you would like your group to be compared against. In this example, you may find research indicating that the general population in the United States has an average age of 36 years.

Explore other options given in the menu space. For instance, it may be useful to look at Assumption Checks, as a One Sample *t*-Test assumes Normality. It is also helpful to select “Effect Size,” under Additional Statistics. When you have made your selections, click “OK.”



3. Your results will be displayed in the right-hand space.

In this case, there is evidence of a significant difference between this group and our test value, as our *p*-value is less than .05. By going back to Step 3 and clicking “Descriptives” under Additional Statistics, you will see that the group’s average age was 22.10, which our test has just told us is significantly less than 36.

T-Test

One Sample T-Test

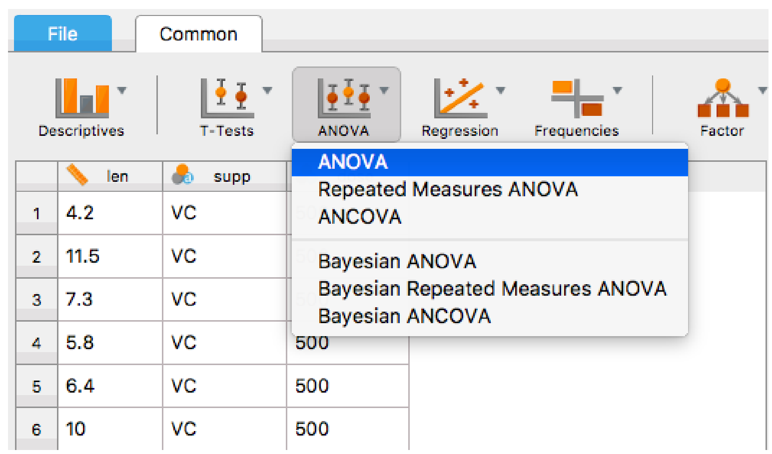
	t	df	p
Age	−30.42	101	< .001

Note. Student's T-Test.
Note. All tests, hypothesis is population mean is different from 36.

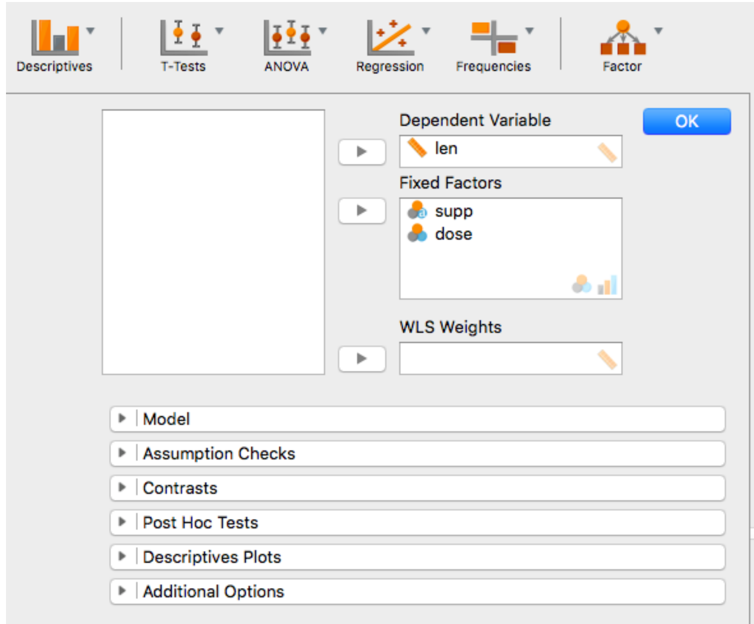
End of procedure

ANOVA

An ANOVA is a parametric test that is used to evaluate the difference between groups. It can be used with at least two groups (e.g. men and women), and is preferred over a t-Test when there are three or more groups (e.g. primary school, high school, graduate school). It can also be used to evaluate more than one independent variable (e.g. gender and educational achievement) and see if there is an interaction between the variables. The ANOVA is an omnibus test which means that the outcome of the test only tells you if there is a difference somewhere among the groups. For a variable with more than two levels (e.g. educational achievement, here), follow-up tests are required to determine which groups differ.

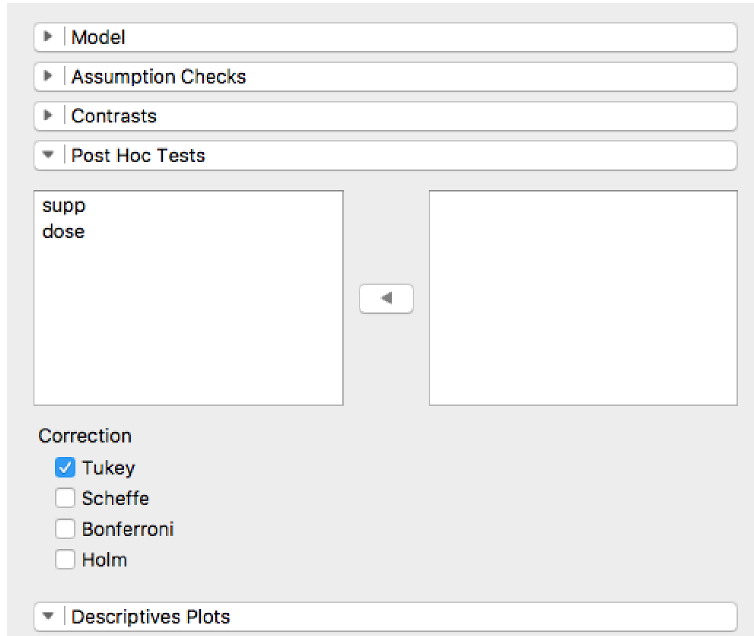
Step	Action	Result
ANOVA		
The ANOVA allows you to test the null hypothesis that the mean for all groups are the same. We will be using the example data set "**Tooth Growth**." Supposed we wondered about variables that affect length and how those variables may interact to affect length.		
1.	Click "ANOVA" at the top left-hand corner and "ANOVA" from the drop-down menu.	

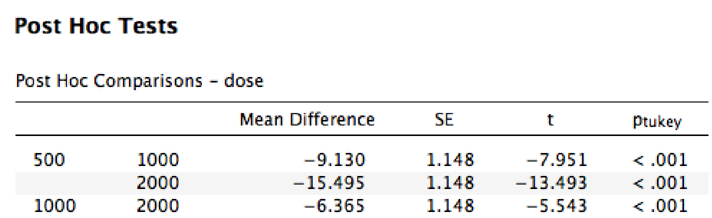
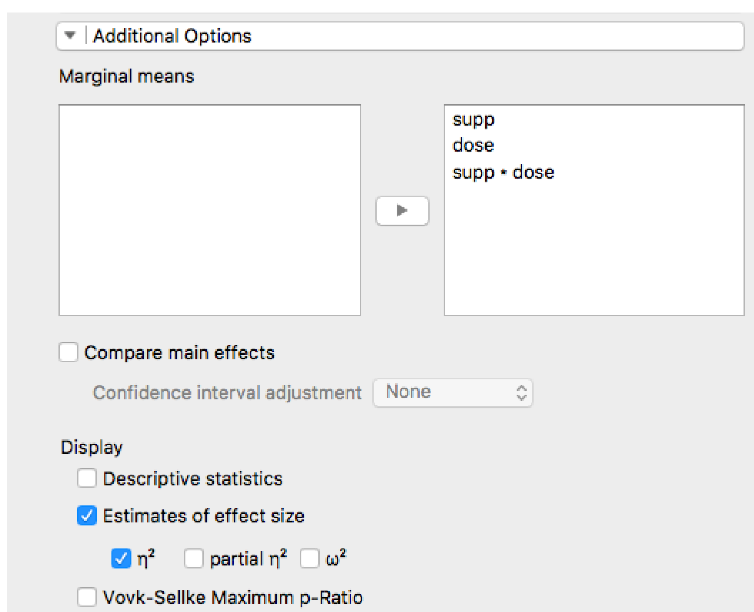
<table>
<tr><th>Step</th><th>Action</th><th>Result</th></tr>
<tr><td>2.</td><td>Add your Dependent Variable and Fixed Factors. For the ANOVA, “Fixed Factors” refers to your independent variable(s). As mentioned, in this example, we will be using Len as a dependent variable and Supp and Dose as independent variables. Keep in mind the following constraints:
• The dependent variable must be scale
• The fixed factors most be ordinal categorical

Explore other options given in the menu space. For instance, it may be useful to look at Assumption Checks, as an ANOVA assumes Normality (Q-Q plot of residuals) and Homoscedasticity (Homogeneity tests). It is also helpful to select “Estimates of effect size” and “partial η^2.” When you have made your selections, click “OK.”</td><td>
</td></tr>
<tr><td>3.</td><td>Your results will be displayed in the right-hand space.

In this case, there is a significant main effect of Supp, a significant main effect of Dose, and a significant interaction between Supp and Dose. All these effects have a p-value less than .05.</td><td>ANOVA

ANOVA – len
<table>
<tr><th>Cases</th><th>Sum of Squares</th><th>df</th><th>Mean Square</th><th>F</th><th>p</th><th>η^2_p</th></tr>
<tr><td>supp</td><td>205.4</td><td>1</td><td>205.35</td><td>15.572</td><td>< .001</td><td>0.224</td></tr>
<tr><td>dose</td><td>2426.4</td><td>2</td><td>1213.22</td><td>92.000</td><td>< .001</td><td>0.773</td></tr>
<tr><td>supp ∗ dose</td><td>108.3</td><td>2</td><td>54.16</td><td>4.107</td><td>0.022</td><td>0.132</td></tr>
<tr><td>Residual</td><td>712.1</td><td>54</td><td>13.19</td><td></td><td></td><td></td></tr>
</table>
Note. Type III Sum of Squares</td></tr>
</table>

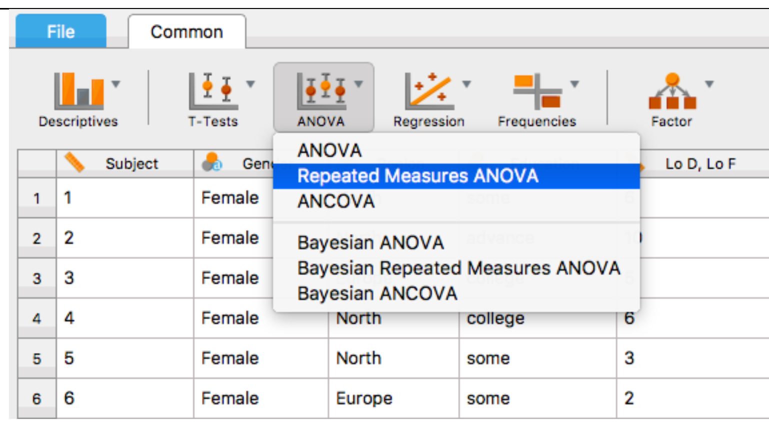
<table>
<tr><th>Step</th><th>Action</th><th>Result</th></tr>
<tr><td>4.</td><td>As the ANOVA showed a significant overall effect in each main effect case and in the case of the interaction, some follow-up tests are required. Supp only has two levels, so we do not need a follow-up test. However, dose has three levels. Click on the bar labeled Post Hoc Tests. In the left box there will be a list of your factors and below that there will be a list of four tests (Tukey, Scheffe, Bonfferoni, and Holm). In this case, we will select "Tukey" and move Dose to the right.</td><td>
</td></tr>
<tr><td>5.</td><td>The results of this test will be displayed in the right-hand space.

