Using jamovi
A Brief Introduction

Stats. Open. Now.

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Outline

1. Getting Started in jamovi
2. Defining Variables in jamovi
3. Exploring Data
4. Hypothesis Testing
5. Regression Models
6. Programming with R in jamovi
7. Other Modules that are Useful

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Getting Started in jamovi

Stats. Open. Now.

1. **jamovi is free, open-source, and available for a range of operating systems for download at https://www.jamovi.org/download.html.**

2. **Installation steps specific to your operating system can be found in the online user manual https://www.jamovi.org/user-manual.html.**

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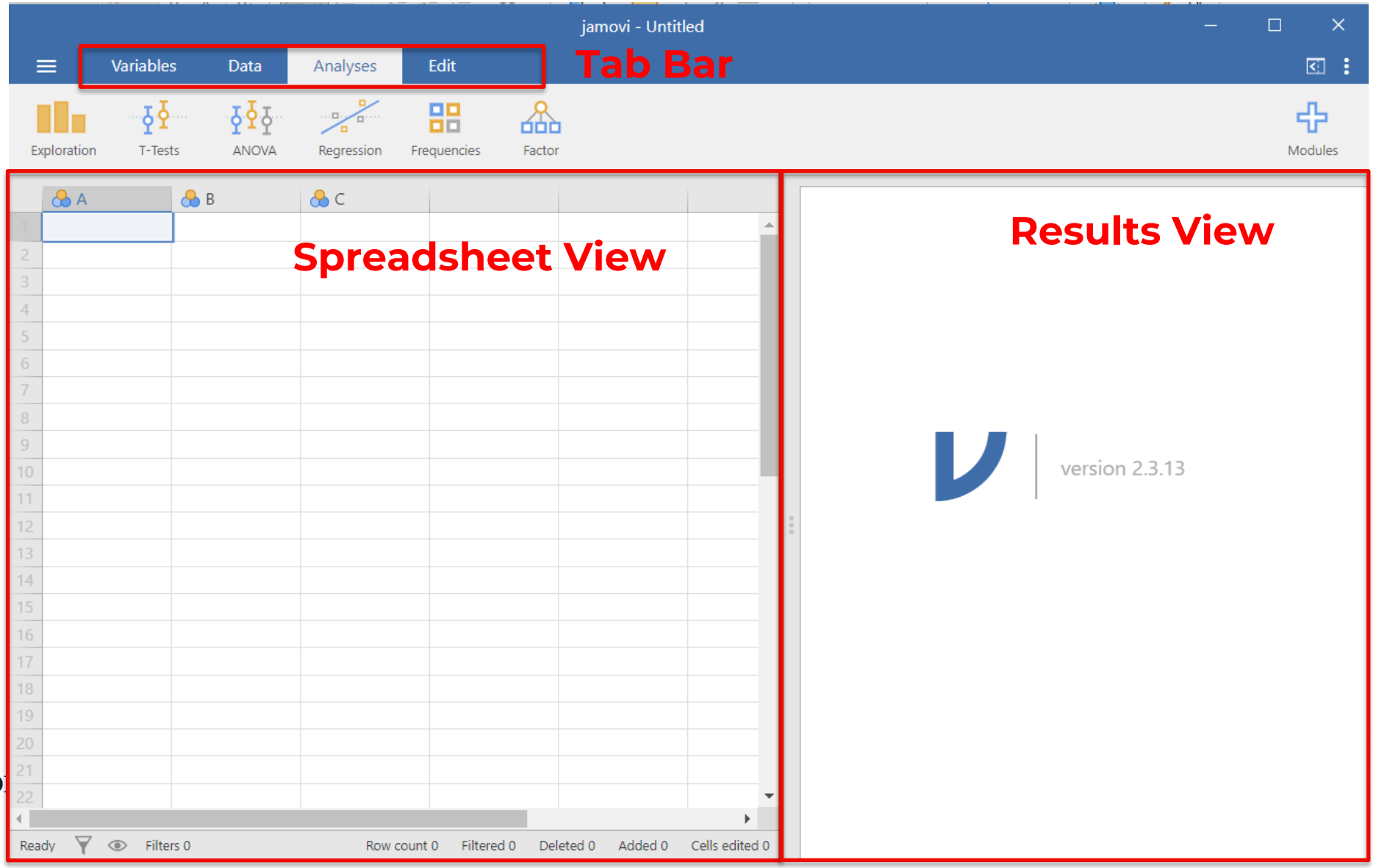
When opening jamovi, the window should look like this.



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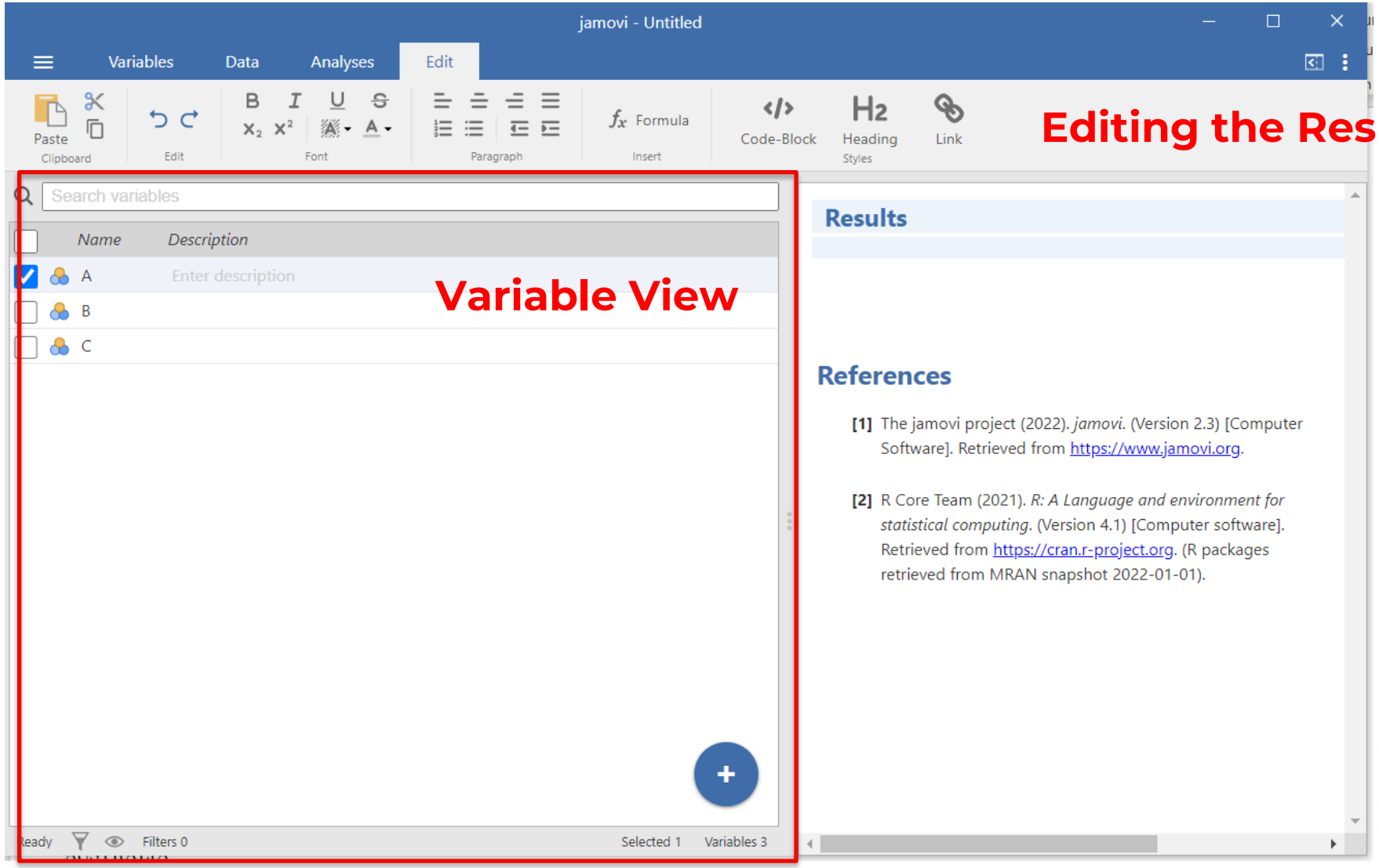
By clicking the Variable tab – you can open the variable view.

By clicking the Edit tab – you can edit the results view.



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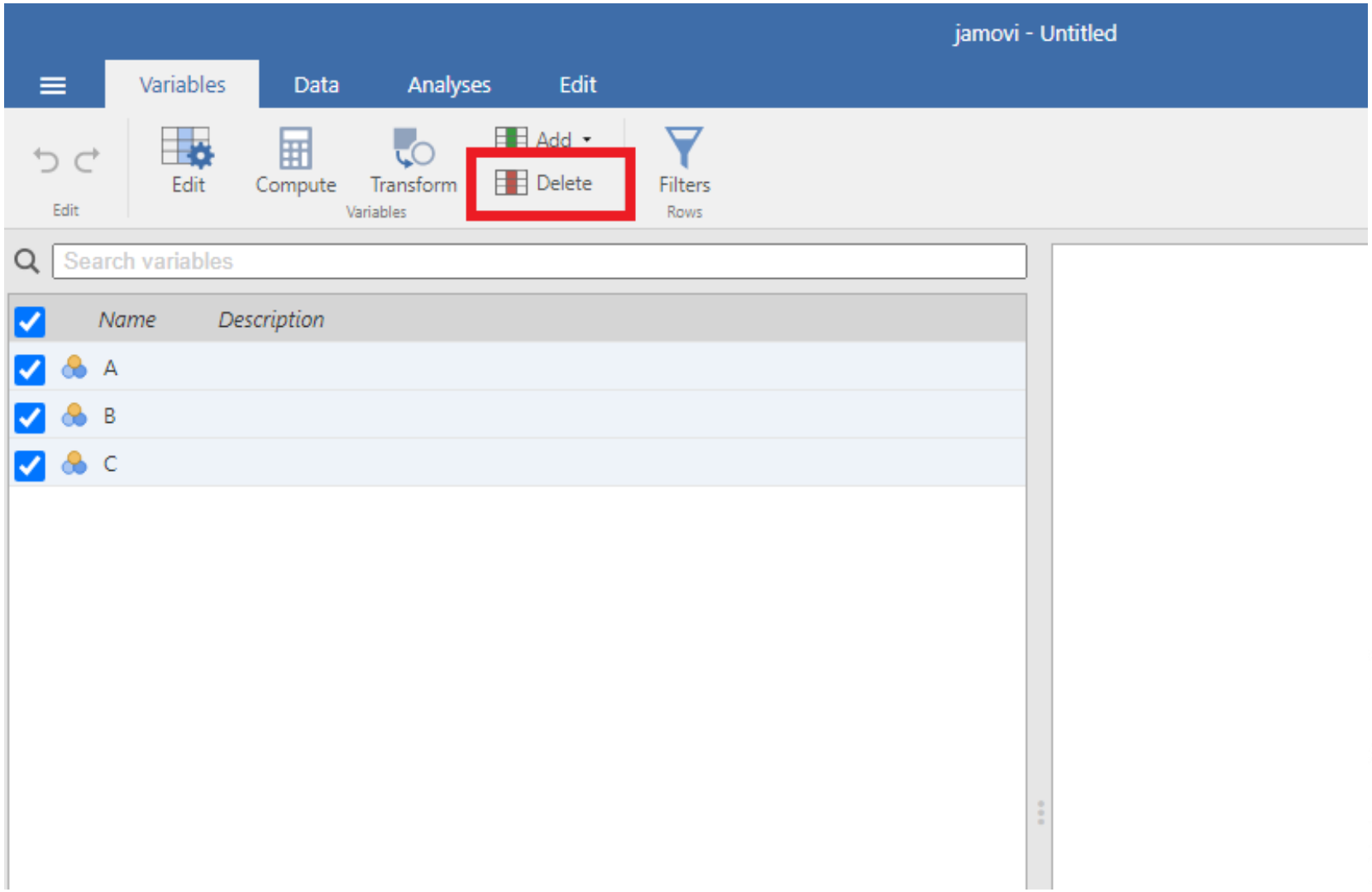
Before importing data, delete the three default variables.



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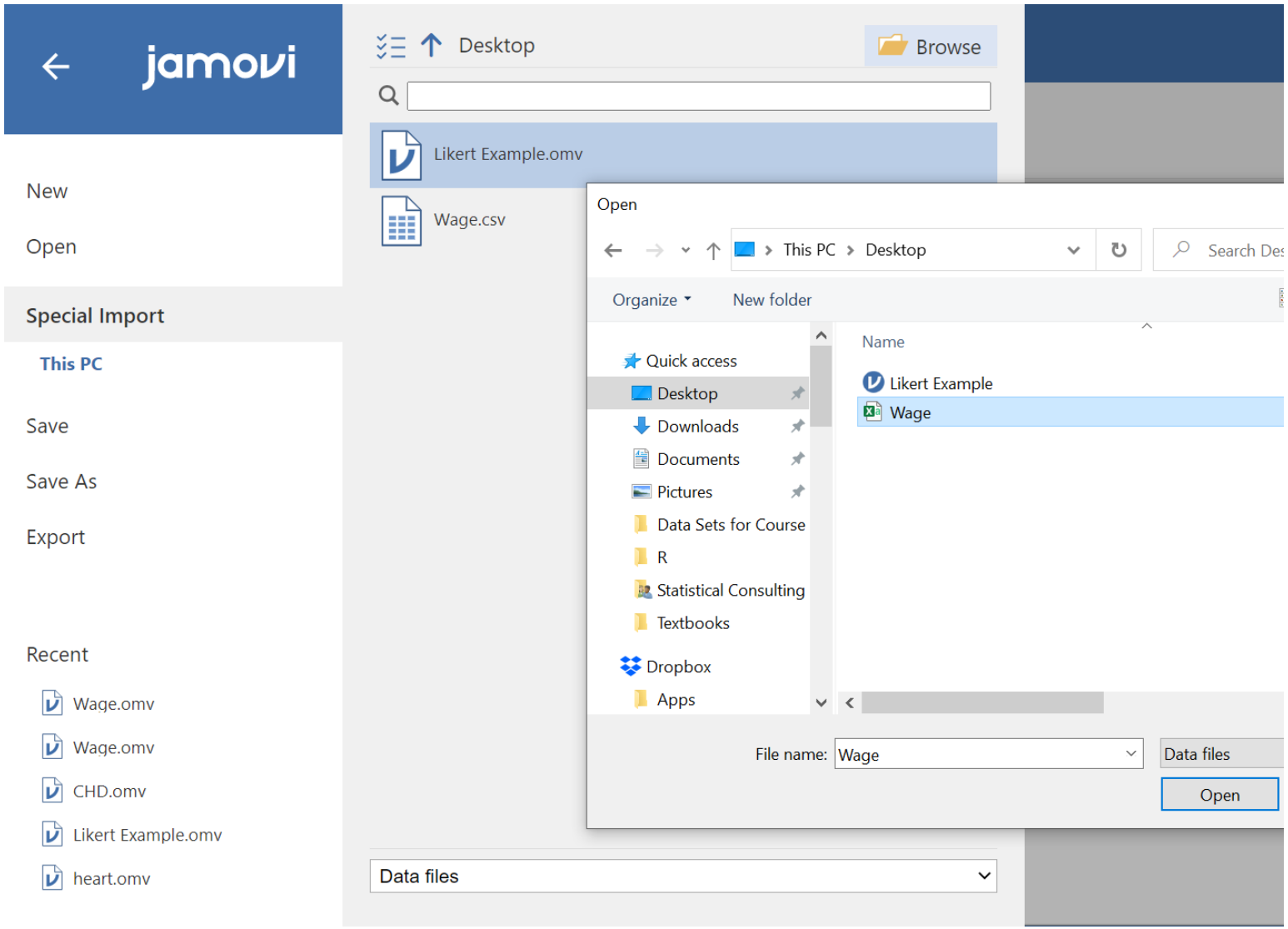
To Import a data set

Go to File (≡); Special Import; Browse and then select your Data set.