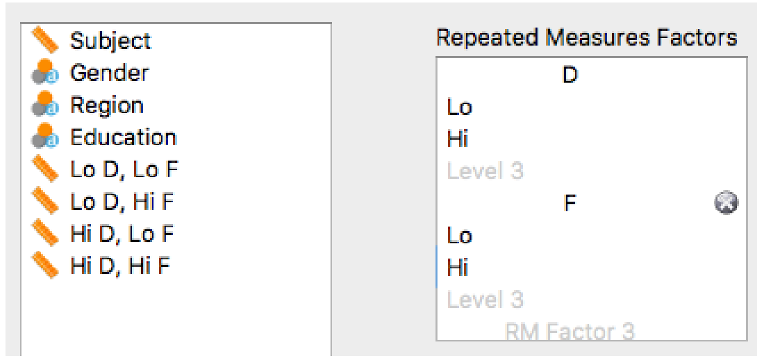
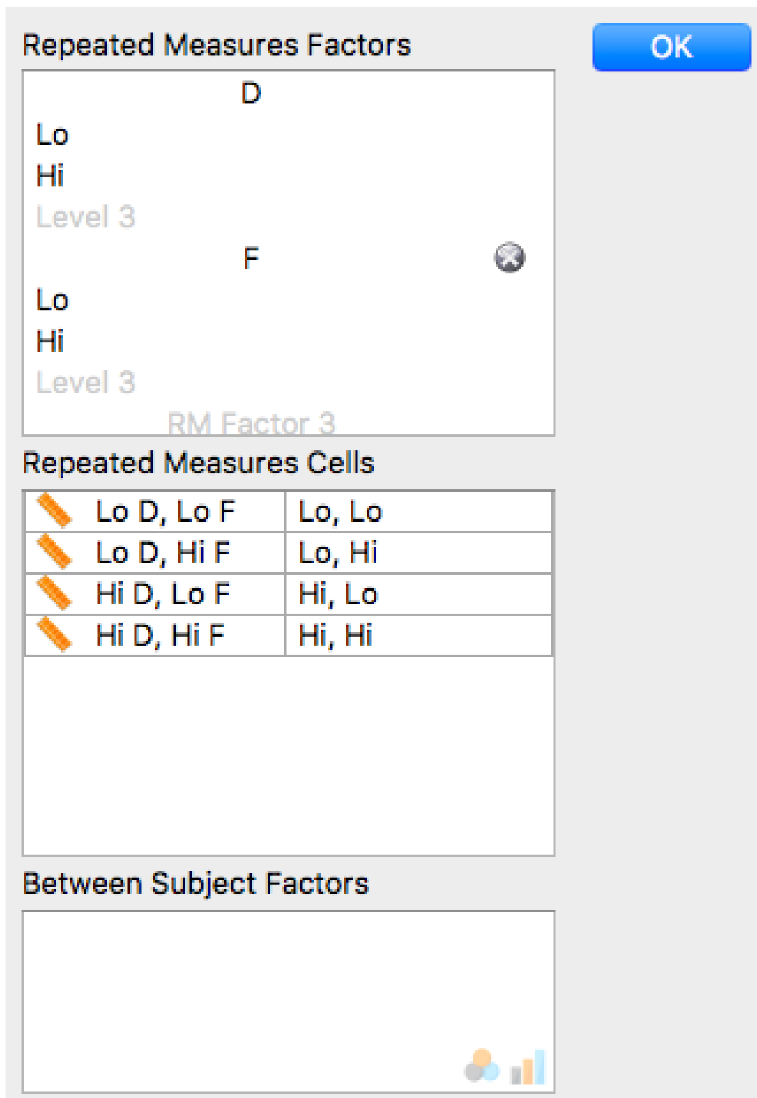
The Tukey gives each combination of Dose level comparisons. The p_{tukey} column gives the p-value. The differences between all the combinations are significantly different, as our p-values are less than .05.</td><td>
Post Hoc Tests
Post Hoc Comparisons – dose
<table>
<tr><th></th><th></th><th>Mean Difference</th><th>SE</th><th>t</th><th>p_{tukey}</th></tr>
<tr><td>500</td><td>1000</td><td>−9.130</td><td>1.148</td><td>−7.951</td><td>< .001</td></tr>
<tr><td></td><td>2000</td><td>−15.495</td><td>1.148</td><td>−13.493</td><td>< .001</td></tr>
<tr><td>1000</td><td>2000</td><td>−6.365</td><td>1.148</td><td>−5.543</td><td>< .001</td></tr>
</table></td></tr>
<tr><td>6.</td><td>It is also information to ask for Marginal means. This can be found under Additional Options. Move the effects to the right side.</td><td>
</td></tr>
</table>

<table>
<tr><th>Step</th><th>Action</th><th>Result</th></tr>
<tr><td>7.</td><td>The results will be displayed in the right-hand space.

Marginal Means for Supp is tells us that the mean for OJ is higher than the mean for VC. This is informative, as, with two levels, we did not perform a Tukey. We now know which level is higher and that the difference is significant because we had a main effect of Supp from the original output. This output, as with the latter two outputs, give us means and confidence intervals that we should report when describing the analysis.</td><td>
Marginal Means

Marginal Means - supp
<table>
<tr><th>supp</th><th>Marginal Mean</th><th>SE</th><th>Lower CI</th><th>Upper CI</th></tr>
<tr><td>OJ</td><td>20.66</td><td>0.663</td><td>19.33</td><td>21.99</td></tr>
<tr><td>VC</td><td>16.96</td><td>0.663</td><td>15.63</td><td>18.29</td></tr>
</table>
Marginal Means - dose
<table>
<tr><th>dose</th><th>Marginal Mean</th><th>SE</th><th>Lower CI</th><th>Upper CI</th></tr>
<tr><td>500</td><td>10.61</td><td>0.812</td><td>8.977</td><td>12.23</td></tr>
<tr><td>1000</td><td>19.73</td><td>0.812</td><td>18.107</td><td>21.36</td></tr>
<tr><td>2000</td><td>26.10</td><td>0.812</td><td>24.472</td><td>27.73</td></tr>
</table>
Marginal Means - supp * dose
<table>
<tr><th>supp</th><th>dose</th><th>Marginal Mean</th><th>SE</th><th>Lower CI</th><th>Upper CI</th></tr>
<tr><td>OJ</td><td>500</td><td>13.230</td><td>1.148</td><td>10.928</td><td>15.53</td></tr>
<tr><td></td><td>1000</td><td>22.700</td><td>1.148</td><td>20.398</td><td>25.00</td></tr>
<tr><td></td><td>2000</td><td>26.060</td><td>1.148</td><td>23.758</td><td>28.36</td></tr>
<tr><td>VC</td><td>500</td><td>7.980</td><td>1.148</td><td>5.678</td><td>10.28</td></tr>
<tr><td></td><td>1000</td><td>16.770</td><td>1.148</td><td>14.468</td><td>19.07</td></tr>
<tr><td></td><td>2000</td><td>26.140</td><td>1.148</td><td>23.838</td><td>28.44</td></tr>
</table>
</td></tr>
<tr><td colspan="3">Repeated Measures ANOVA</td></tr>
<tr><td colspan="3">The Repeated Measures ANOVA differs from the ANOVA because the same participants are in multiple conditions. Thus, while the above ANOVA was for between-groups, the Repeated Measures ANOVA is for within-subjects.

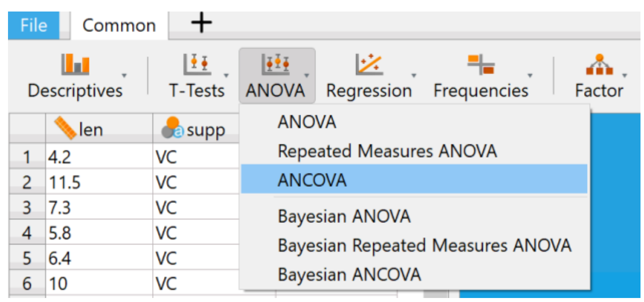
We will be using the example data set "Bugs."</td></tr>
<tr><td>1.</td><td>Click “ANOVA” at the top left-hand corner and “Repeated Measures ANOVA” from the drop-down menu.</td><td>
</td></tr>
</table>

Step	Action	Result
2.	For each repeated measure or the within-subjects variable, label the variable under Repeated Measures Factors in “RM Factor” and then the levels of the variable in “Level.”	
3.	The repeated measures of Lo D, Lo F, Lo D, Hi F, Hi D, Lo F, and Hi D, Hi F should be placed in each section within the Repeated Measures Cells box, aligning with the appropriate labeling which JASP created based on your Repeated Measures Factors. Keep in mind the following constraints: • The variables must be scale If we were using a mixed-methods design, with both within-subjects and between-subjects variables, we could put the between-subjects variables in Between Subject Factors, as well. For these variables, keep in mind the following constraints: • The variables must be ordinal or categorical Explore other options given in the menu space. For instance, it may be useful to look at Assumption Checks, as a Repeated Measures ANOVA assumes Sphericity. It is also helpful to select “Estimates of effect size” and “partial η^2.” When you have made your selections, click “OK.”	

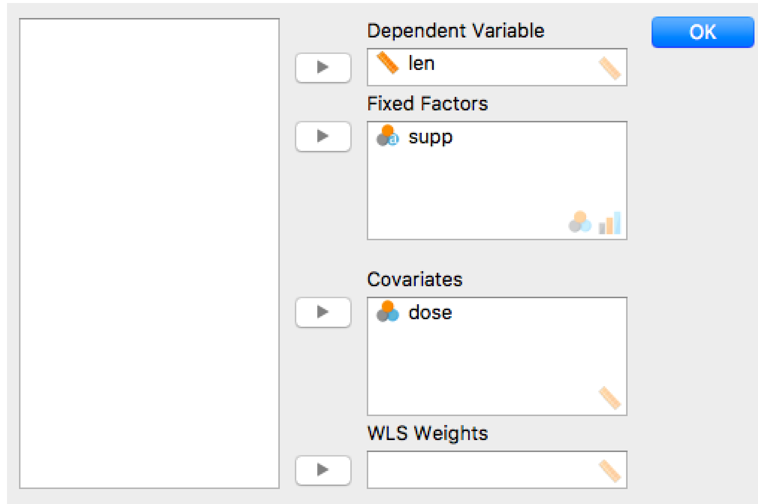
<table>
<tr><th>Step</th><th>Action</th><th>Result</th></tr>
<tr><td>4.</td><td>Your results will be displayed in the right-hand space.

In this case, there is a significant main effect of D and a significant main effect of F, with p-values less than .05. There is not evidence for a significant interaction.

Follow the steps given in the ANOVA “Steps 4-7.” In this example, we do not need a post-hoc test because there are only two levels of each of our variables.</td><td>Repeated Measures ANOVA

Within Subjects Effects
<table>
<tr><th></th><th>Sum of Squares</th><th>df</th><th>Mean Square</th><th>F</th><th>p</th><th>η^2_p</th></tr>
<tr><td>D</td><td>48.753</td><td>1</td><td>48.753</td><td>12.175</td><td>< .001</td><td>0.123</td></tr>
<tr><td>Residual</td><td>348.372</td><td>87</td><td>4.004</td><td></td><td></td><td></td></tr>
<tr><td>F</td><td>177.557</td><td>1</td><td>177.557</td><td>41.630</td><td>< .001</td><td>0.324</td></tr>
<tr><td>Residual</td><td>371.068</td><td>87</td><td>4.265</td><td></td><td></td><td></td></tr>
<tr><td>D ∗ F</td><td>6.545</td><td>1</td><td>6.545</td><td>2.152</td><td>0.146</td><td>0.024</td></tr>
<tr><td>Residual</td><td>264.580</td><td>87</td><td>3.041</td><td></td><td></td><td></td></tr>
</table>
Note. Type III Sum of Squares</td></tr>
<tr><th>Step</th><th>Action</th><th>Result</th></tr>
<tr><td colspan="3">ANCOVA</td></tr>
<tr><td colspan="3">The ANCOVA allows you to test the null hypothesis that the mean for all groups are the same while controling for an extraneous variables that affects the outcome variable.
We will be using the example data set "Tooth Growth."</td></tr>
<tr><td>1.</td><td>Click “ANOVA” at the top left-hand corner and “ANCOVA” from the drop-down menu.</td><td>
</td></tr>
</table>

<table>
<tr><th>Step</th><th>Action</th><th>Result</th></tr>
<tr><td>2.</td><td>Add your Dependent Variable and Fixed Factors. For the ANOVA, “Fixed Factors” refers to your independent variable(s). This time, the display gives you the option to add a Covariate. In this example, we want to know the effect of Supp on Len, while controlling for the effects of Dose.

Keep in mind the following constraints:
The dependent variable must be scale
The fixed factors most be ordinal or categorical
The covariate can be scale or categorical
Explore other options given in the menu space. For instance, it may be useful to look at Assumption Checks, as an ANOVA assumes Normality (Q-Q plot of residuals) and Homoscedasticity (Homogeneity tests). It is also helpful to select “Estimates of effect size” and “partial η^2.” When you have made your selections, click “OK.”</td><td>
</td></tr>
<tr><td>3.</td><td>Your results will be displayed in the right-hand space.

In this case, there is evidence of a significant effect of the Covariate, Dose. There is also a significant effect of Supp over and above the effect of Dose, as these p-values are less than .05.

Follow the steps given in the ANOVA “Steps 4-7.” In this example, we do not need a post-hoc test because there are only two levels of each of our variables.</td><td>ANCOVA

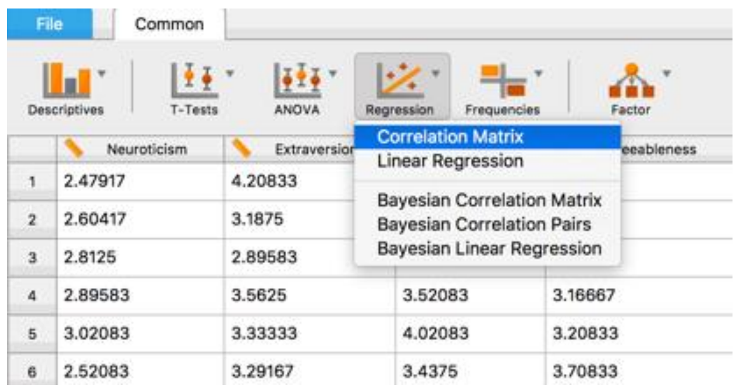
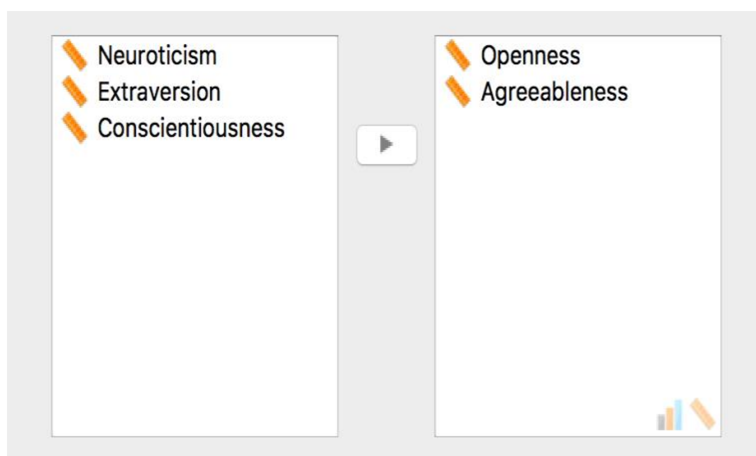
ANCOVA – len
<table>
<tr><th>Cases</th><th>Sum of Squares</th><th>df</th><th>Mean Square</th><th>F</th><th>p</th></tr>
<tr><td>supp</td><td>205.3</td><td>1</td><td>205.35</td><td>11.45</td><td>0.001</td></tr>
<tr><td>dose</td><td>2224.3</td><td>1</td><td>2224.30</td><td>123.99</td><td>< .001</td></tr>
<tr><td>Residual</td><td>1022.6</td><td>57</td><td>17.94</td><td></td><td></td></tr>
</table>
Note. Type III Sum of Squares</td></tr>
</table>

End of procedure

Regression

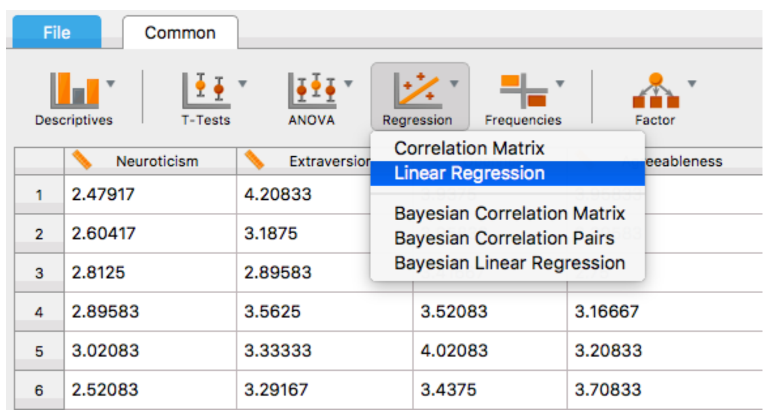
Correlation and regression tell you about the relationship between variables. Correlation describes if the variables tend to increase or decrease together or go in opposite directions. Regression is a form of statistical modeling that examines how much variance is explained by the model we have created with various variables.

<table>
<tr><th>Step</th><th>Action</th><th>Result</th></tr>
<tr><td colspan="3">Correlation</td></tr>
<tr><td colspan="3">Correlation tells us if variables are positively related (they move in the same direction) or negatively correlated (they move in opposing directions).

We will be using the example data set "Big 5." Suppose we were interested in the relationship between Openness and Agreeableness.</td></tr>
<tr><td>1.</td><td>Click “Regression” at the top left-hand corner and “Correlation Matrix” from the drop-down menu.</td><td>
</td></tr>
<tr><td>2.</td><td>Add your variable of interest. As mentioned, in this example, we will be using Openness and Agreeableness. Keep in mind the following constraints:
The variables must be scale or ordinal
Explore other options given in the menu space. For instance, the correlation coefficient will depend on what type of variables we are working with. In this case, both variables are scale, so we will use Pearson. We can also ask it to report significant (p-values) and to flag significant correlations to tell us when a p-value indicates significance. When you have made your selections, click “OK.”</td><td>
</td></tr>
</table>

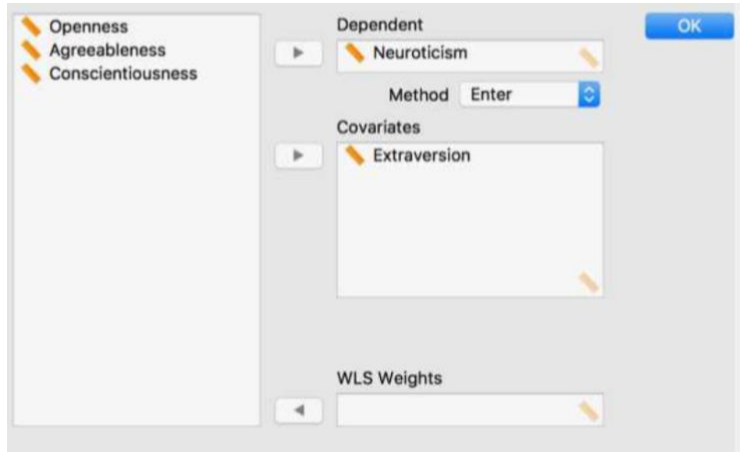
<table>
<tr><th>Step</th><th>Action</th><th>Result</th></tr>
<tr><td>3.</td><td>Your results will be displayed in the right-hand space.

The matrix matches each variable with the others that we selected. In this case, there is evidence of a significant positive correlation between Openness and Agreeableness, as the *p*-value is less than .05. This is a small effect (0.159).</td><td>Correlation Matrix

Pearson Correlations<table>
<tr><th></th><th></th><th>Openness</th><th>Agreeableness</th></tr>
<tr><td>Openness</td><td>Pearson's r</td><td>—</td><td>0.159***</td></tr>
<tr><td></td><td>p-value</td><td>—</td><td>< .001</td></tr>
<tr><td>Agreeableness</td><td>Pearson's r</td><td></td><td>—</td></tr>
<tr><td></td><td>p-value</td><td></td><td>—</td></tr>
</table>* p < .05, ** p < .01, *** p < .001</td></tr>
<tr><td colspan="3">Regression</td></tr>
<tr><td colspan="3">We will be using the example data set "Big 5."</td></tr>
<tr><td>1.</td><td>Click “Regression” at the top left-hand corner and “Linear Regression” from the drop-down menu.</td><td>
</td></tr>
</table>

<table>
<tr><th>Step</th><th>Action</th><th>Result</th></tr>
<tr><td>2.</td><td>Add your variable of interest. In this example, we will be using Neuroticism as the Dependent Variable and Extraversion as the Covariate. In Regression, a “Covariate” refers to variables that will be includes in the model. Keep in mind the following constraints:

• The variables must be scale

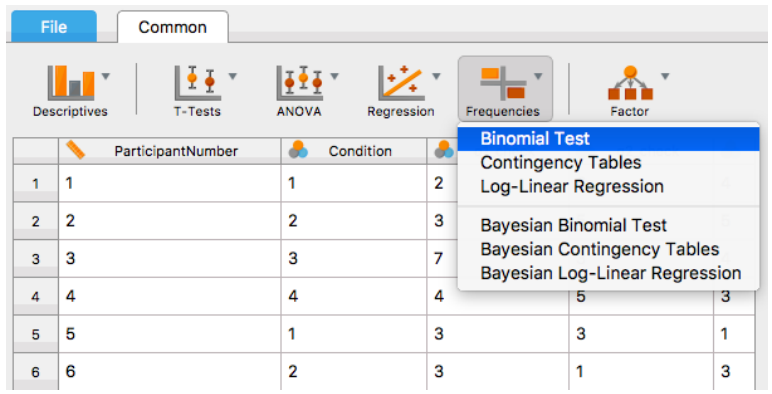
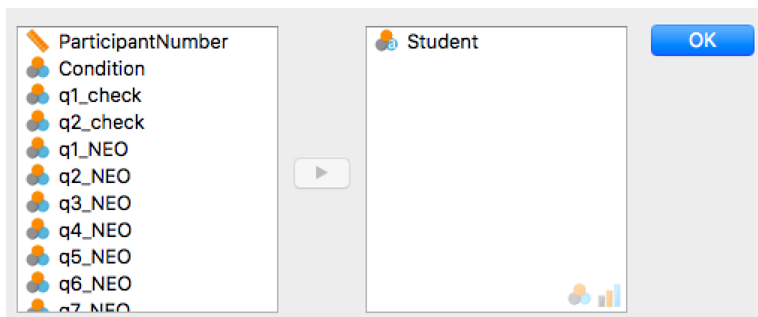
Explore other options given in the menu space. For instance, the Method can be “Enter,” “Backward,” “Forward,” or “Stepwise,” referring to the order in which our Covariates (if we have multiple) will be entered into the model. When you have made your selections, click “OK.”</td><td>
</td></tr>
<tr><td>3.</td><td>Your results will be displayed in the right-hand space.