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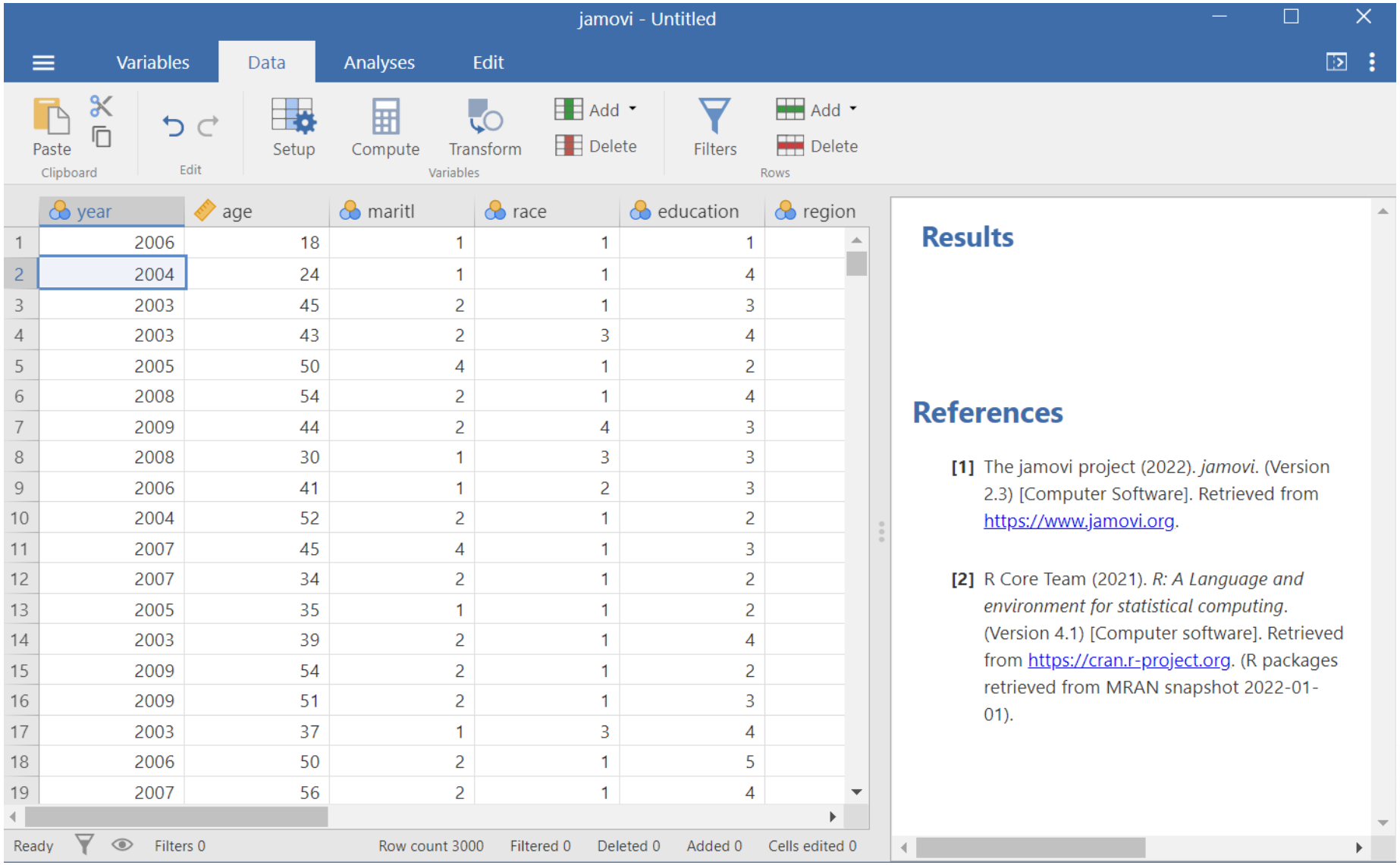
By selecting the Data tab, you should see your Data.



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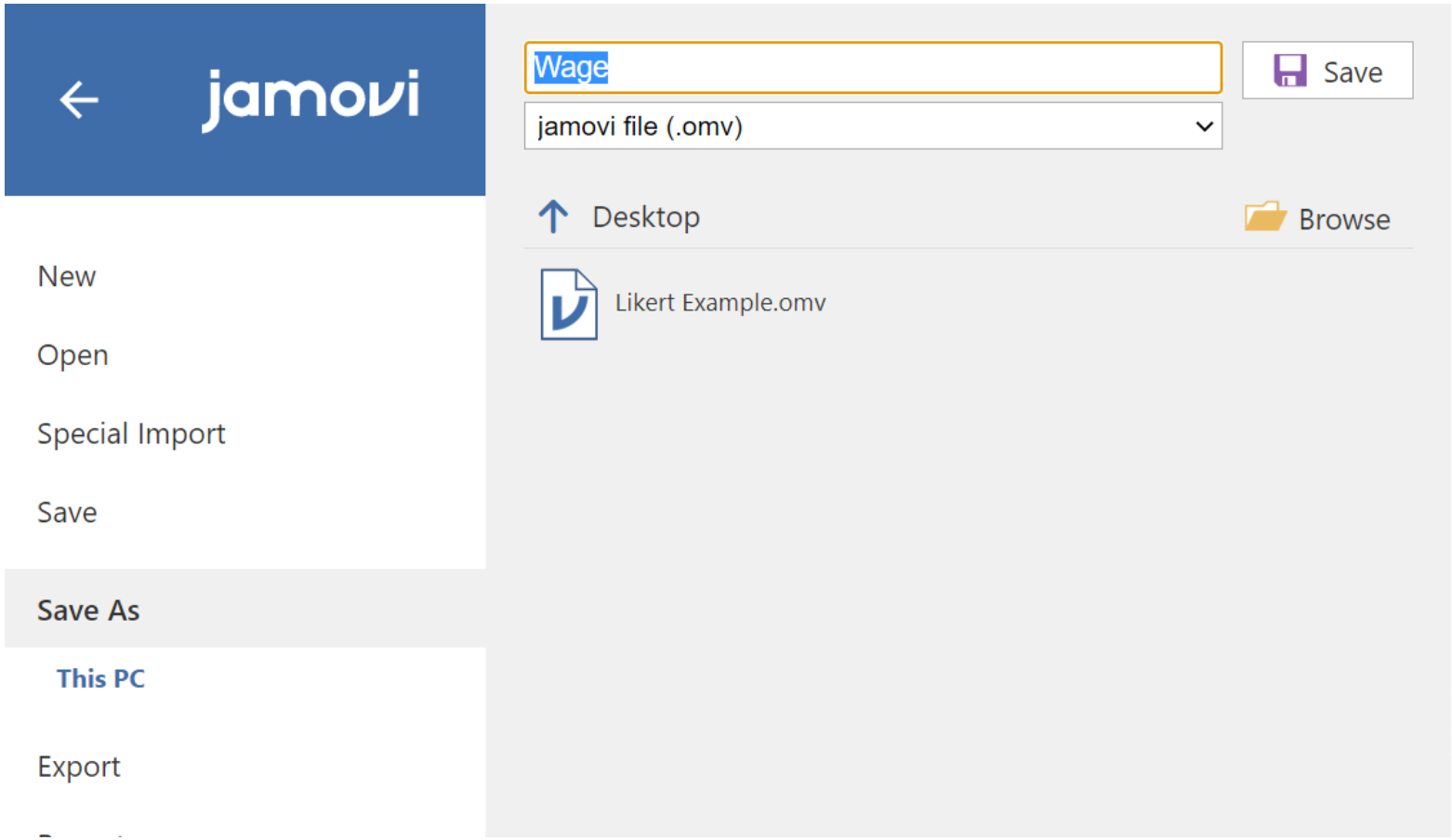
To save your data

Go to File (≡); Save As; Browse and then save your Data onto your hard drive.

- jamovi saves the file as a .omv file.



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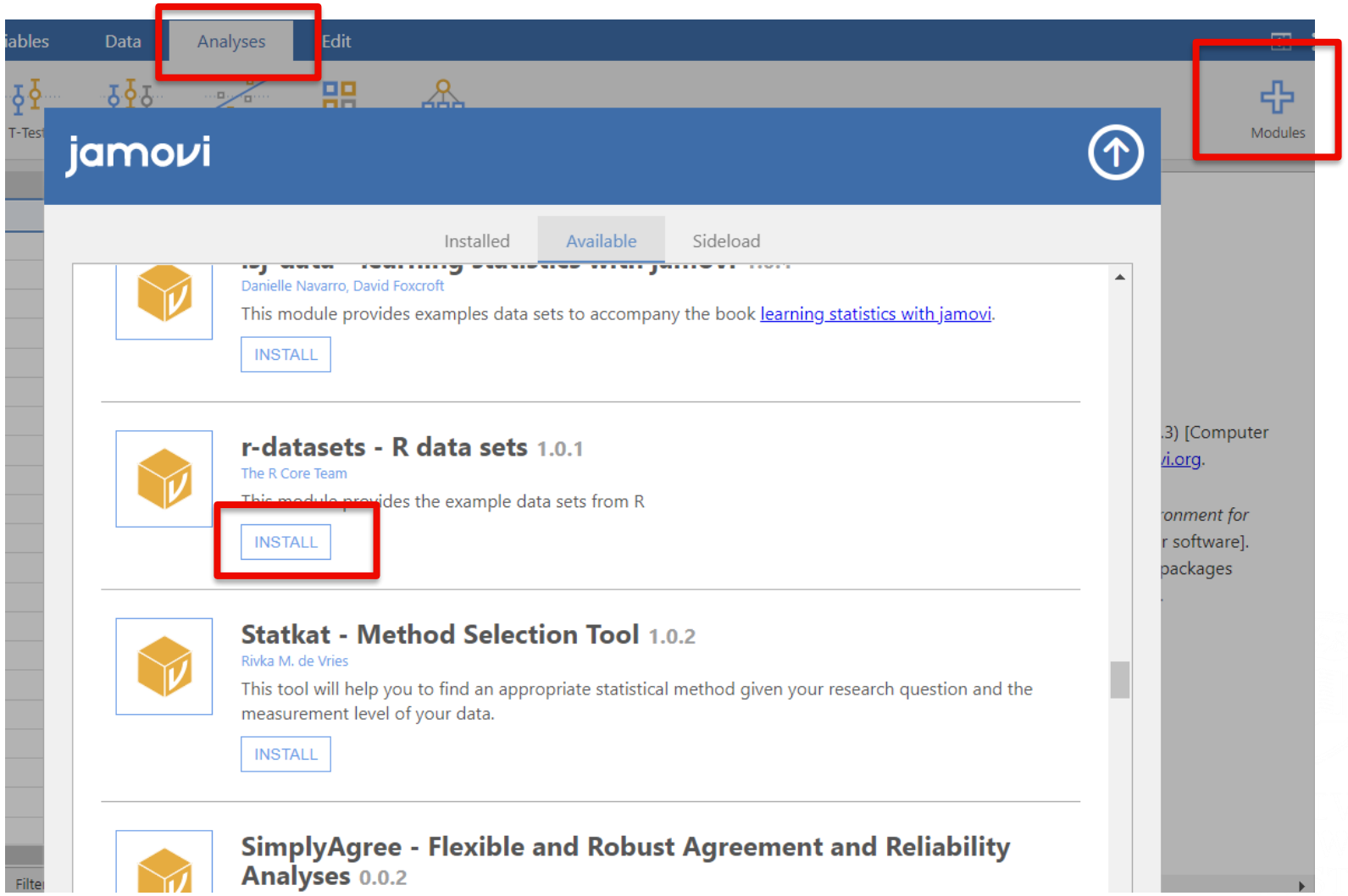
We can also install additional Modules.

Click Analyses; Module; jamovi library; and then find the Module you would like to install and press INSTALL



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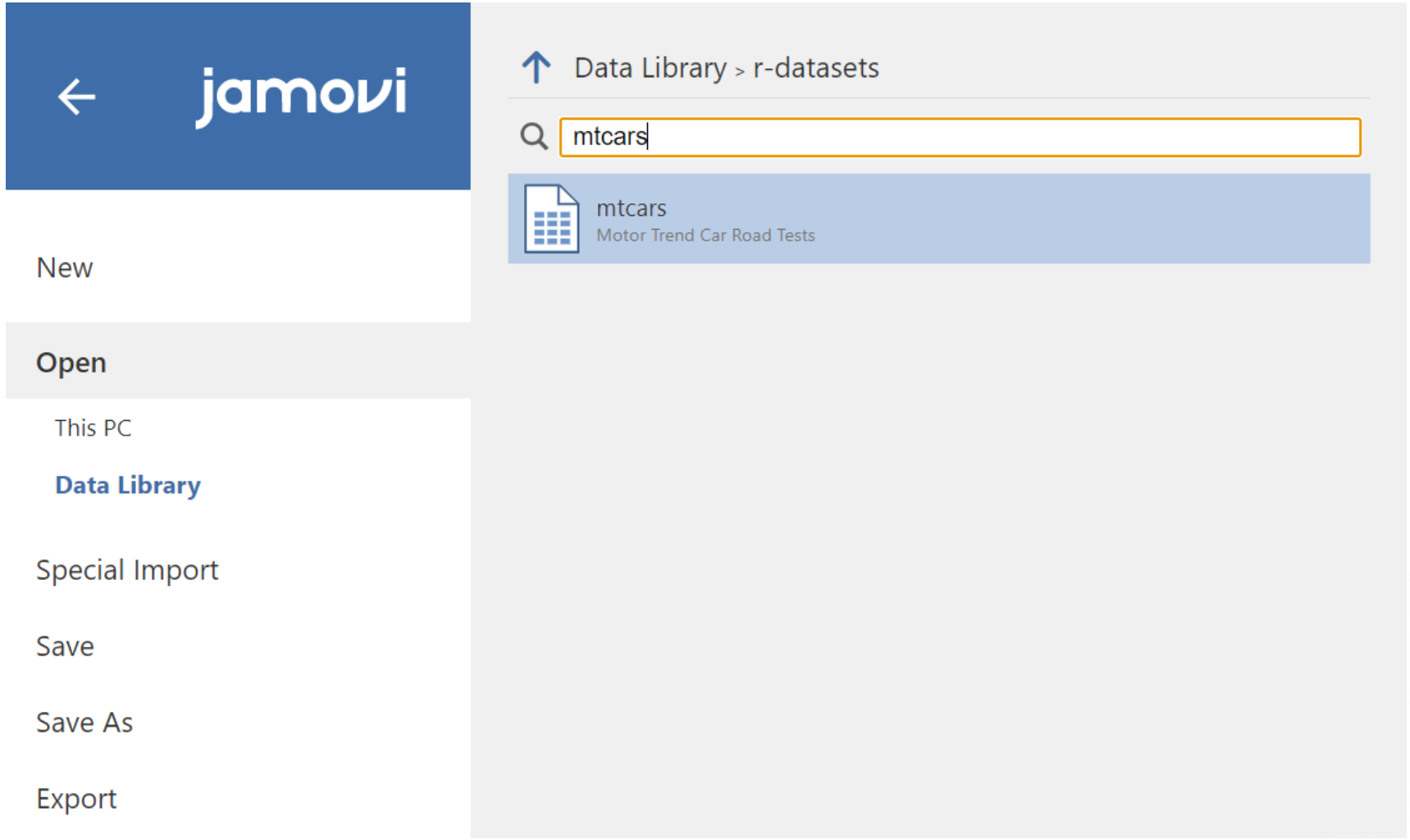
The r-datasets module contains a range of sample data sets.
Click File (≡); Open; Data Library; to see these data sets.
The following examples will use the mtcars data set.