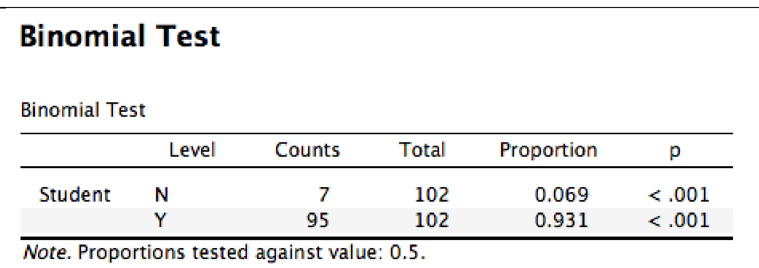
In this case, R^2 tells us that 12.3% of the total variance is explained by the model including Extraversion. The Coefficients output tells us that Extraversion is a significant predictor for the model, as the p-value is less than .05.</td><td>Linear Regression

Model Summary
<table>
<tr><th>Model</th><th>R</th><th>R²</th><th>Adjusted R²</th><th>RMSE</th></tr>
<tr><td>1</td><td>0.350</td><td>0.123</td><td>0.121</td><td>0.424</td></tr>
</table>
ANOVA
<table>
<tr><th>Model</th><th></th><th>Sum of Squares</th><th>df</th><th>Mean Square</th><th>F</th><th>p</th></tr>
<tr><td>1</td><td>Regression</td><td>12.53</td><td>1</td><td>12.530</td><td>69.56</td><td>< .001</td></tr>
<tr><td></td><td>Residual</td><td>89.71</td><td>498</td><td>0.180</td><td></td><td></td></tr>
<tr><td></td><td>Total</td><td>102.24</td><td>499</td><td></td><td></td><td></td></tr>
</table>
Coefficients
<table>
<tr><th>Model</th><th></th><th>Unstandardized</th><th>Standard Error</th><th>Standardized</th><th>t</th><th>p</th></tr>
<tr><td>1</td><td>intercept</td><td>4.383</td><td>0.188</td><td></td><td>23.366</td><td>< .001</td></tr>
<tr><td></td><td>Extraversion</td><td>−0.446</td><td>0.054</td><td>−0.350</td><td>−8.340</td><td>< .001</td></tr>
</table></td></tr>
</table>

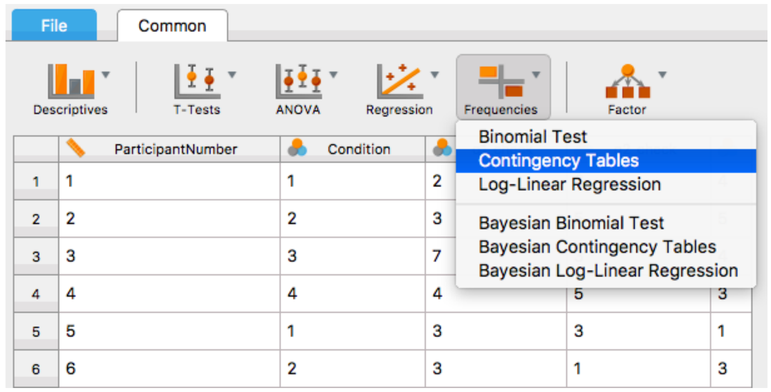
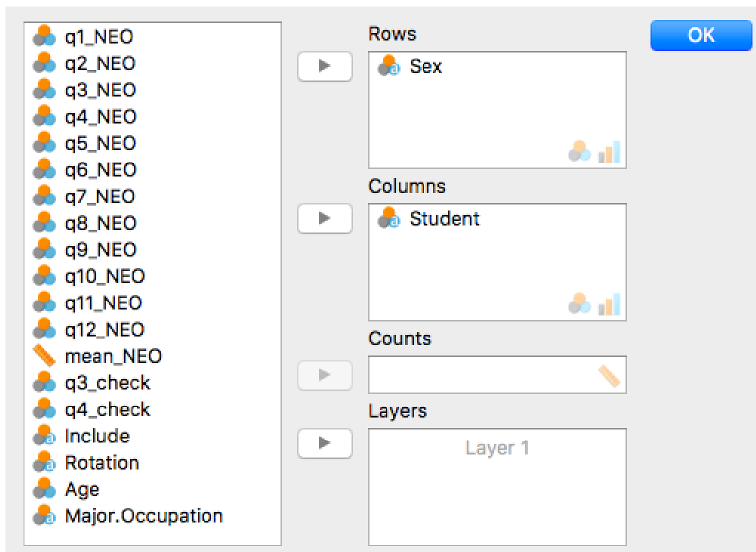
End of procedure

Frequencies

<table>
<tr><th>Step</th><th>Action</th><th>Result</th></tr>
<tr><td colspan="3">Binomial Test</td></tr>
<tr><td colspan="3">We will be using the example data set "Kitchen Rolls."</td></tr>
<tr><td>1.</td><td>Click “Frequencies” at the top left-hand corner and “Binomial Test” from the drop-down menu.</td><td>
</td></tr>
<tr><td>2.</td><td>Add your variable of interest. Keep in mind the following constraints:
The variable must be ordinal or categorical
Explore other options given in the menu space. When you have made your selections, click “OK.”</td><td>
</td></tr>
<tr><td>3.</td><td>Your results will be displayed in the right-hand space.

In this case, we wondered how many participants are students and how many are not. The output gives us the count for each level of this categorical variable.</td><td>
Binomial Test

Binomial Test
<table>
<tr><th></th><th>Level</th><th>Counts</th><th>Total</th><th>Proportion</th><th>p</th></tr>
<tr><td>Student</td><td>N</td><td>7</td><td>102</td><td>0.069</td><td>< .001</td></tr>
<tr><td></td><td>Y</td><td>95</td><td>102</td><td>0.931</td><td>< .001</td></tr>
</table>
Note. Proportions tested against value: 0.5.</td></tr>
</table>

<table>
<tr><td colspan="3">Contingency Tables</td></tr>
<tr><td colspan="3">We will be using the example data set "Kitchen Rolls."</td></tr>
<tr><td>1.</td><td>Click “Frequencies” at the top left-hand corner and “Contingency Tables” from the drop-down menu.</td><td>
</td></tr>
<tr><td>2.</td><td>Add your variables of interest (two different variables) to Rows and Columns. Keep in mind the following constraints:
The variables must be ordinal or categorical
Explore other options given in the menu space. When you have made your selections, click “OK.”</td><td>
</td></tr>
</table>

3\. Your results will be displayed in the right-hand space.

The main output tells us the association between two variables. In this case, we see that there is a large discrepancy between the number of women included and the number of men included. Related to Student, the majority of both women and men are students.

Contingency Tables

Contingency Tables

	Student		
Sex	N	Y	Total
F	6	71	77
M	1	24	25
Total	7	95	102

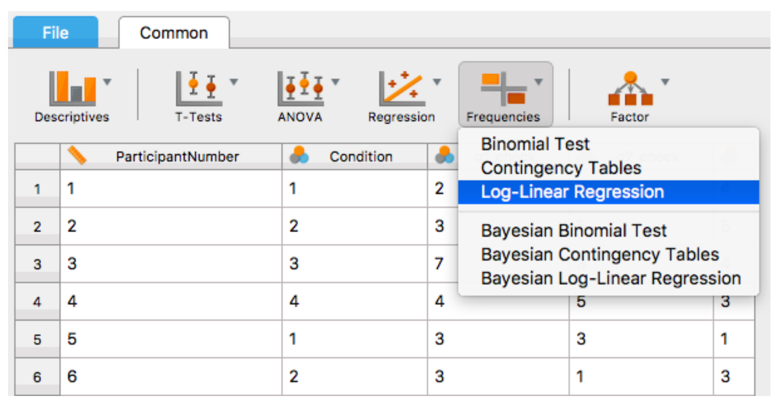
Chi-Squared Tests

	Value	df	p
X^2	0.425	1	0.515
N	102		

Log-Linear Regression

We will be using the example data set "**Kitchen Rolls**."

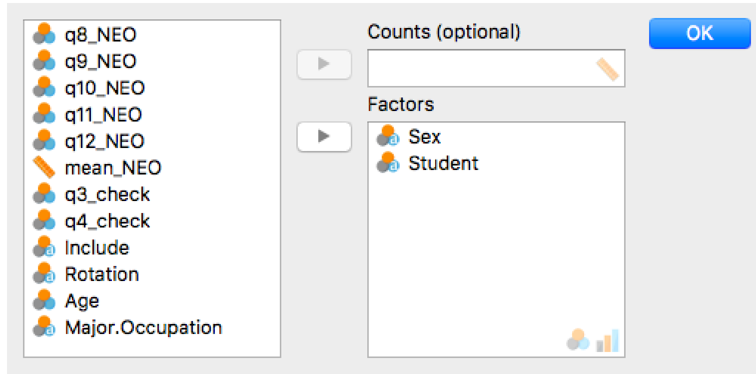
1\. Click “Frequencies” at the top left-hand corner and “Log-Linear Regression” from the drop-down menu.



2. Add your variable(s) of interest to Factors. Keep in mind the following constraints:

- The variables must be ordinal or categorical

Explore other options given in the menu space. When you have made your selections, click “OK.”



3. Your results will be displayed in the right-hand space.

In this case, we were interested in a model produced by these categorical variables. There is evidence of a significant influence of Sex and Student with *p*-values less than .05.

Log-Linear Regression

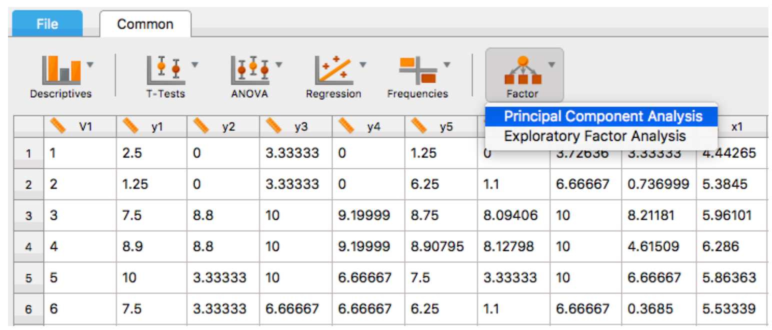
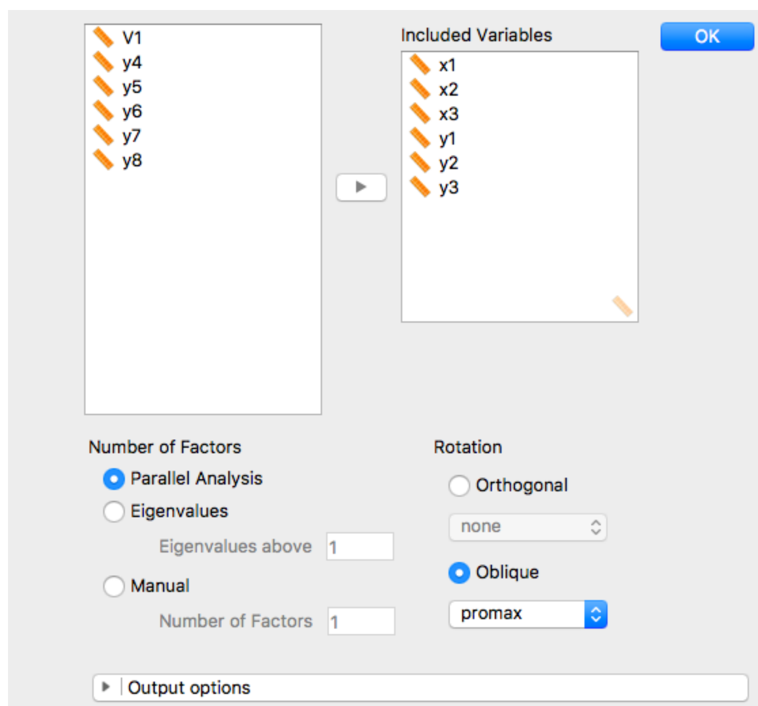
ANOVA

	df	Deviance	Residual df	Residual Deviance	p
NULL			3	118.658	
Sex	1	27.797	2	90.860	< .001
Student	1	90.387	1	0.474	< .001
Sex ∗ Student	1	0.474	0	0.000	0.491

End of procedure

Factor Analysis

Factor analysis is a way to describe the variability of correlated variables. The idea is that two or more variables might reflect a single unknown variable. In other words, the aim is to create a fewer number of factors by combining two or more variables. This technique is particularly useful for personality theories, biology, or marketing. These fields may easily hypothesize too many variables, so factor analysis helps to find essentials of a theory. JASP can do two types of factor analysis: principal component analysis (PCA) and exploratory factor analysis (EFA).

<table>
<tr><th>Step</th><th>Action</th><th>Result</th></tr>
<tr><td colspan="3">Principal Component Analysis</td></tr>
<tr><td colspan="3">We will be using the example data set "Political Democracy."</td></tr>
<tr><td>1.</td><td>Click “Factor” at the top and “Principal Component Analysis” from the drop-down menu.</td><td>
</td></tr>
<tr><td>2.</td><td>Add the variables of interest into Included Variables. Keep in mind the following constraints:
The variables must be scale
Explore other options given in the menu space. When you have made your selections, click “OK.”</td><td>
</td></tr>
</table>

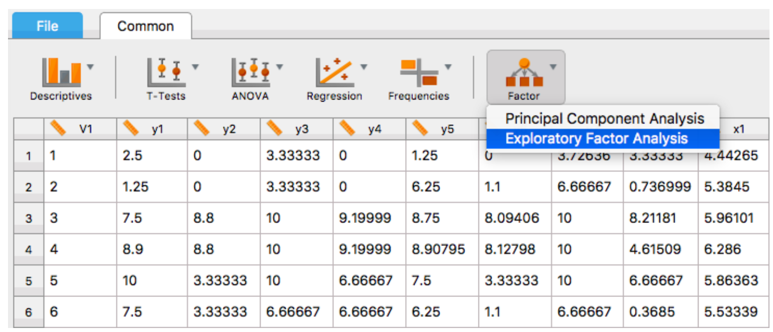
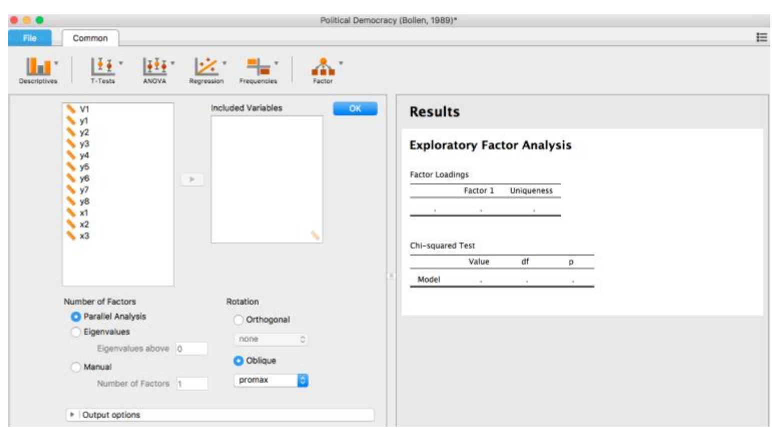
<table>
<tr><th>Step</th><th>Action</th><th>Result</th></tr>
<tr><td>3.</td><td>Your results will be displayed in the right-hand space.

The primary output for a principal component analysis shows the correlation between each variable of a principal component and the principal component itself (displayed under the RC 1 and RC 2 columns for the two principal components).</td><td>

Principal Component Analysis

Component Loadings

	RC 1	RC 2	Uniqueness
x1	0.929	.	0.100
x2	0.957	.	0.068
x3	0.952	.	0.129
y1	.	0.894	0.180
y2	.	0.819	0.356
y3	.	0.827	0.300

</td></tr>
<tr><td colspan="3">Exploratory Factor Analysis</td></tr>
<tr><td colspan="3">We will be using the example data set "Political Democracy."</td></tr>
<tr><td>1.</td><td>Click “Factor” at the top and “Exploratory Factor Analysis” from the drop-down menu.</td><td>
</td></tr>
<tr><td>2.</td><td>Add the variables of interest into Included Variables. Keep in mind the following constraints:
The variables must be scale
Explore other options given in the menu space. When you have made your selections, click “OK.”</td><td>
</td></tr>
</table>

Step	Action	Result
3.	Your results will be displayed in the right-hand space. The primary output shows how the variables load into factors.	**Exploratory Factor Analysis**

Factor Loadings

	Factor 1	Factor 2	Uniqueness
x1	0.885	.	0.152
x2	0.979	.	0.049
x3	0.895	.	0.236
y1	.	1.007	0.035
y2	.	0.615	0.620
y3	.	0.677	0.514

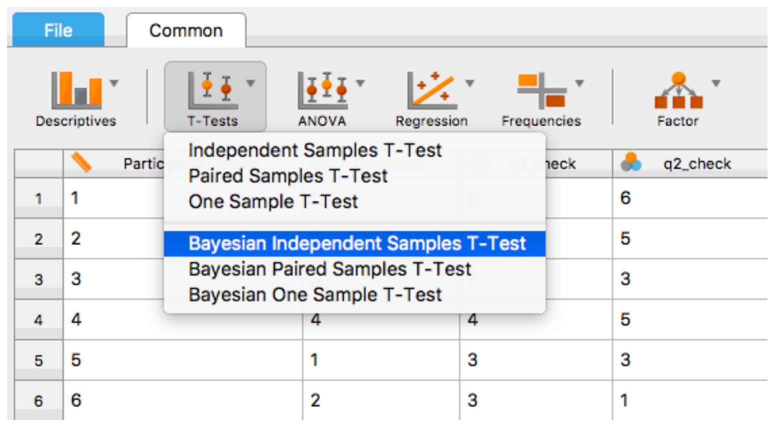
Chi-squared Test

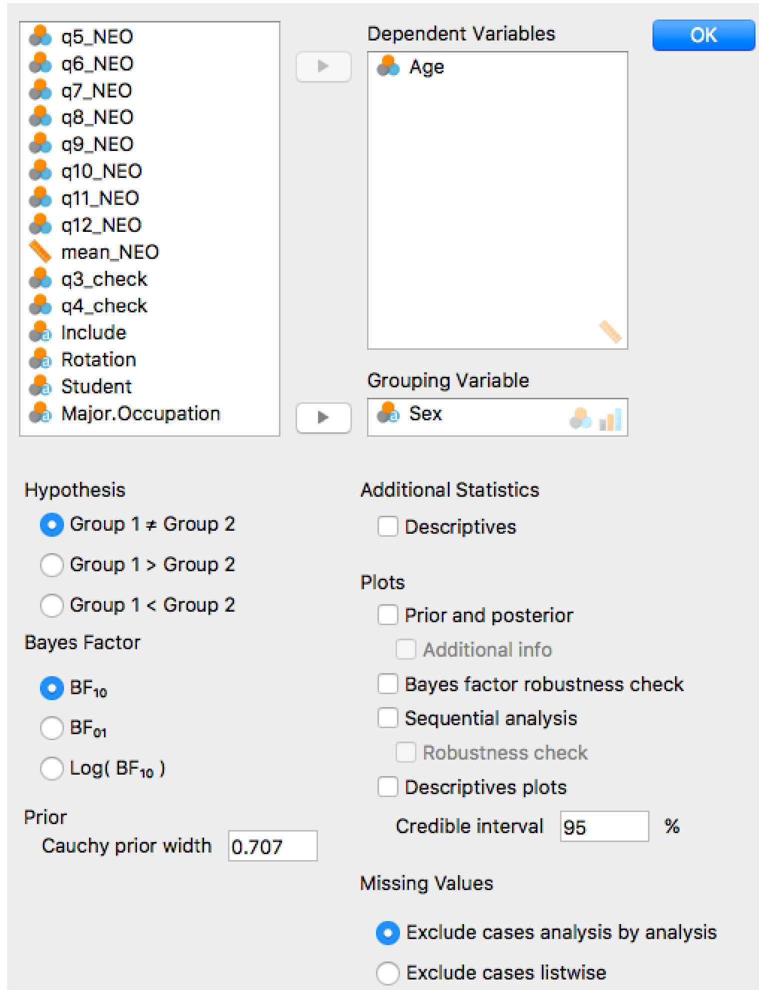
	Value	df	p
Model	3.761	4	0.439

End of procedure

Bayesian Methods

JASP offers Bayesian alternatives to many of the analyses. Particularly, there are alternatives for Independent Samples T-Test, Paired Samples T-Test, One Sample T-Test, ANOVA, Repeated Measures ANOVA, ANCOVA, Correlation Matrix, Correlation Pairs, Linear Regression, Binomial Test, Contingency Tables, and Log-Linear Regression. Below we include some examples of procedures for these analyses. Bayesian statistics are an alternative to null hypothesis testing that is becoming increasingly preferred in fields that use statistics.

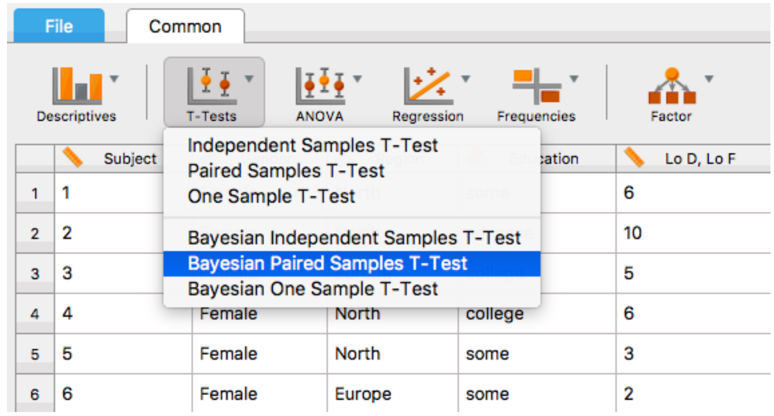
Step	Action	Result
Bayesian Independent Samples T-Test		
We will be using the example data set "**Kitchen Rolls**."		
1.	Click "T-Tests" at the top left-hand corner and "Bayesian Independent Samples T-Test" from the drop-down menu.	