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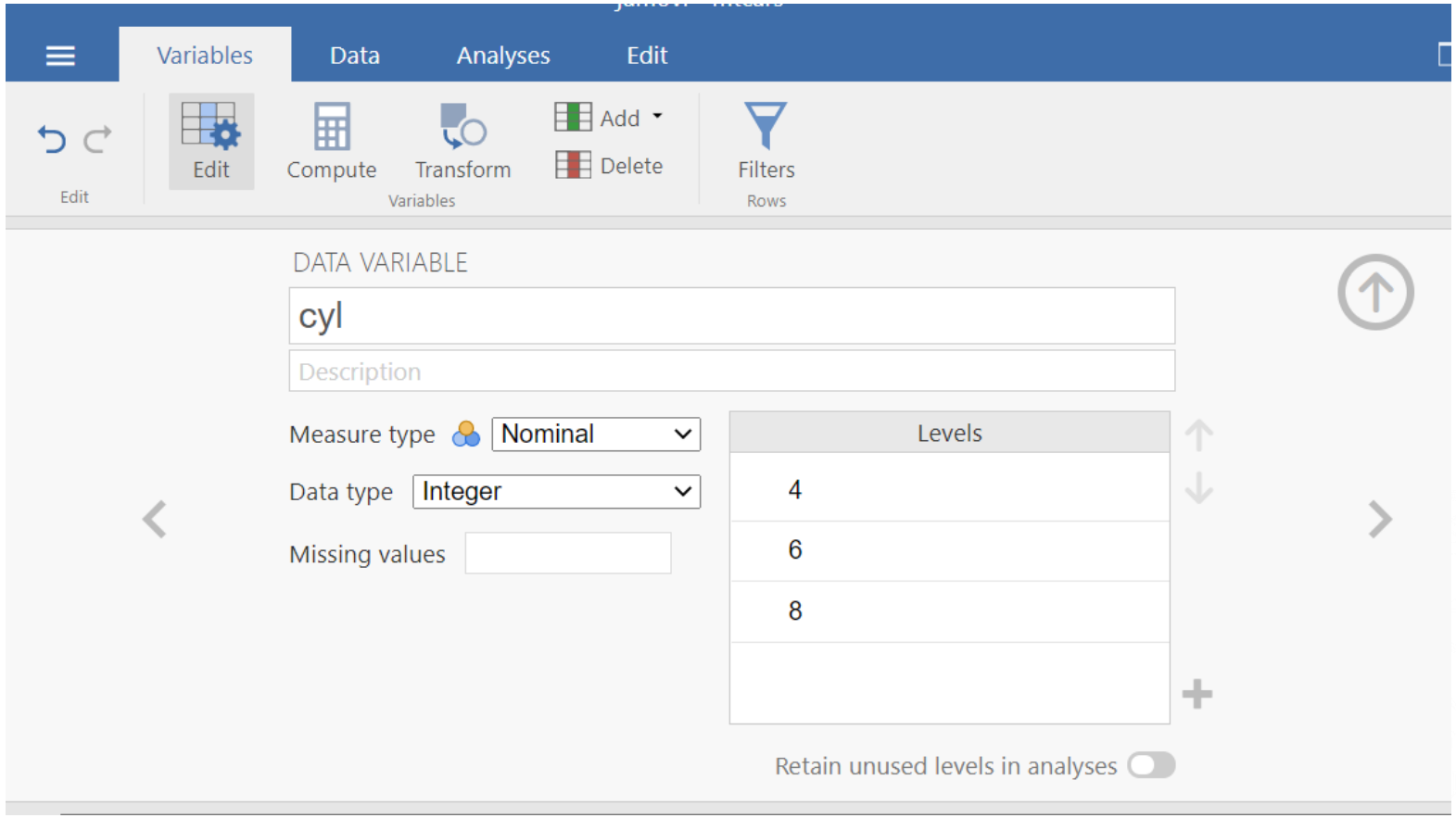
Defining Variables in jamovi

To setup variables click the Variables tab, select the variable you want to change and click Edit.



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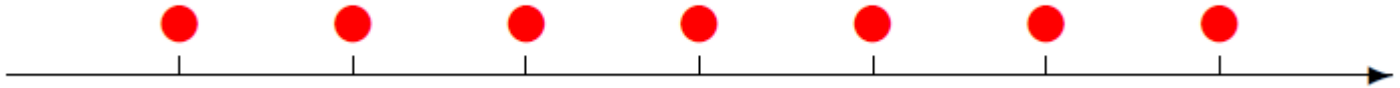
QUANTITATIVE VARIABLES IN JAMOVI

A variable that can be measured numerically is called a quantitative variable.

In jamovi, all quantitative variables are labeled as **Continuous.**



For discrete quantitative variables select a **Continuous** Measure Type with an **Integer** Data Type

For continuous quantitative variables select a **Continuous** Measure Type with a **Decimal** Data Type

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QUALITATIVE MEASURE TYPES IN JAMOVI

Nominal variables are qualitative variables that can be classified into two or more categories which have no order.
e.g. Male, Female,
e.g. Brand of Car,
e.g. Nationality

Ordinal variables are qualitative variables that can be classified into two or more categories which have order.
e.g. Age group,
e.g. Size of shirt

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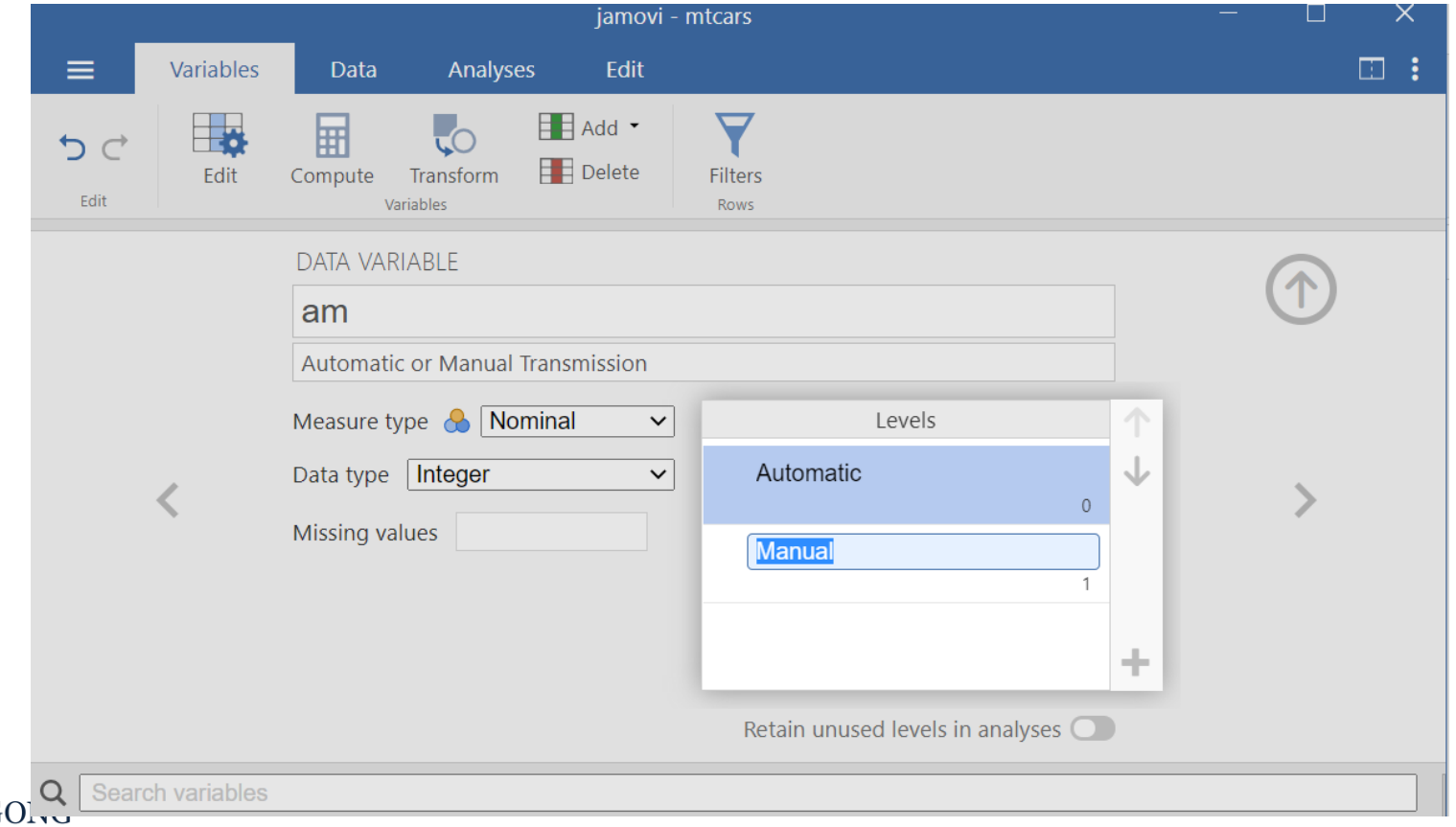
For numerically coded qualitative variables select an **Integer** Data Type. For text coded variables, select a **Text** Data Type.

QUALITATIVE VARIABLES IN JAMOVI

Categories of qualitative variables are referred to as Levels in jamovi.



Levels can be given text labels in the Levels list.

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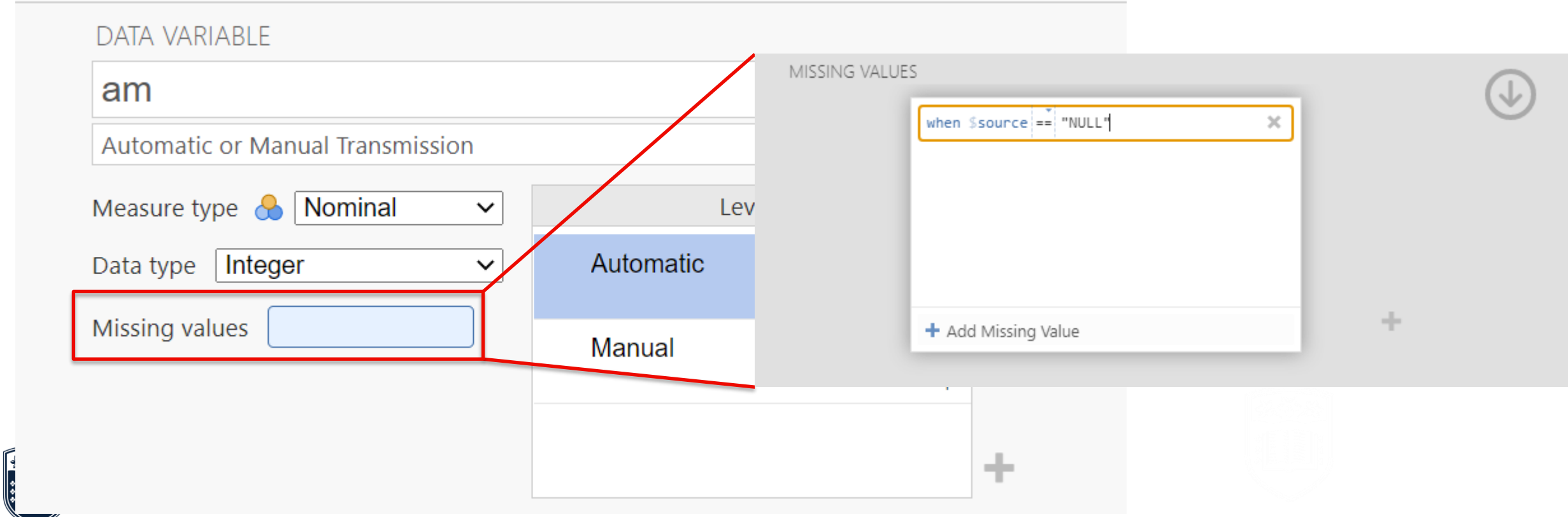
MISSING DATA IN JAMOVI

Missing Data is often recorded as a specific value.
Common examples include NA, NULL, 999.



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These values can be coded in jamovi in the Missing values list.

DEFINING VARIABLES

Here is an example of how the motor trend cars data set may look once you go through and define and label all your variables..

	Name	Description
☐	A	
☐	mpg	Fuel Efficiency (miles per gallon)
☐	cyl	Number of cylinders
☑	disp	Displacement (cubic inches)
☐	hp	Gross horespower
☐	drat	Rear axel ratio
☐	wt	Weight (1000 lbs)
☐	qsec	1/4 mile time
☐	vs	Engine Shape
☐	am	Transmission Type
☐	gear	Number of forward gears
☐	carb	Number of carburetors

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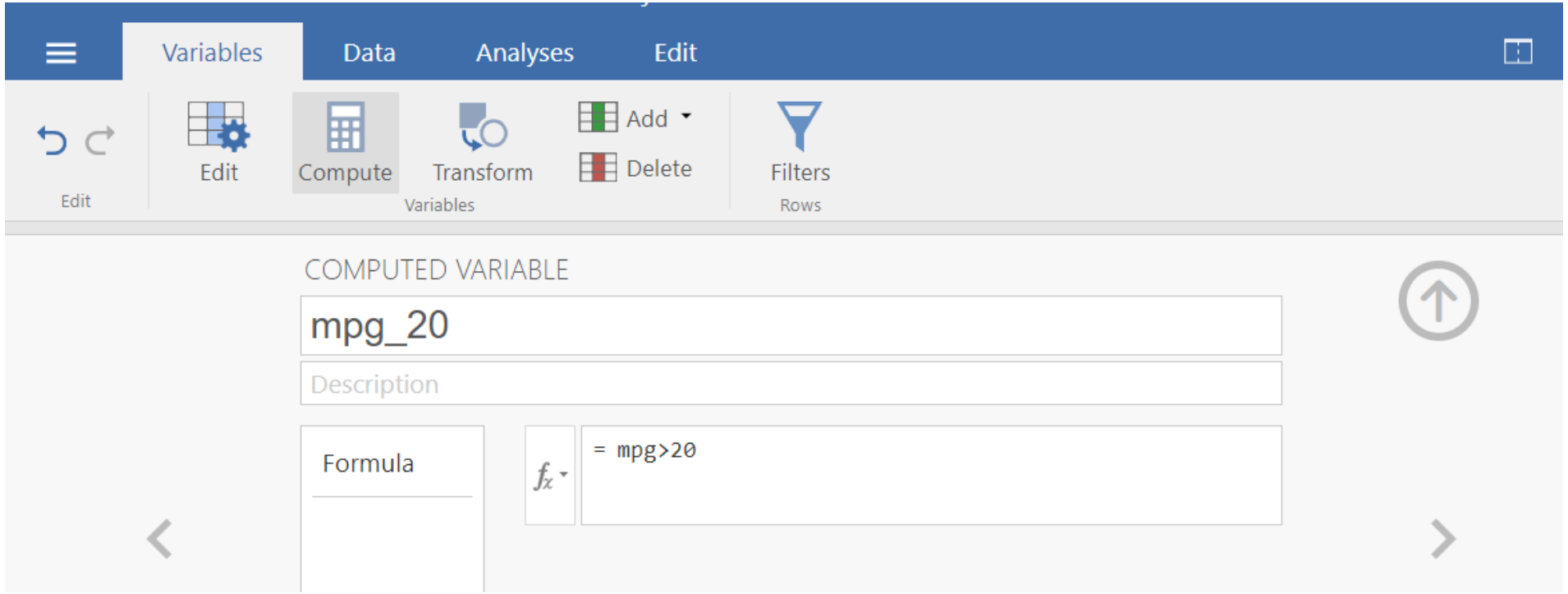
COMPUTING VARIABLES

New variables can be computed by selecting Variables; Compute

To compute a new variable that tells us which car goes more than 20 miles per gallon, use the formula mpg > 20



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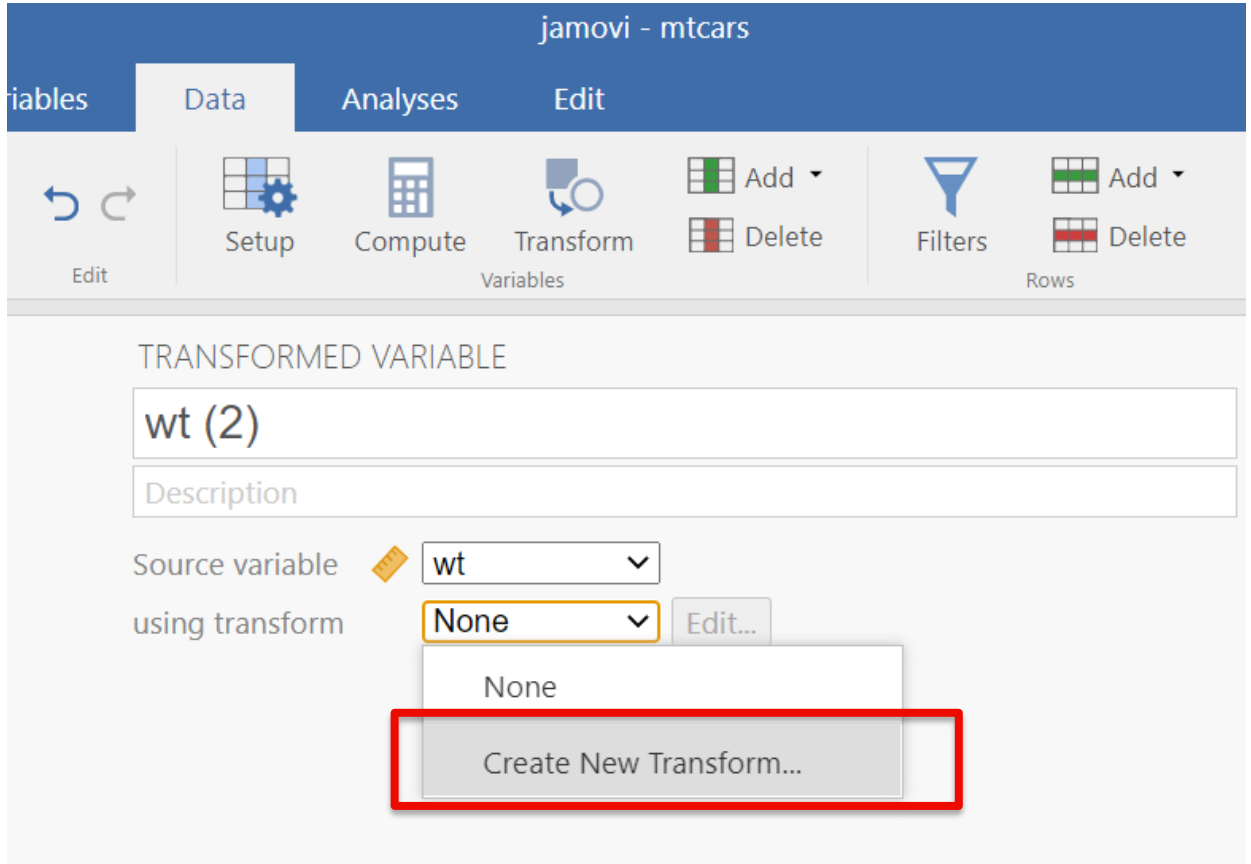
Note: Computation in jamovi is dynamic.

TRANSFORMING VARIABLES

Existing variables can be transformed by selecting them and then selecting Variables; Transform

To log transform the wt (weight) variable in the mtcars data, select the wt column, Variables; Transform, and then select Create New Transform under using transform.



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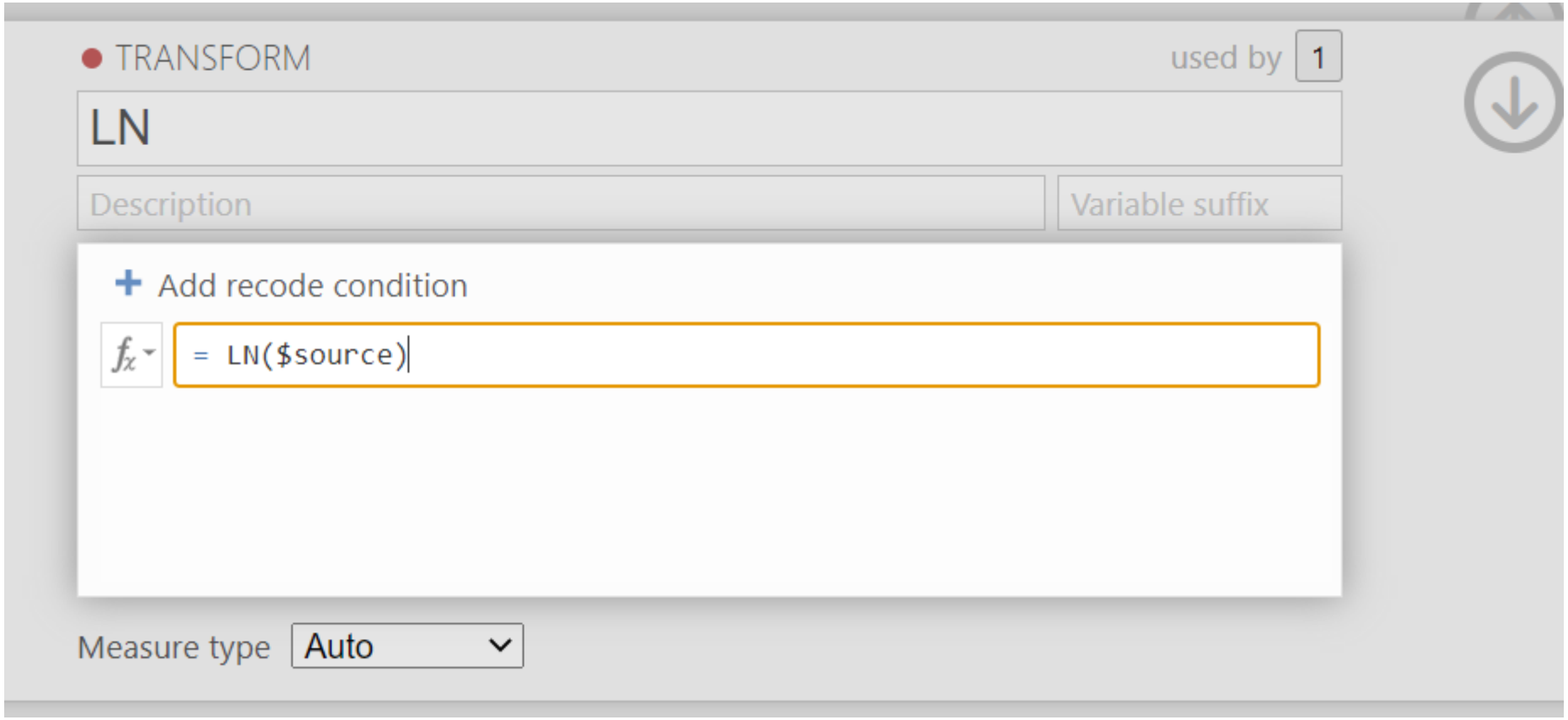
TRANSFORMING VARIABLES

Name the transformation and write the transformation code.
For the natural log transform, type LN($source).



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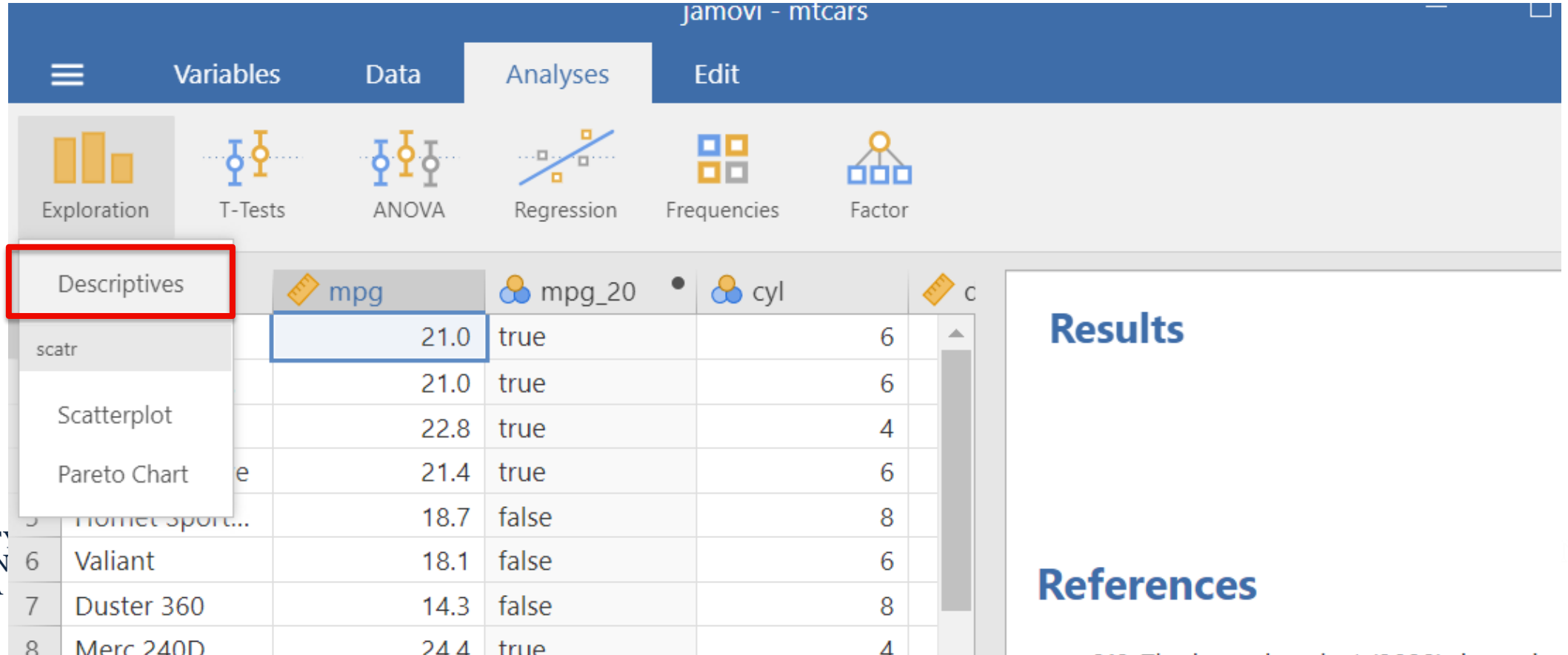
Note: Transformation in jamovi is dynamic.

Exploring Data

To perform basic exploratory data analysis, select
Analyses; Exploration; Descriptives