<table>
<tr><th>Step</th><th>Action</th><th>Result</th></tr>
<tr><td>2.</td><td>Add your Dependent Variable and Grouping Variable. In this example, we will be using Age as a dependent variable and Sex as a grouping variable. Keep in mind the following constraints:
The dependent variable must be scale
The grouping variable must have exactly 2 levels
When you have made your selections, click “OK.”</td><td>
</td></tr>
<tr><td>3.</td><td>Your results will be displayed in the right-hand space.</td><td>Bayesian T-Test
Bayesian Independent Samples T-Test<table><tr><th></th><th>BF_{10}</th><th>error %</th></tr><tr><td>Age</td><td>0.509</td><td>7.833e –5</td></tr></table></td></tr>
</table>

Bayesian Paired Samples T-Test

We will be using the example data set "**Bugs.**"

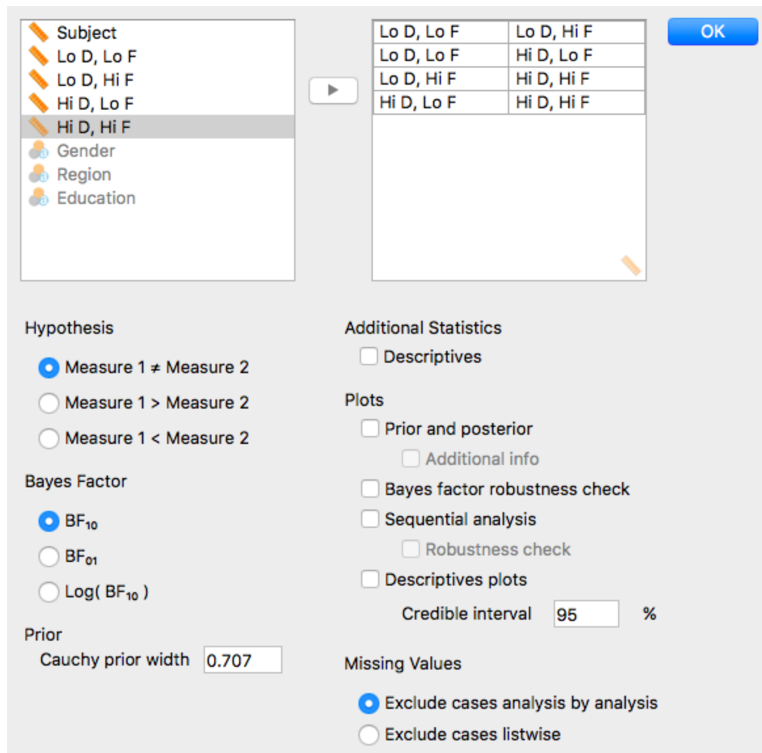
1. Click “T-Tests” at the top left-hand corner and “Bayesian Paired Samples T-Test” from the drop-down menu.



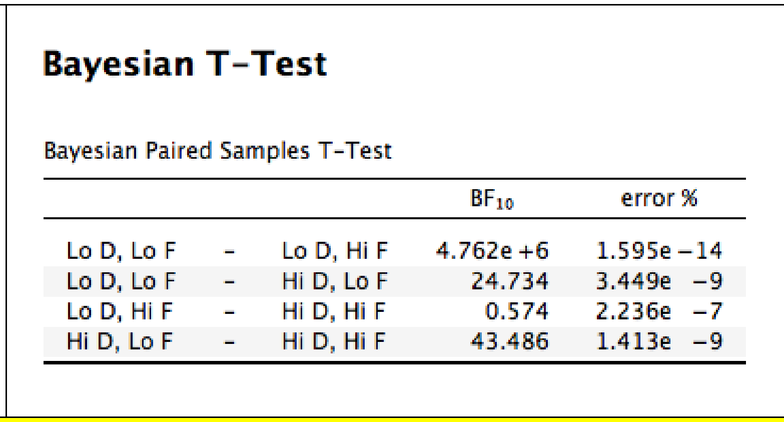
2. Add the combination of variables of interest. Keep in mind the following constraints:

   - The variable must be scale

   When you have made your selections, click “OK.”



3. Your results will be displayed in the right-hand space.



Bayesian T-Test

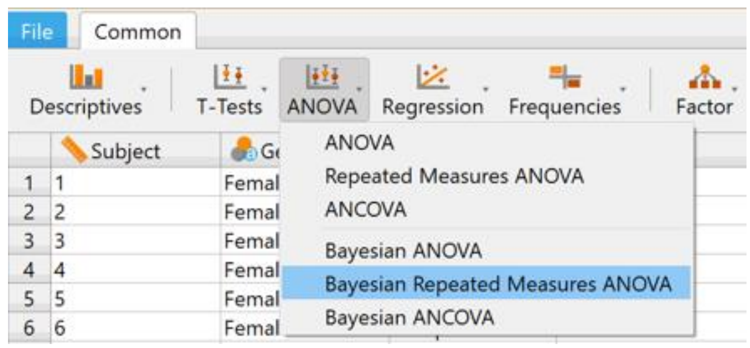
Bayesian Paired Samples T-Test

			BF_{10}	error %
Lo D, Lo F	-	Lo D, Hi F	4.762e +6	1.595e −14
Lo D, Lo F	-	Hi D, Lo F	24.734	3.449e −9
Lo D, Hi F	-	Hi D, Hi F	0.574	2.236e −7
Hi D, Lo F	-	Hi D, Hi F	43.486	1.413e −9

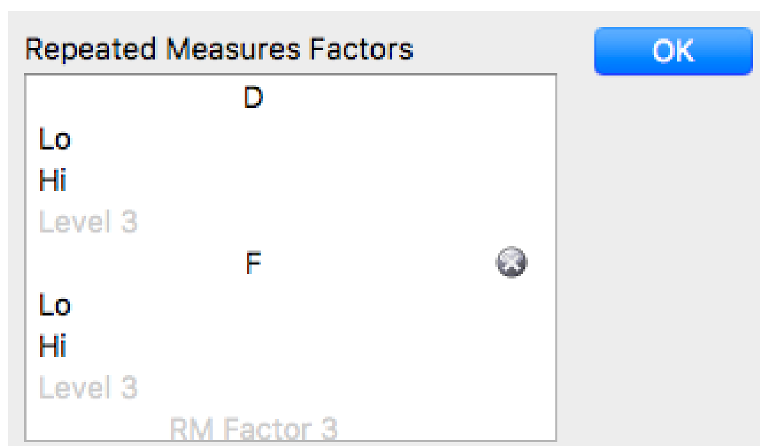
Bayesian Repeated Measures ANOVA

We will be using the example data set "**Bugs.”**

1. Click “ANOVA” at the top left-hand corner and select “Bayesian Repeated Measures ANOVA” from the drop-down menu.



2. For each repeated measure or the within-subjects variable, label the variable under Repeated Measures Factors in “RM Factor” and then the levels of the variable in “Level.”

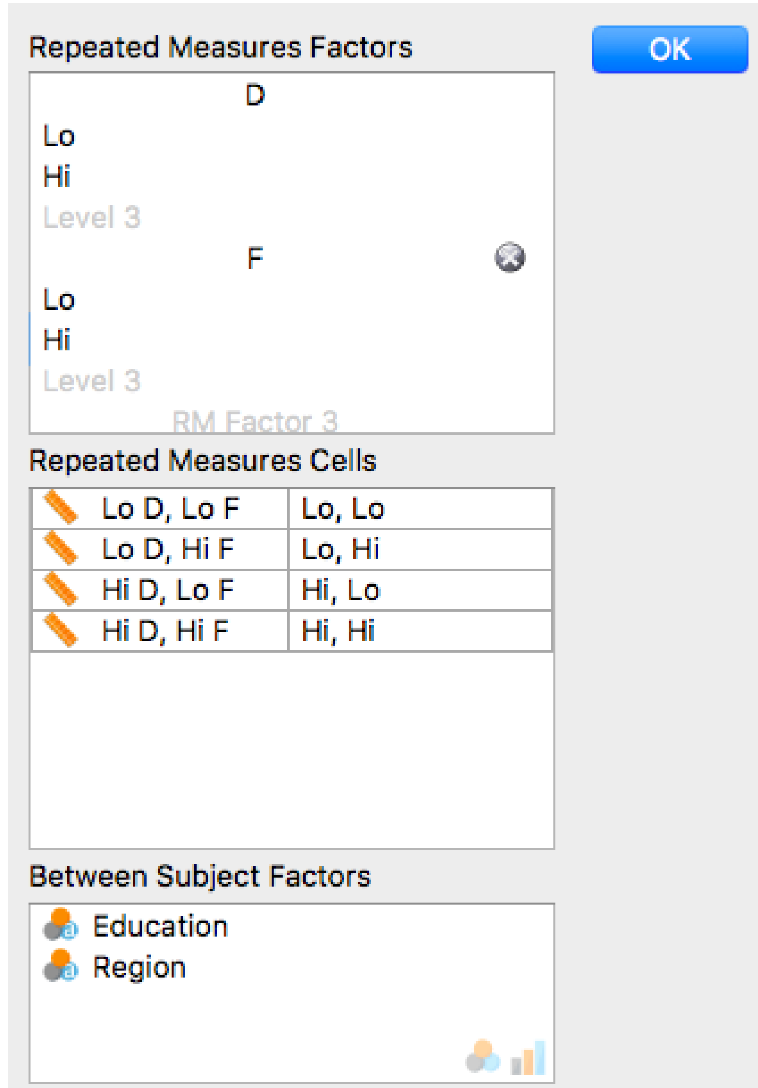
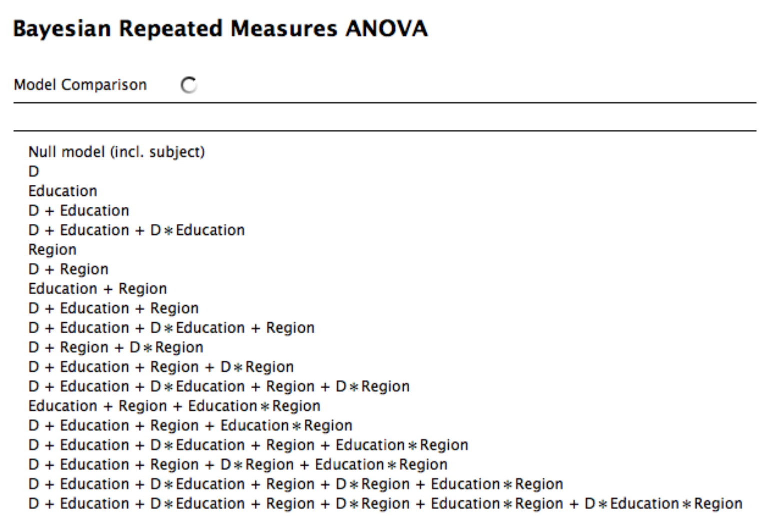