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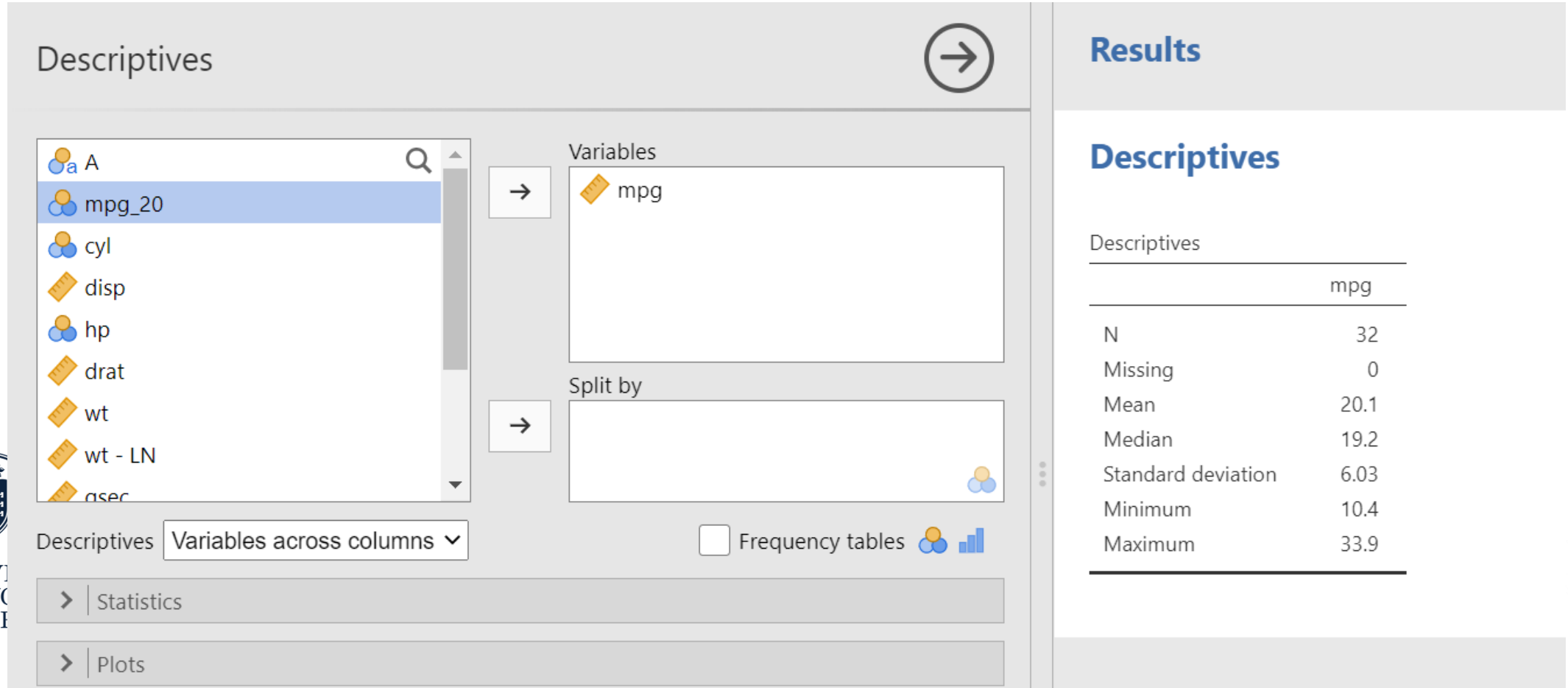
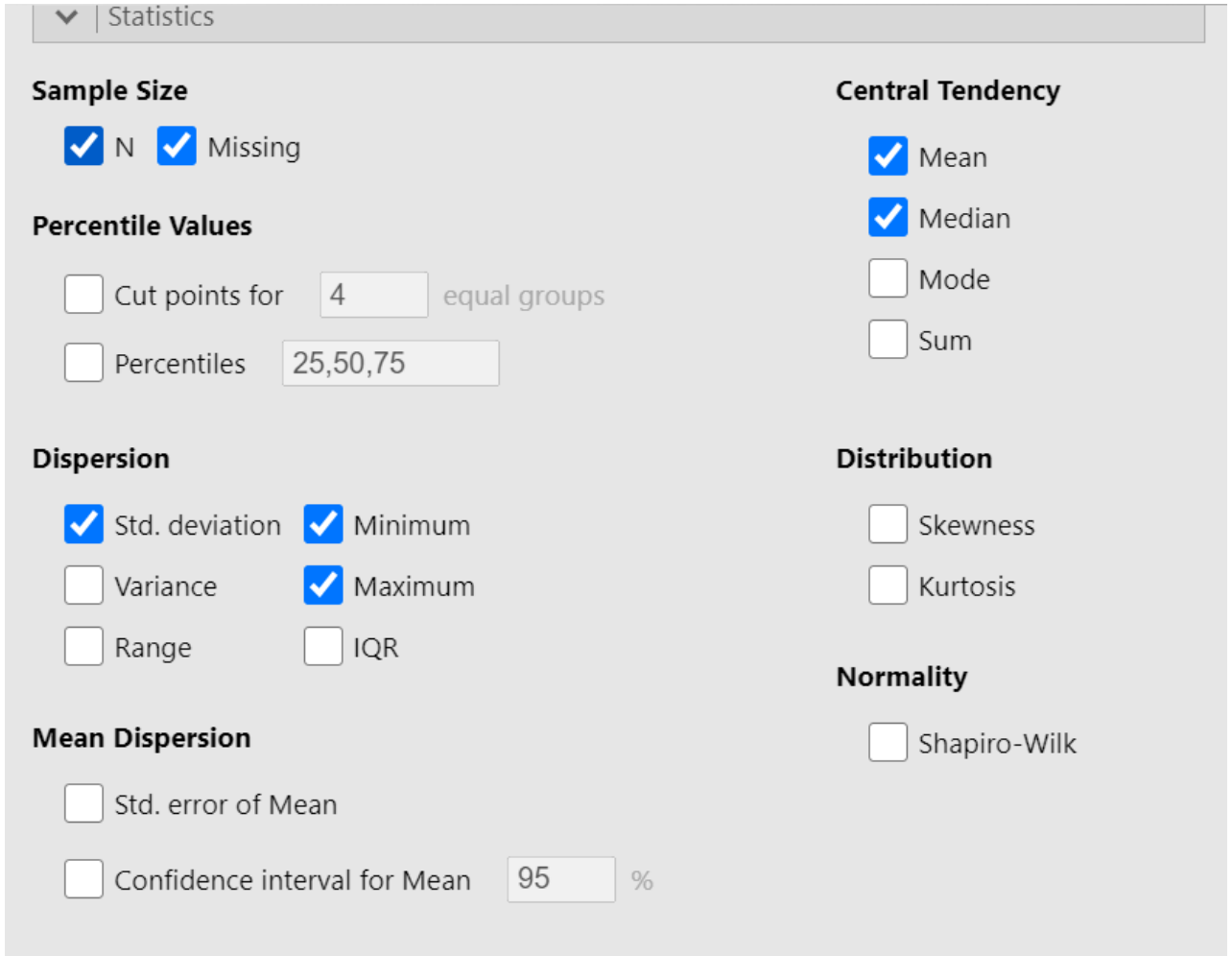
EXPLORATORY DATA ANALYSIS

Add the variable(s) of interest to the Variables list.
To calculate descriptive statistics and plots for the mpg variable arrow the mpg variable across.



EXPLORATORY DATA ANALYSIS

To alter which statistics are computed select the Statistics drop-down menu.



Descriptives

Descriptives

	mpg
N	32
Missing	0
Mean	20.1
Median	19.2
Standard deviation	6.03
Minimum	10.4
Maximum	33.9

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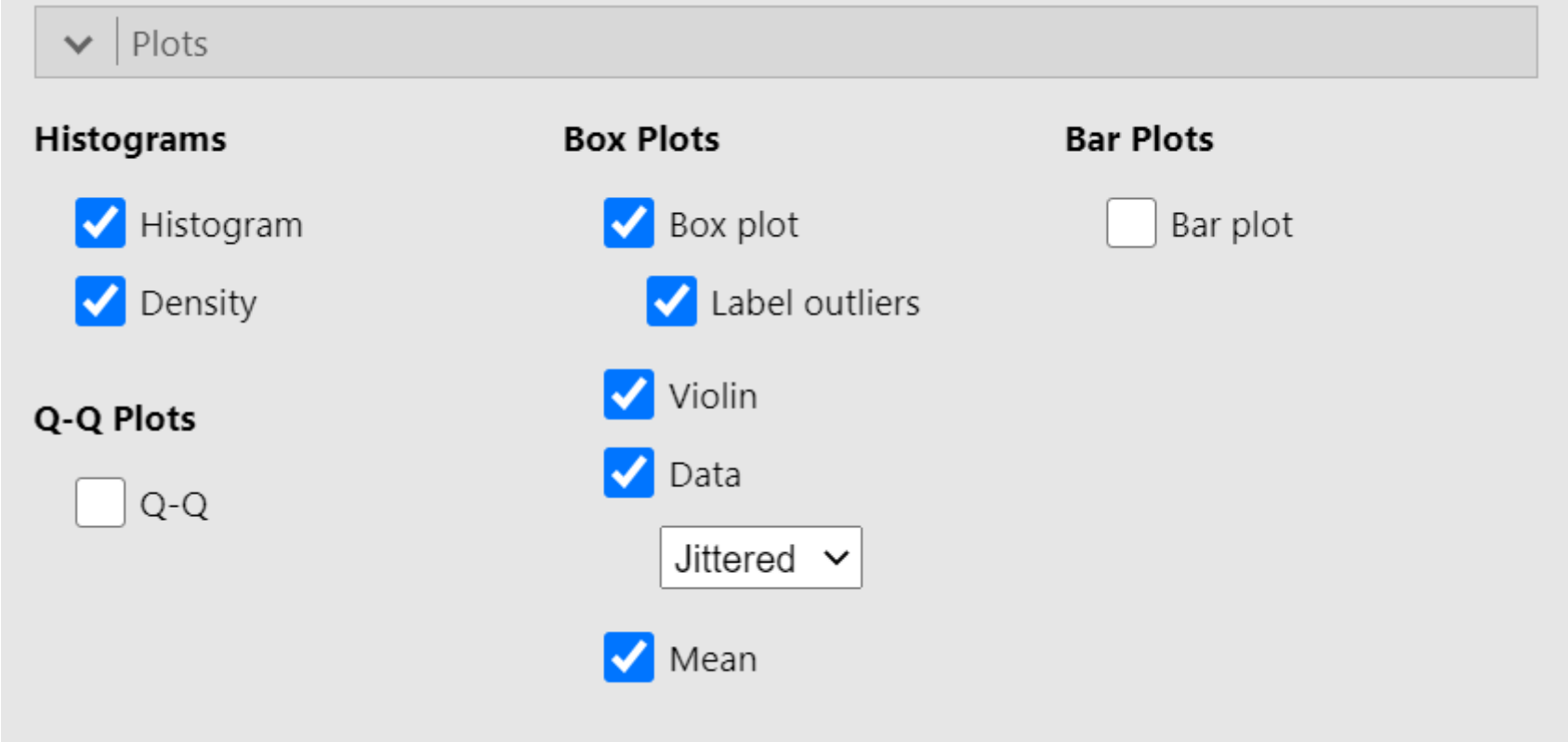
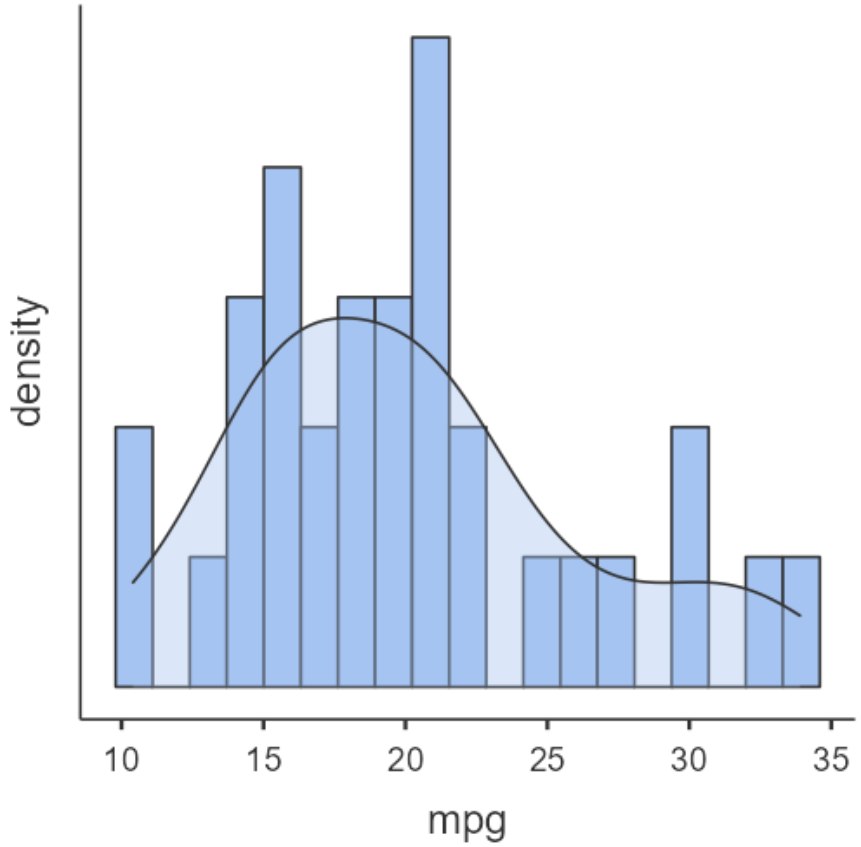
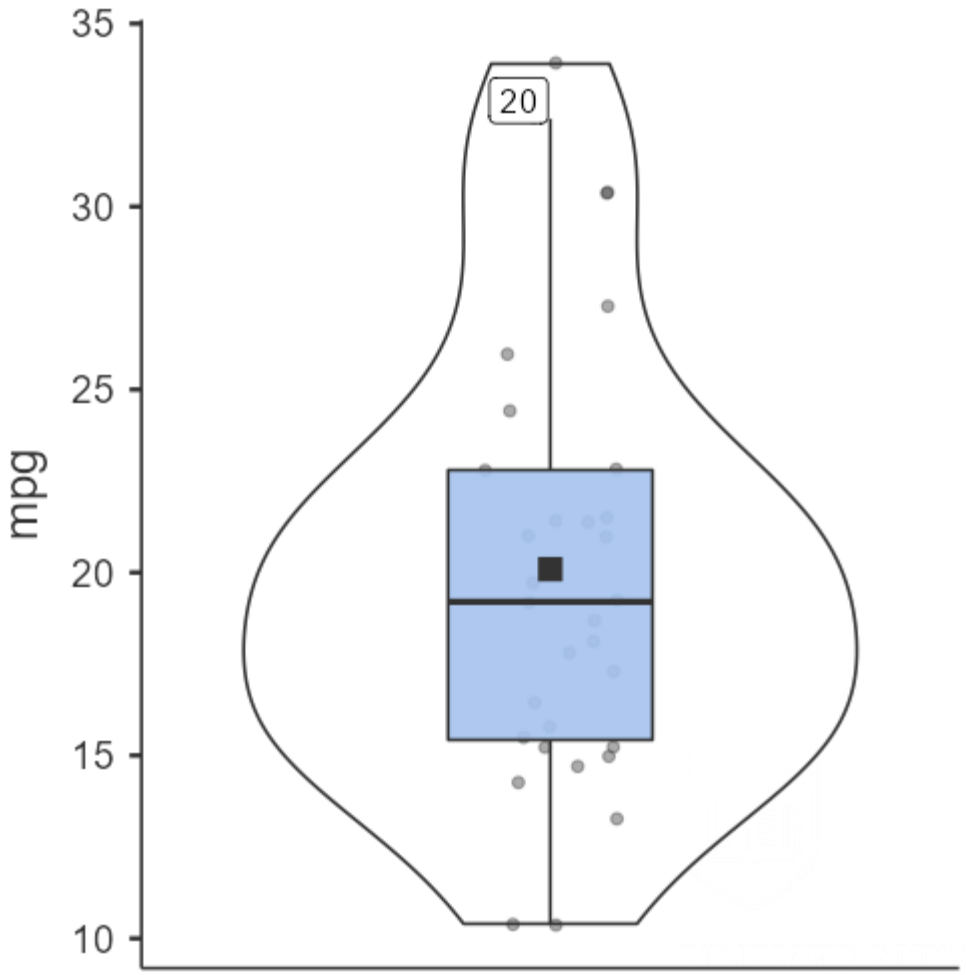
EXPLORATORY DATA ANALYSIS

To alter which plots are produced select the Plots drop-down menu.