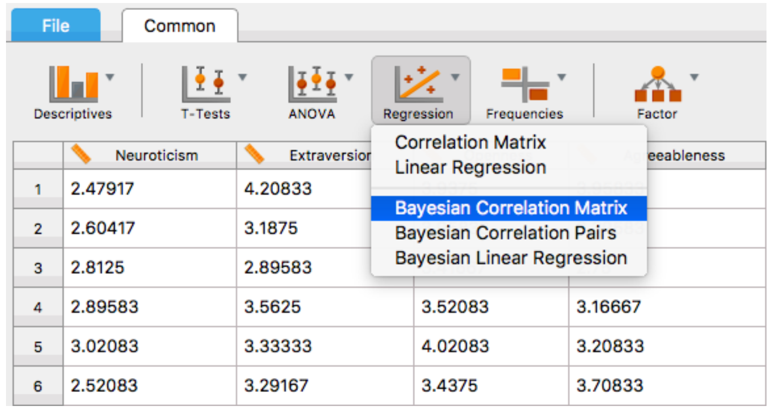
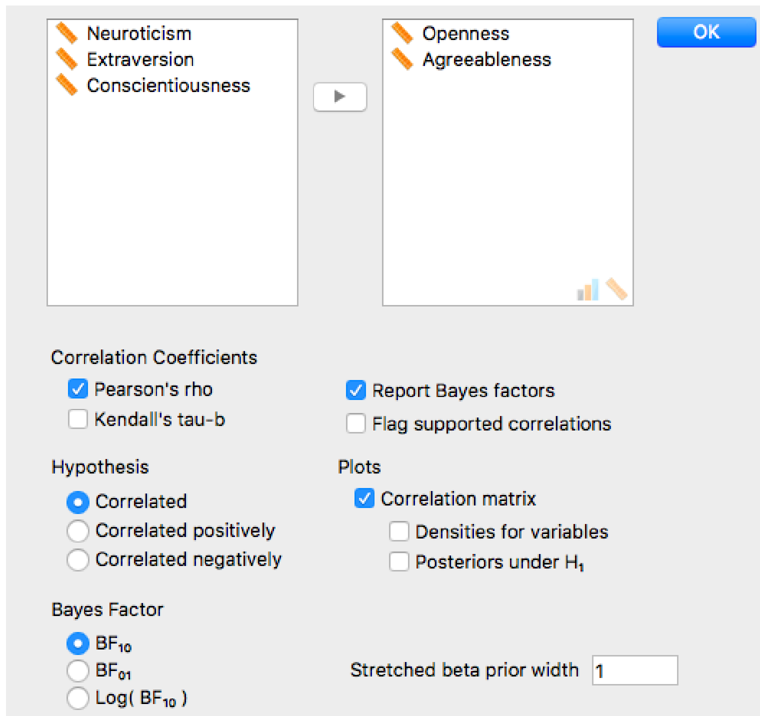
<table>
<tr>
<td>3.</td>
<td>The repeated measures of Lo D, Lo F, Lo D, Hi F, Hi D, Lo F, and Hi D, Hi F should be placed in each section within the Repeated Measures Cells box, aligning with the appropriate labeling which JASP created based on your Repeated Measures Factors. Keep in mind the following constraints:

- The variables must be scale

We will use a mixed-methods design, with both within-subjects and between-subjects variables. Add between-subjects variables in Between Subject Factors, as well. For these variables, keep in mind the following constraints:

- The variables must be ordinal or categorical

Explore other options given in the menu space. When you have made your selections, click “OK.”</td>
<td>
</td>
</tr>
<tr>
<td>4.</td>
<td>Your results will be displayed in the right-hand space.</td>
<td>
</td>
</tr>
</table>

<table>
<tr><td colspan="3">Bayesian Correlation Matrix</td></tr>
<tr><td colspan="3">We will be using the example data set "Big 5."</td></tr>
<tr><td>1.</td><td>Click “Regression” at the top left-hand corner and “Bayesian Correlation Matrix” from the drop-down menu.</td><td>
</td></tr>
<tr><td>2.</td><td>Add your variables of interest. Keep in mind the following constraints:
The variable must be scale or ordinal
Select “Correlation matrix” under Plots. Explore other options given in the menu space. When you have made your selections, click “OK.”</td><td>
</td></tr>
</table>

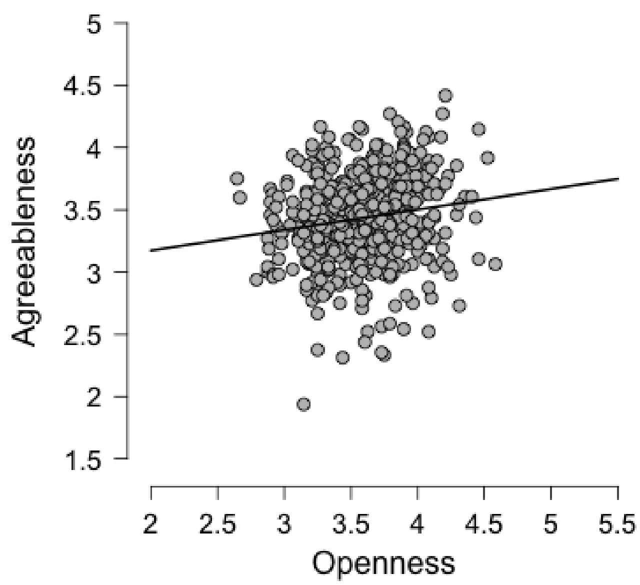
3.	Your results will be displayed in the right-hand space.	(see below)

Bayesian Correlation Matrix

Bayesian Pearson Correlations

		Openness	Agreeableness
Openness	Pearson's r	—	0.159
	BF_{10}	—	32.64
Agreeableness	Pearson's r		—
	BF_{10}		—

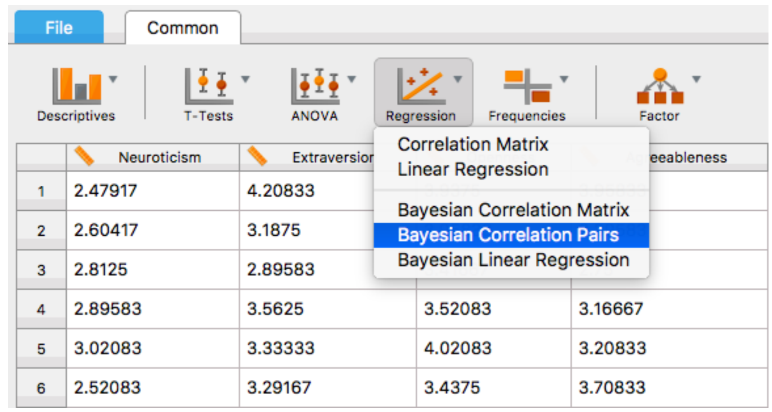
Correlation Plot



Bayesian Correlation Pairs

We will be using the example data set "**Big 5**."

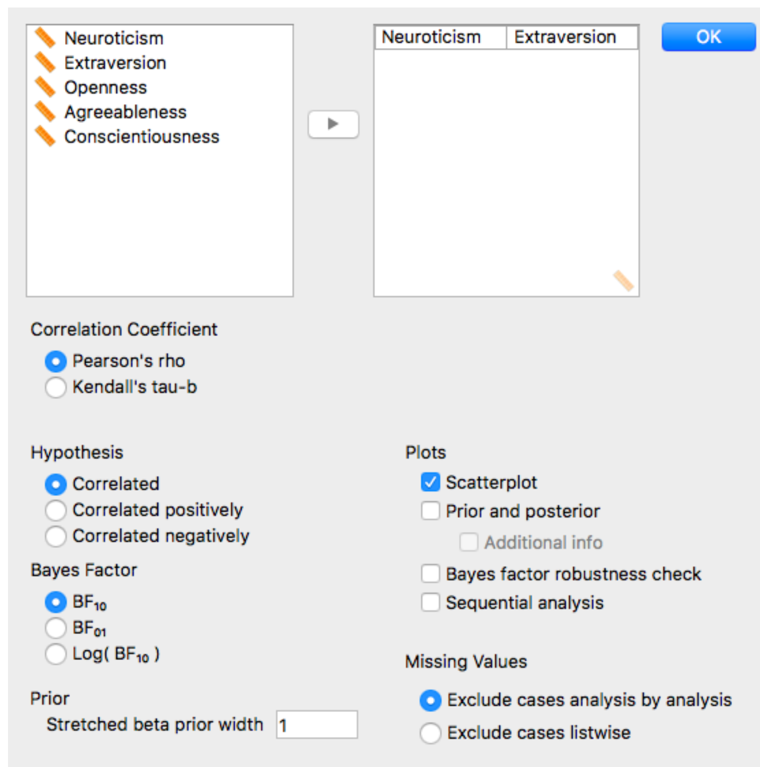
1. Click “Regression” at the top left-hand corner and “Bayesian Correlation Pairs” from the drop-down menu.



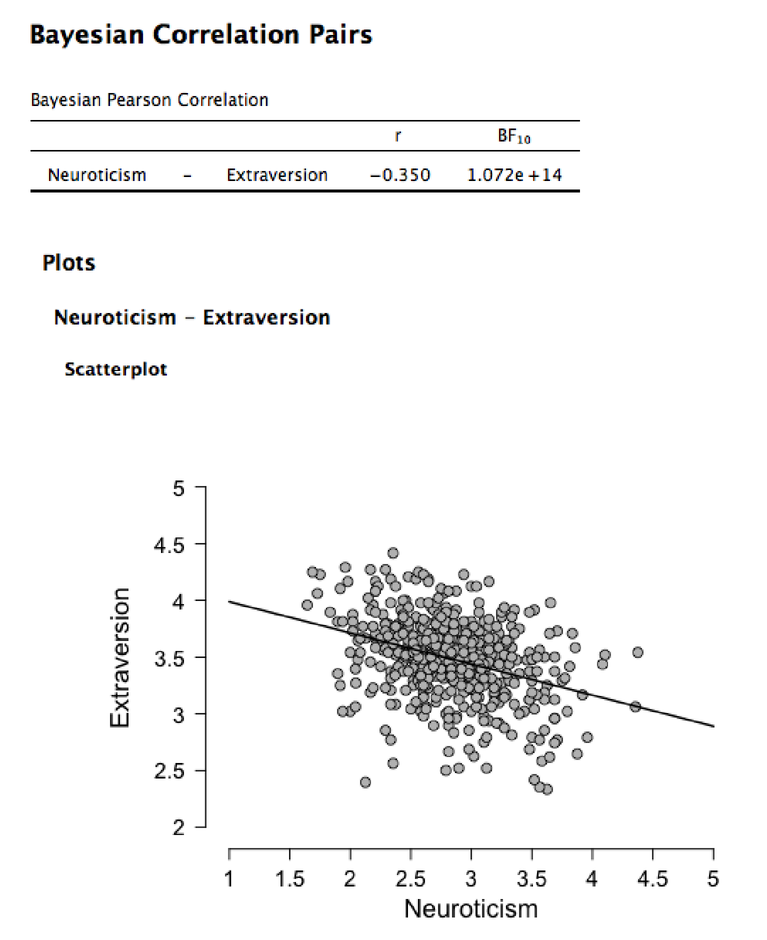
2. Add your variables of interest. Keep in mind the following constraints:

   - The variable must be scale

   Select “Scatterplot” under Plots. Explore other options given in the menu space. When you have made your selections, click “OK.”