EXPLORATORY DATA ANALYSIS

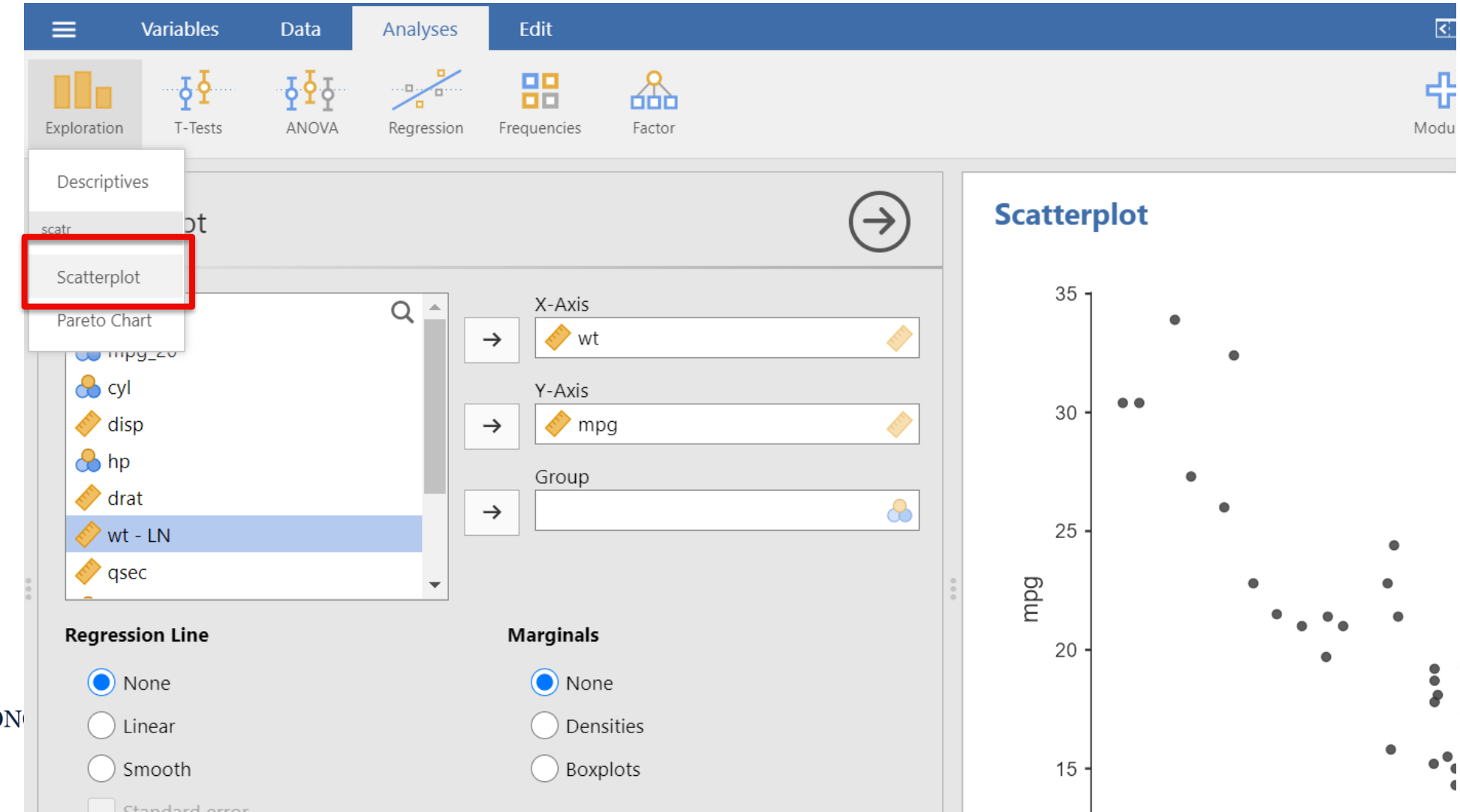




EXPLORATORY DATA ANALYSIS

To produce a scatterplot select Analyses; Exploration; Scatterplot

Here we compare wt and mpg



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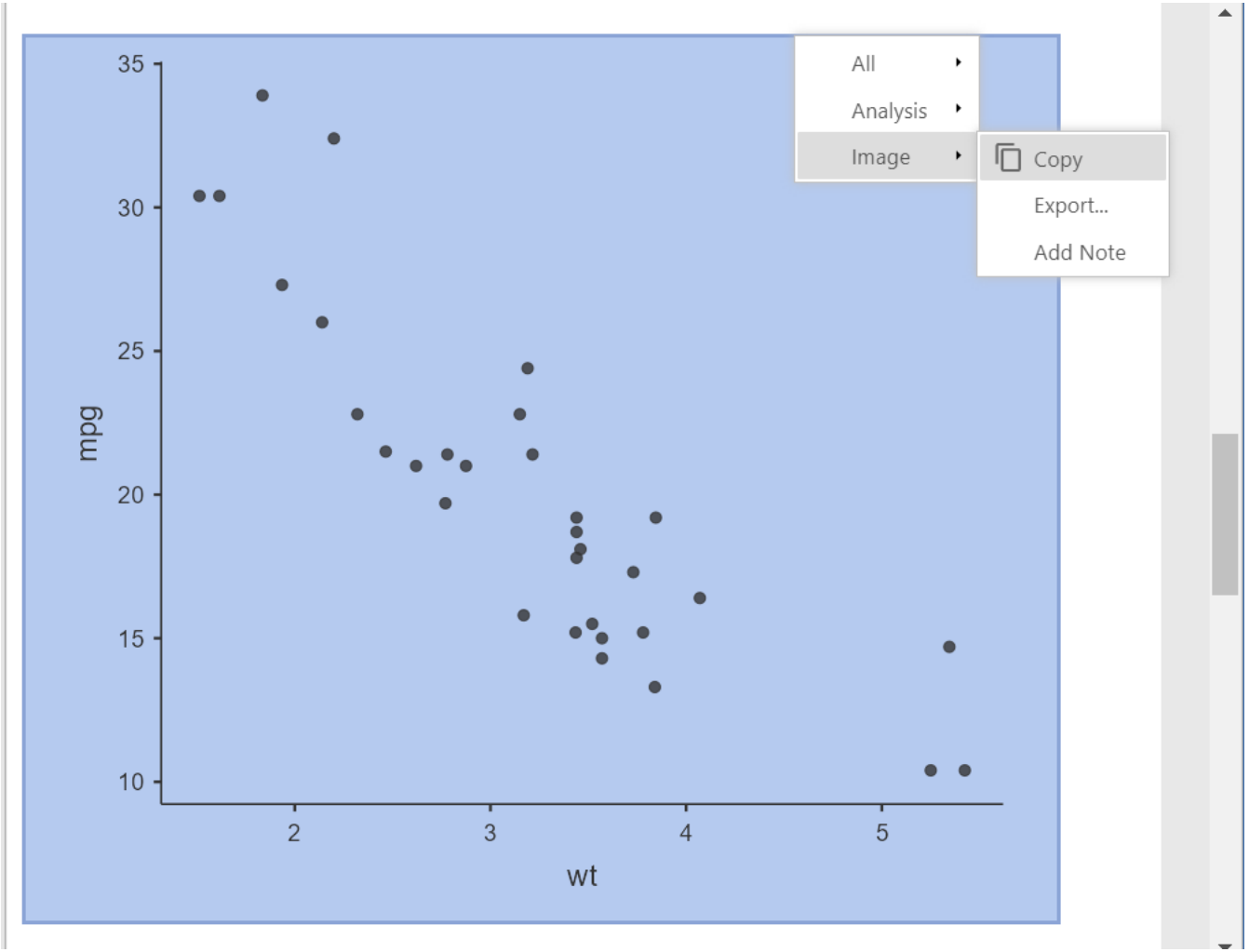
EXPLORATORY DATA ANALYSIS

By right-clicking on the output and selecting Copy or Export, output can be copied and pasted into word documents or exported as an image.



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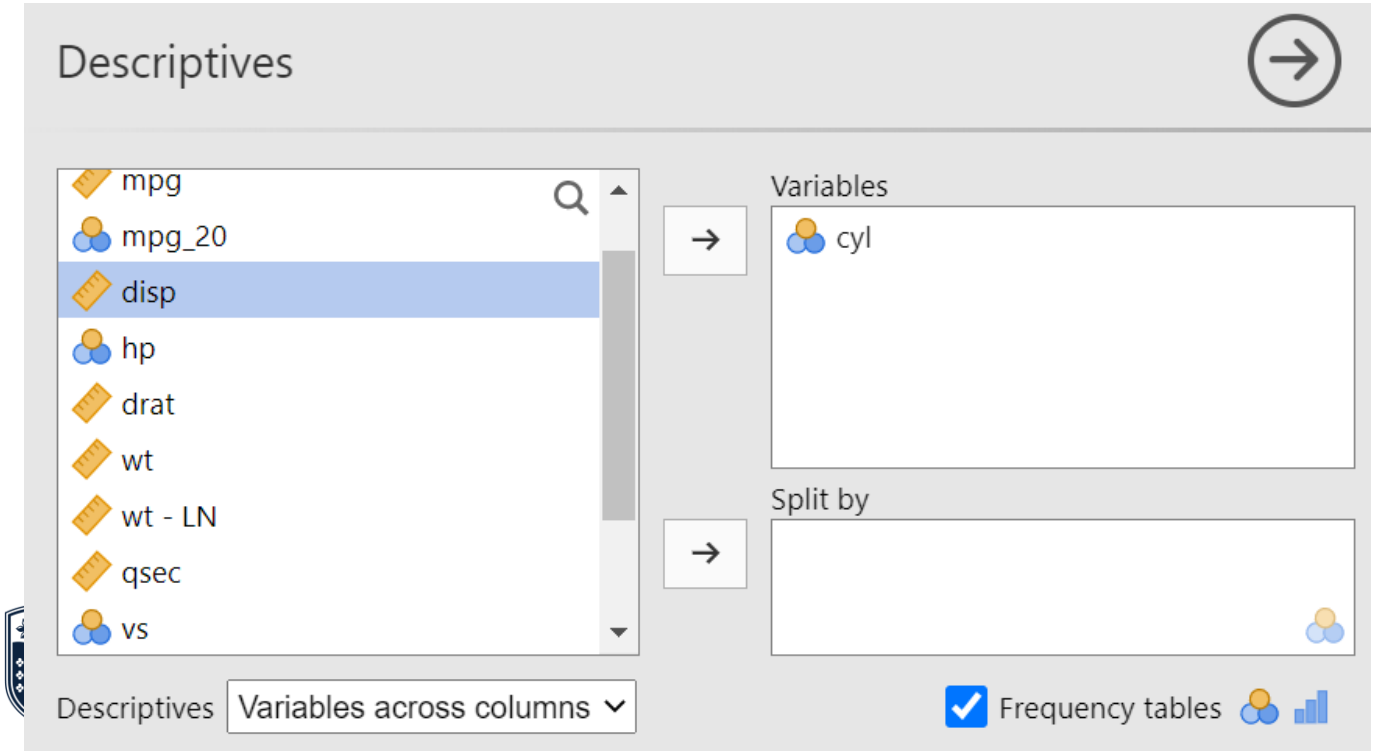
EXPLORATORY DATA ANALYSIS

When the variable(s) of interest in the Variables list are categorical, Frequency tables can also be produced.



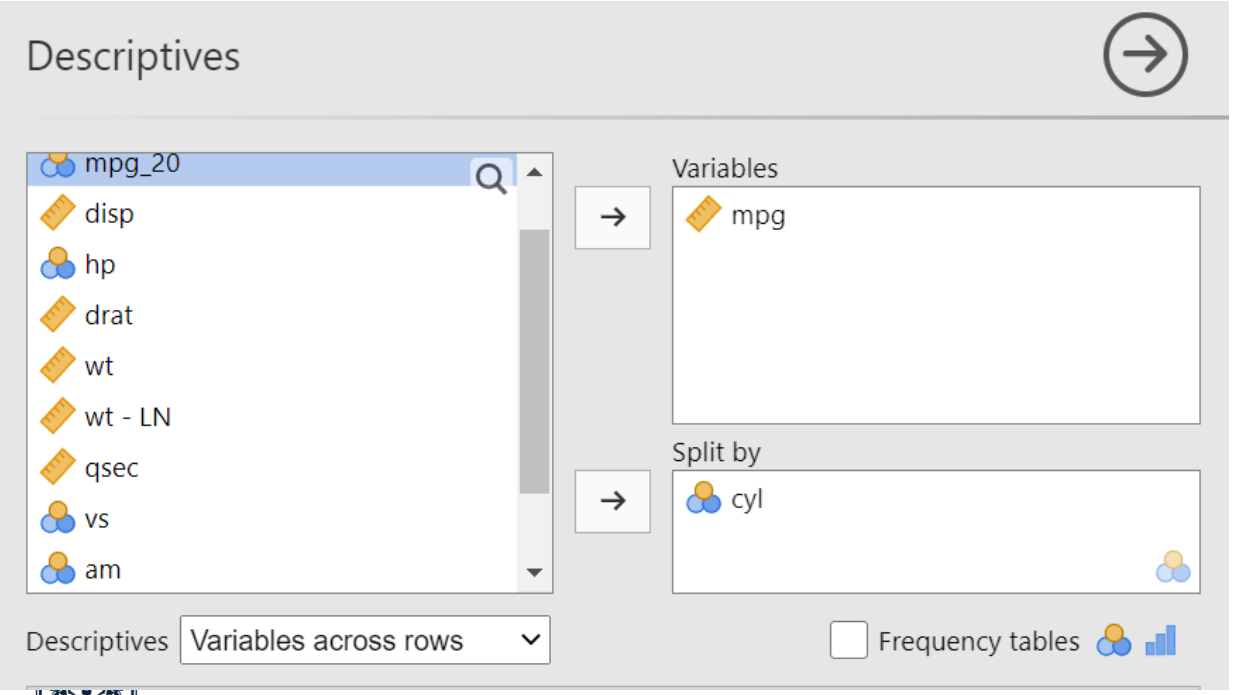
Frequencies

Frequencies of cyl

cyl	Counts	% of Total	Cumulative %
4	11	34.4 %	34.4 %
6	7	21.9 %	56.3 %
8	14	43.8 %	100.0 %

EXPLORATORY DATA ANALYSIS

And Continuous variable(s) of interest in the Variables list can be Split by (given for different levels of) categorical variables.



Descriptives

Descriptives

	cyl	N	Missing	Mean	Median	SD	Mini
mpg	4	11	0	26.7	26.0	4.51	
	6	7	0	19.7	19.7	1.45	
	8	14	0	15.1	15.2	2.56	

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Hypothesis Testing

We will now look at performing some common hypothesis testing methods:

1. **A one-sample T-test**
2. **An independent samples T-test**
3. **An ANOVA**
4. **Chi-square test**

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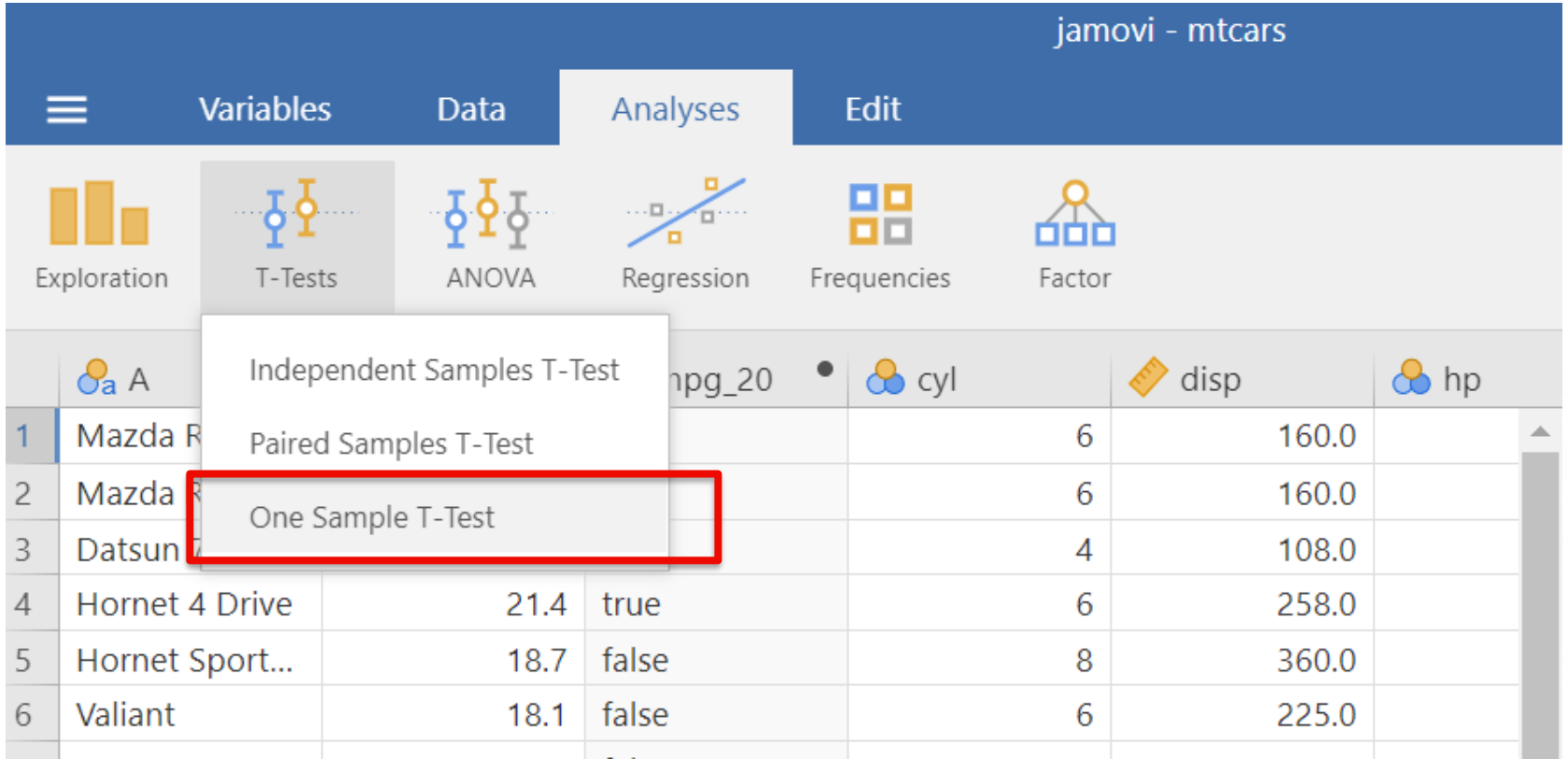
TESTING A SINGLE MEAN

Suppose we wanted to test whether the average fuel efficiency of the cars tested exceeds 15 miles per gallon.
We can use a one sample t-test to test this hypothesis.

To perform a one sample t-test select

Analyses; T-Tests; One Sample T-Test



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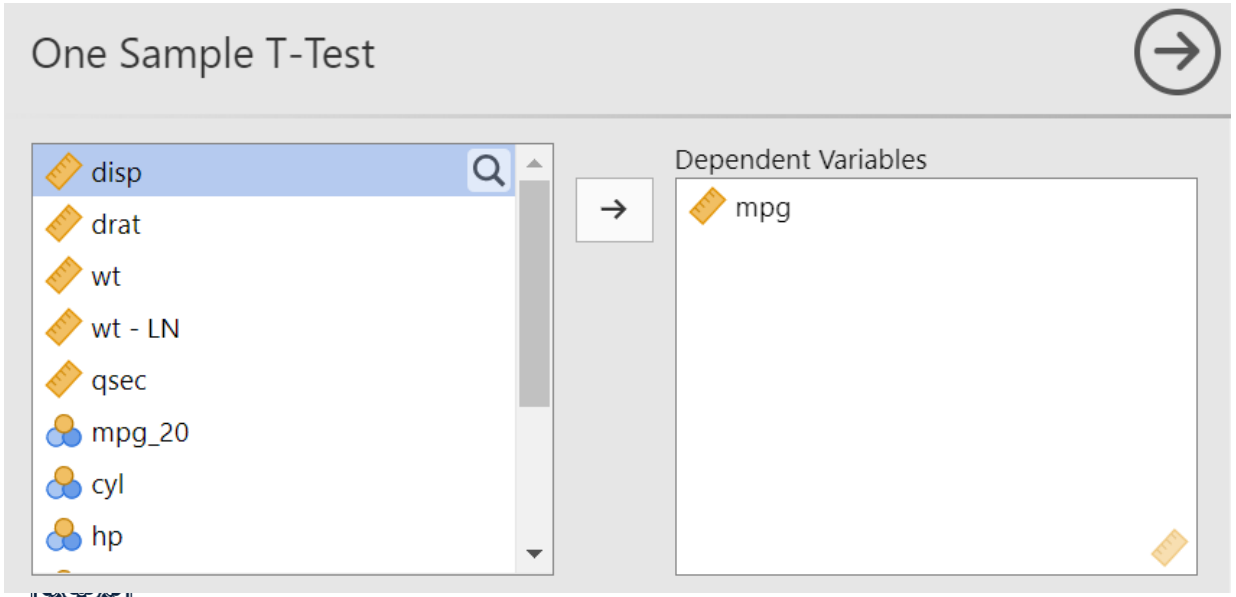
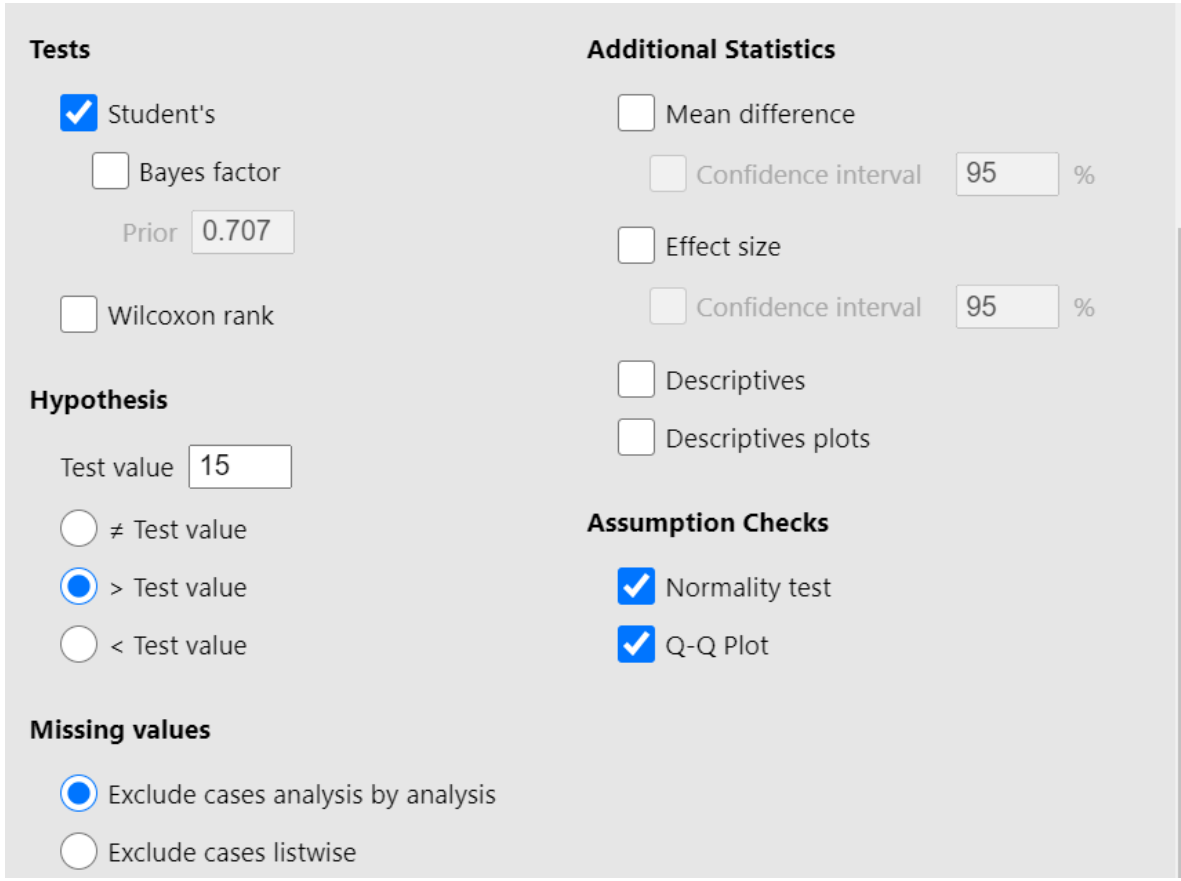
TESTING A SINGLE MEAN

To perform the hypothesis test, ensure mpg is placed in the Dependent Variables list, Student's is selected, the Test value is 15, and the > Test value is selected.
To test the normality assumption, select Normality test and Q-Q Plot





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TESTING A SINGLE MEAN

The following output gets produced.

We conclude that the average fuel efficiency of the cars is significantly greater than 15mpg.

Results

One Sample T-Test

One Sample T-Test

		Statistic	df	p
mpg	Student's t	4.78	31.0	< .001

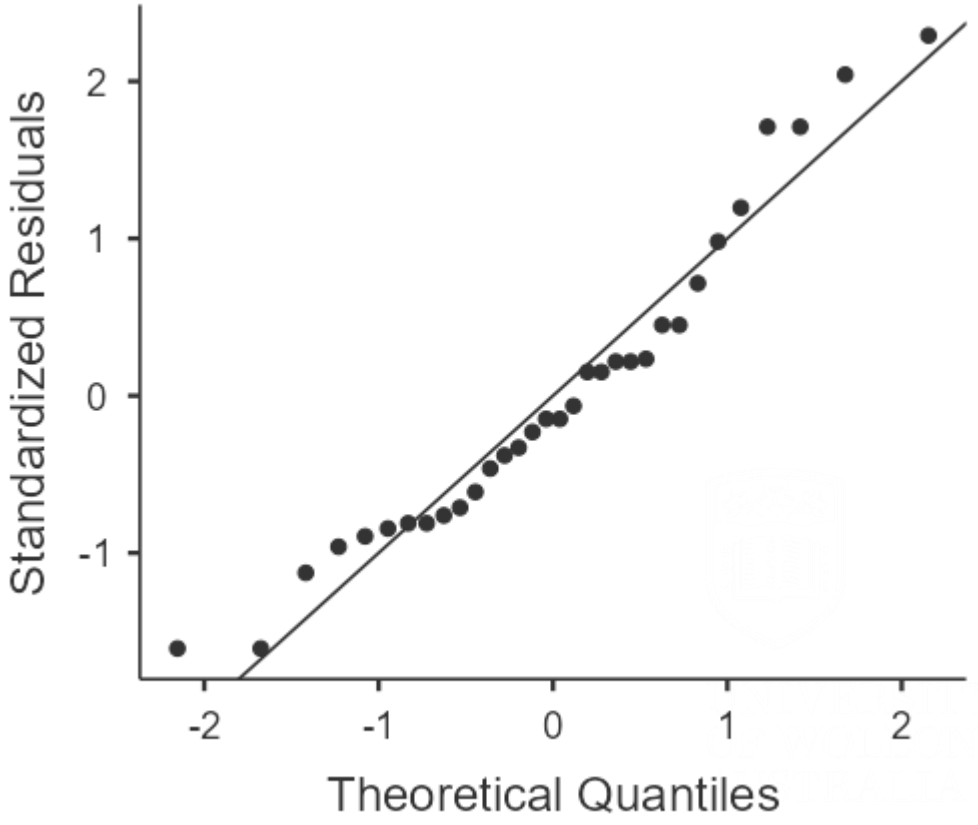
Note. H_a $\mu > 15$

Normality Test (Shapiro-Wilk)

	W	p
mpg	0.948	0.123

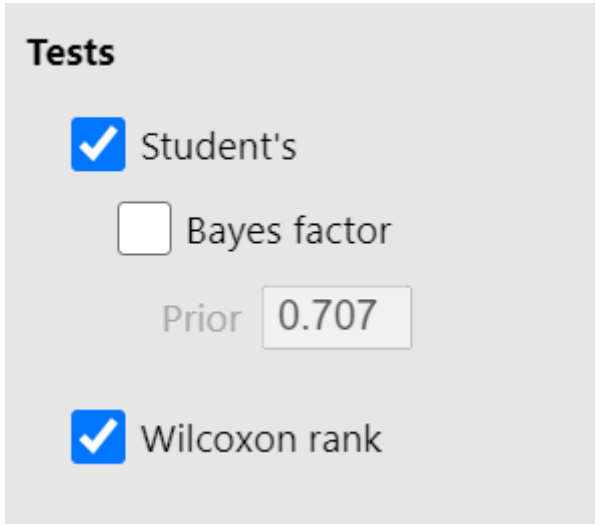
Note. A low p-value suggests a violation of the assumption of normality

Q-Q plots



TESTING A SINGLE MEAN

The non-parametric Wilcoxon rank test can also be performed.



One Sample T-Test

One Sample T-Test

		Statistic	df	p
mpg	Student's t	4.78	31.0	< .001
	Wilcoxon W	449		< .001

Note. H_a μ > 15

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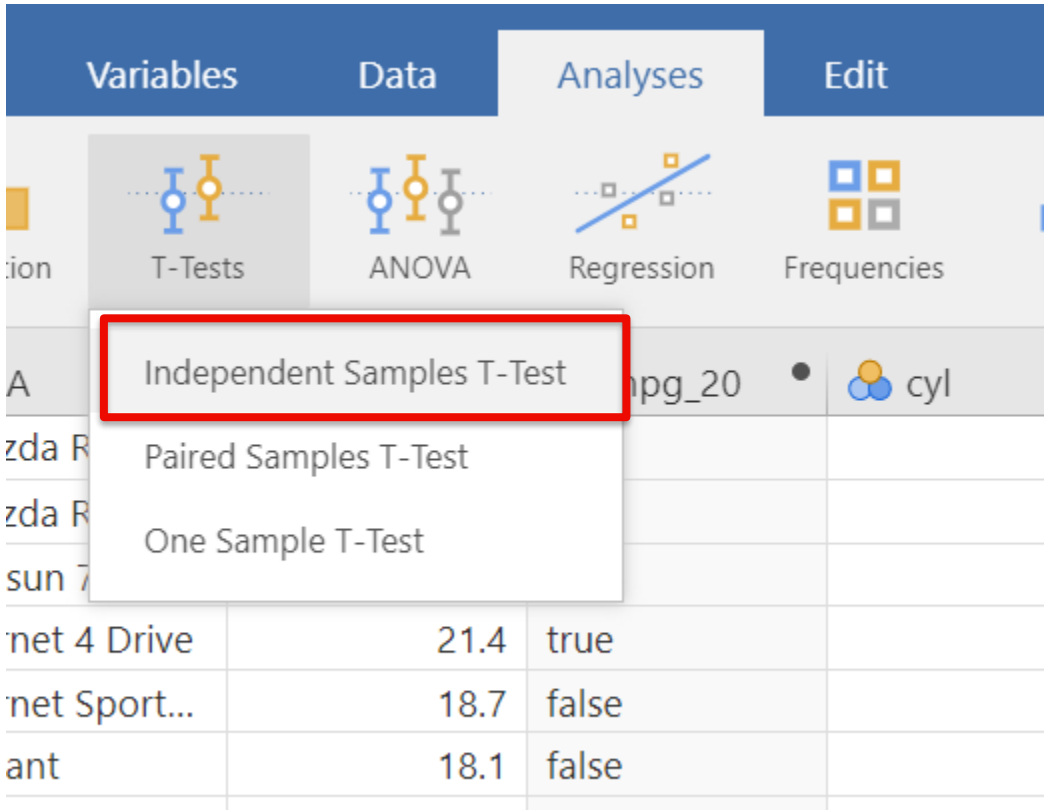
TESTING THE DIFFERENCE IN MEANS

Suppose we wanted to test whether the average fuel efficiency of the cars is significantly different between automatic and manual cars.
We can use an independent samples t-test to test this hypothesis.