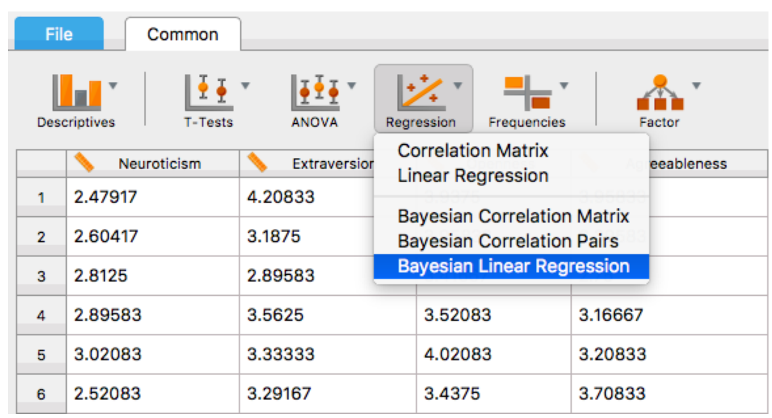
3. Your results will be displayed in the right-hand space.



Bayesian Linear Regression

We will be using the example data set "**Big 5**."

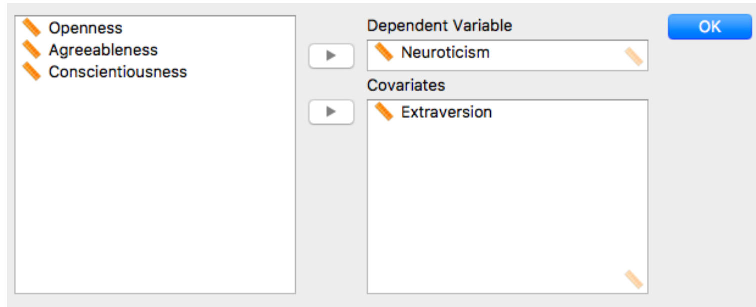
1. Click “Regression” at the top left-hand corner and “Bayesian Linear Regression” from the drop-down menu.



2. Add your variable of interest. In this example, we will be using Neuroticism as the Dependent Variable and Extraversion as the Covariate. In Regression, a “Covariate” refers to variables that will be includes in the model. Keep in mind the following constraints:

- The variables must be scale

When you have made your selections, click “OK.”



3. Your results will be displayed in the right-hand space.

Bayesian Linear Regression

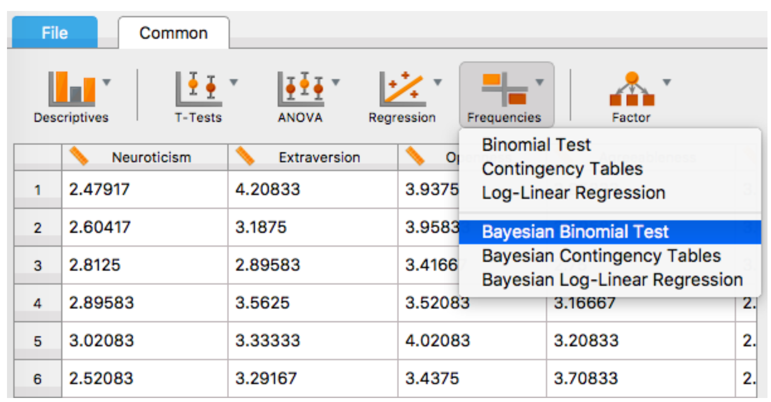
Model Comparison – Neuroticism

Models	P(M)	P(M|data)	BF_M	BF_{10}	error %
Null model	0.500	1.415e −13	1.415e −13	1.000	
Extraversion	0.500	1.000	7.069e +12	7.069e +12	1.464e −6

Bayesian Binomial Test

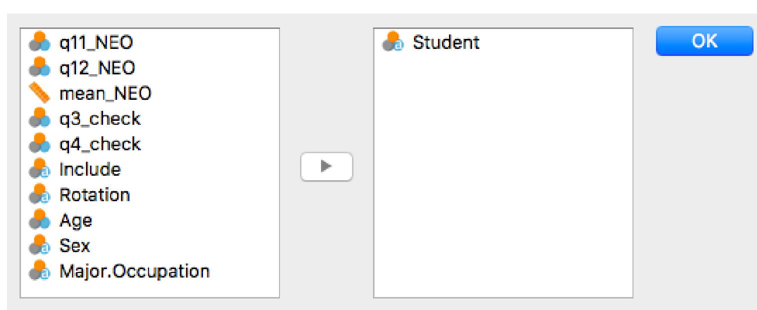
We will be using the example data set "**Kitchen Rolls**."

1. Click “Frequencies” at the top left-hand corner and “Bayesian Binomial Test” from the drop-down menu.

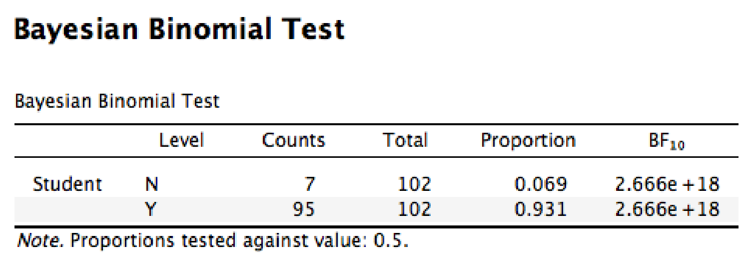


2. Add your variable of interest.

Explore other options given in the menu space. When you have made your selections, click “OK.”



3. Your results will be displayed in the right-hand space.



Bayesian Binomial Test

Bayesian Binomial Test

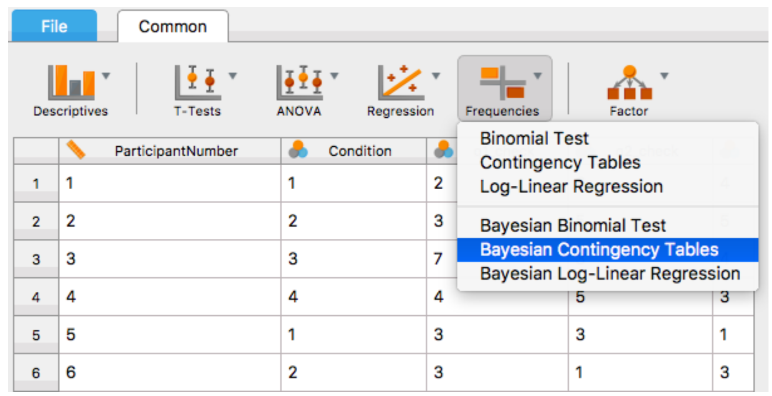
	Level	Counts	Total	Proportion	BF_{10}
Student	N	7	102	0.069	2.666e+18
	Y	95	102	0.931	2.666e+18

Note. Proportions tested against value: 0.5.

Bayesian Contingency Tables

We will be using the example data set "**Kitchen Rolls**."

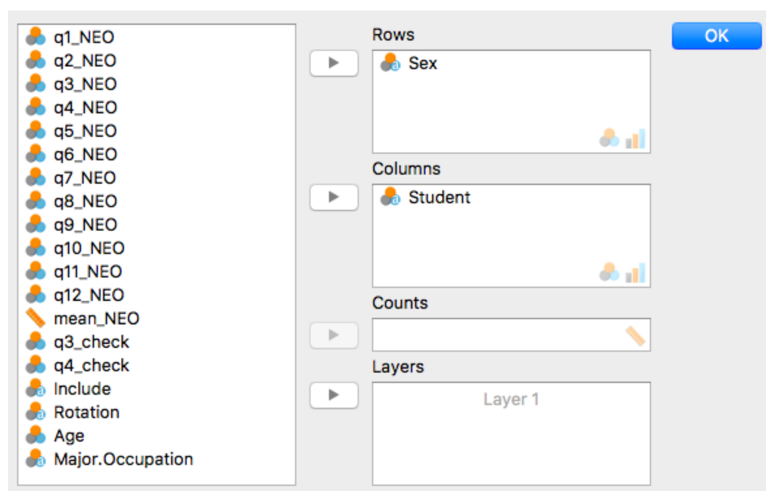
1. Click "Frequencies" at the top left-hand corner and "Bayesian Contingency Tables" from the drop-down menu.



2. Add your variables of interest (two different variables) to Rows and Columns. Keep in mind the following constraints:

   - The variables must be ordinal or categorical

   Explore other options given in the menu space. When you have made your selections, click "OK."



3. Your results will be displayed in the right-hand space.

Bayesian Contingency Tables

Bayesian Contingency Tables

	Student		
Sex	N	Y	Total
F	6	71	77
M	1	24	25
Total	7	95	102

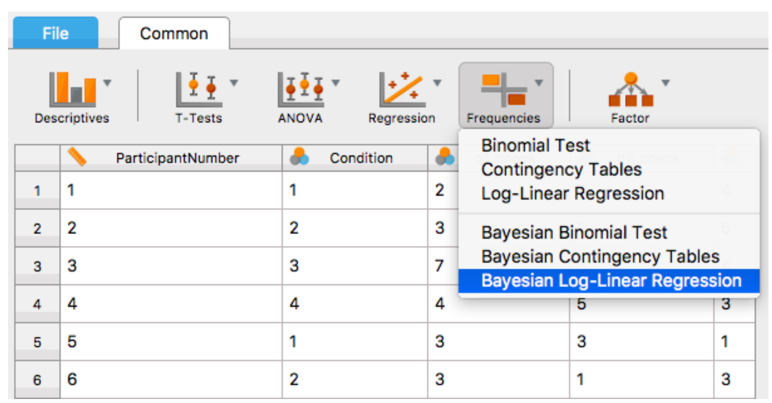
Bayesian Contingency Tables Tests

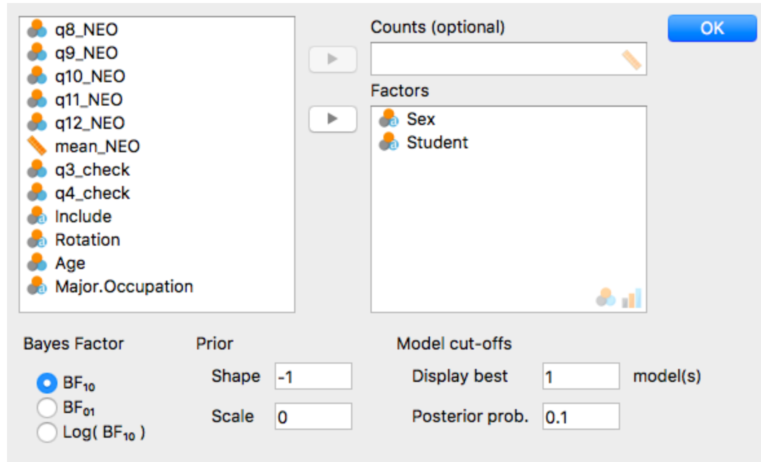
	Value
BF_{10} independent multinomial	0.158
N	102

Bayesian Log-Linear Regression

We will be using the example data set "**Kitchen Rolls**."

1. Click “Frequencies” at the top left-hand corner and “Bayesian Log-Linear Regression” from the drop-down menu.



<table>
<tr>
<td>2.</td>
<td>Add your variable(s) of interest to Factors. Keep in mind the following constraints:
The variables must be ordinal or categorical
Explore other options given in the menu space. When you have made your selections, click “OK.”</td>
<td>
</td>
</tr>
<tr>
<td>3.</td>
<td>Your results will be displayed in the right-hand space.</td>
<td>Bayesian Log-Linear Regression

Model Comparison
<table>
<tr><th></th><th>Models</th><th>P(M|data)</th><th>BF_{10}</th></tr>
<tr><td>1</td><td>Sex + Student</td><td>0.873</td><td>1.000</td></tr>
</table>
Note. Total number of models visited = 2</td>
</tr>
</table>

End of procedure

AUTHOR INFORMATION:
Last Edited: September 1, 2018

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