To perform an independent samples t-test select
Analyses; T-Tests; Independent Samples T-Test



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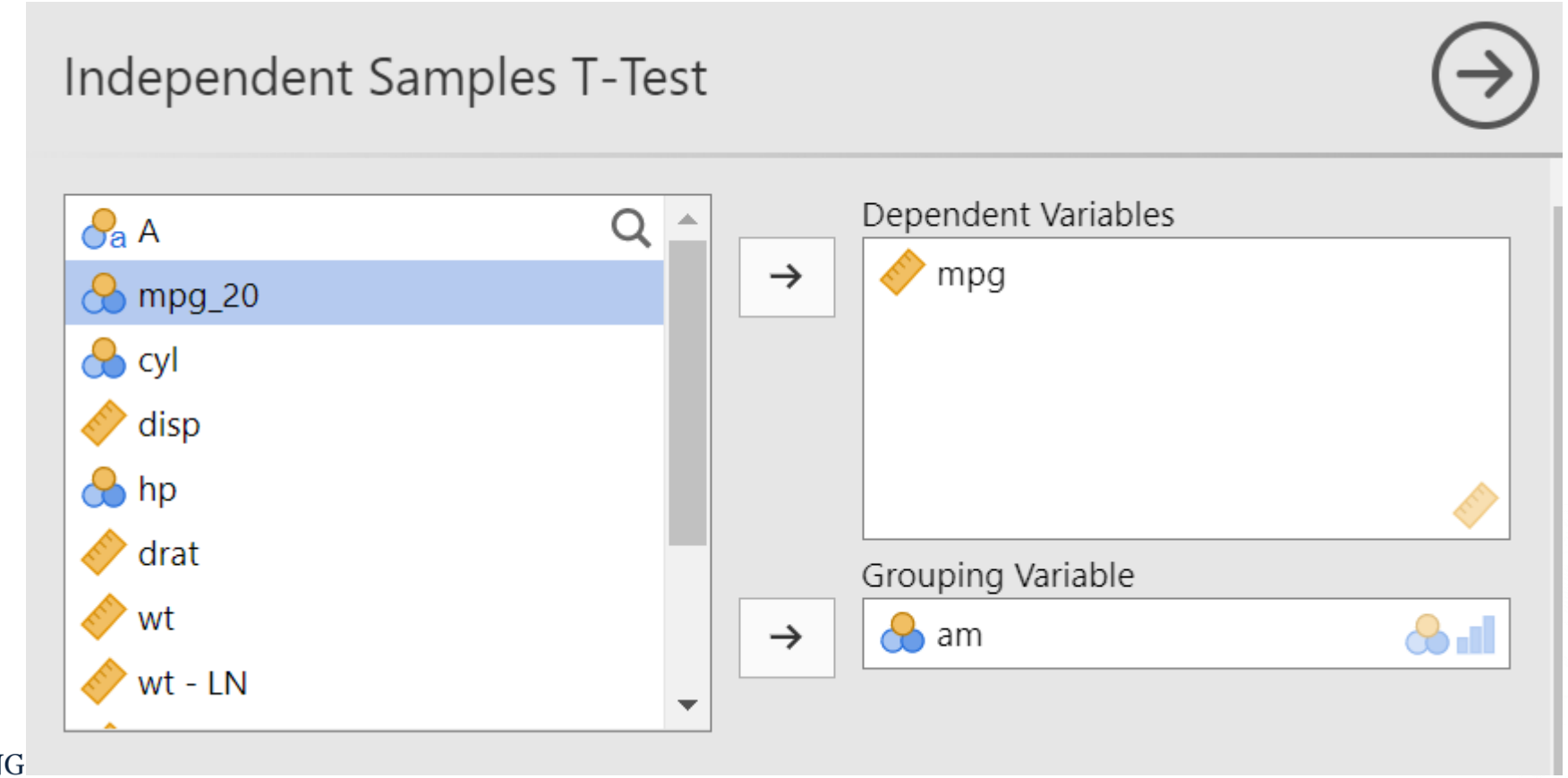
TESTING THE DIFFERENCE IN MEANS

To perform the hypothesis test, ensure mpg is placed in the Dependent Variables list and select am as the Grouping Variable.



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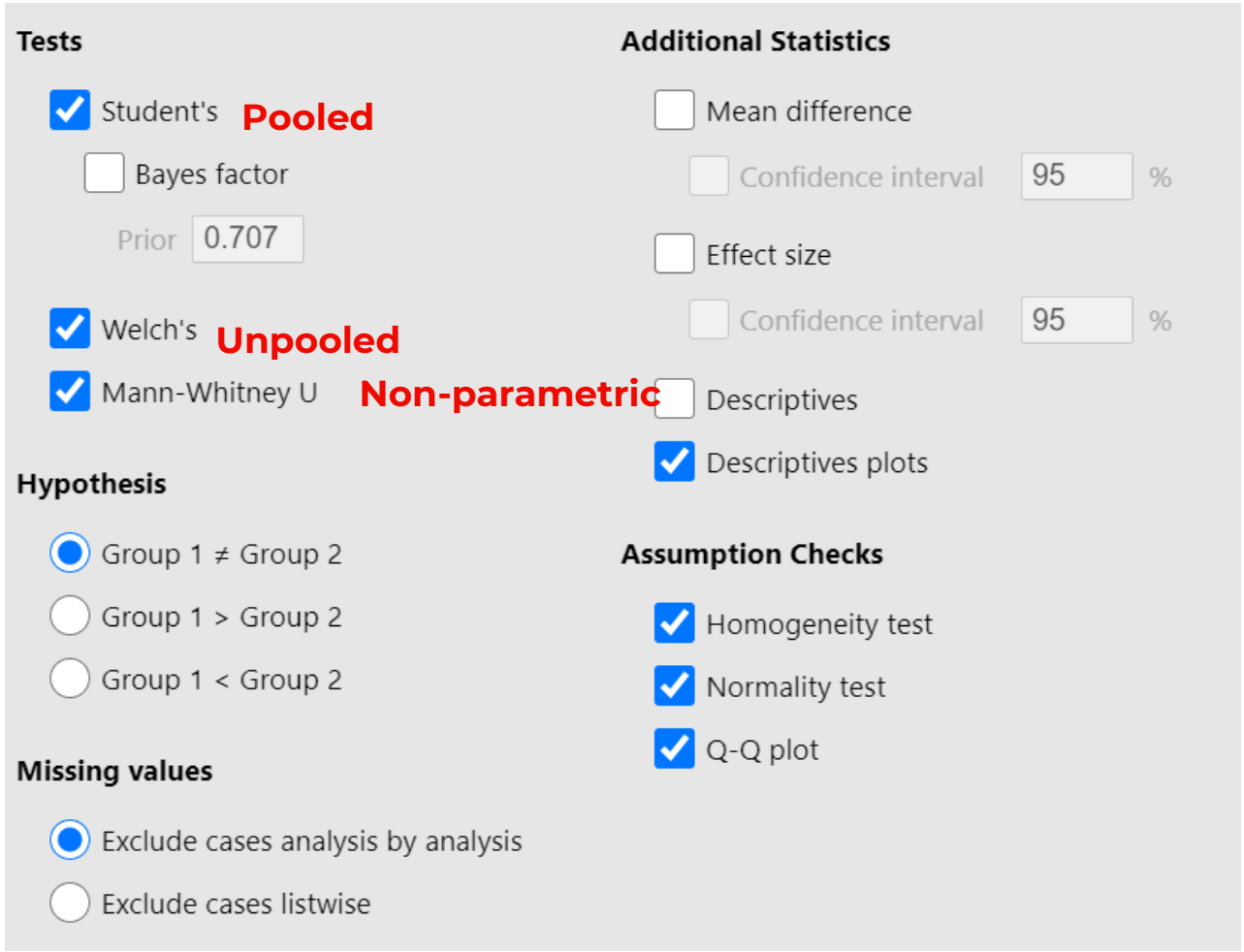
TESTING THE DIFFERENCE IN MEANS

Within the same menu we can determine the pooled, unpooled, and non-parameteric statistic value and perform the Assumption Checks



Independent Samples T-Test

Independent Samples T-Test

		Statistic	df	p
mpg	Student's t	−4.11 [a]	30.0	< .001
	Welch's t	−3.77	18.3	0.001
	Mann-Whitney U	42.0		0.002

[a] Levene's test is significant (p < .05), suggesting a violation of the assumption of equal variances

TESTING THE DIFFERENCE IN MEANS

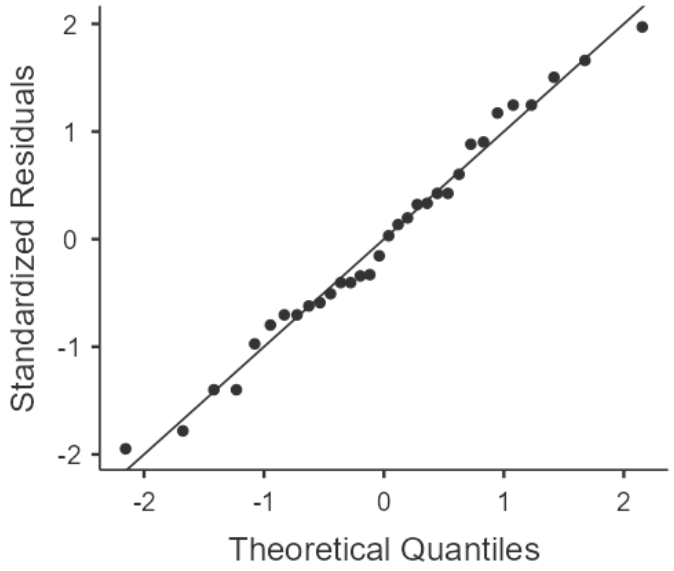
Diagnostics are also outputted.

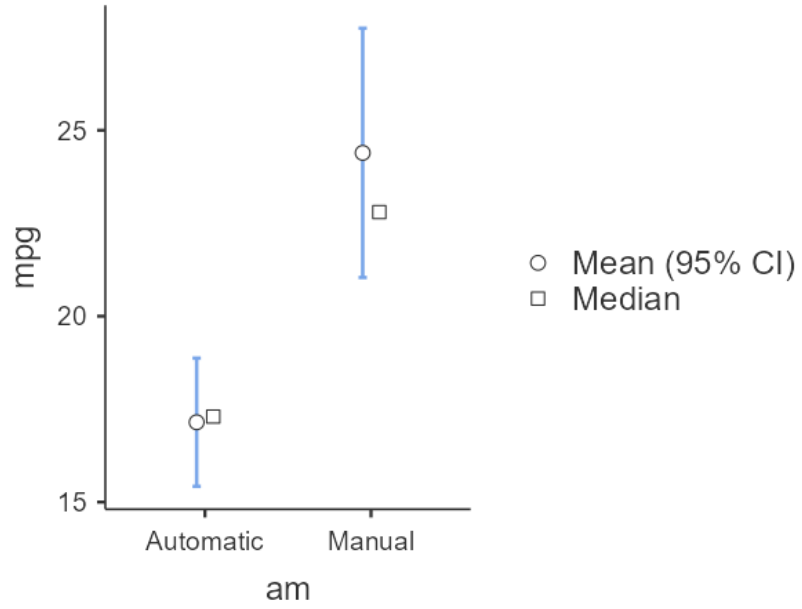
Assumptions

Normality Test (Shapiro-Wilk)

	W	p
mpg	0.982	0.857

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





Homogeneity of Variances Test (Levene's)

	F	df	df2	p
mpg	5.92	1	30	0.021

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

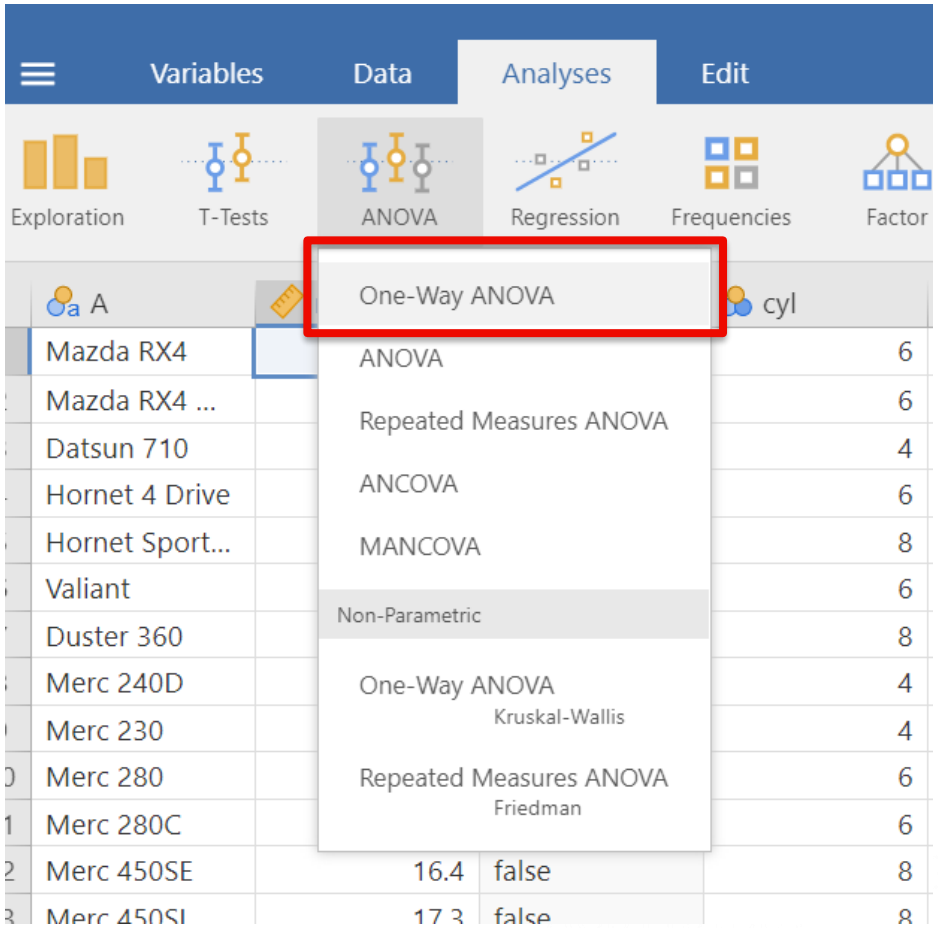
[3]

Based on the diagnositcs we conclude that the Welch's (Unpooled) T-test is the most appropriate statistic to consider and conclude there is a significant difference in fuel efficiency between automatic and manual cars tested.

PERFORMING AN ANOVA

Suppose we wanted to test whether the fuel efficiency of the cars tested differed significantly between groups of cars with 4, 6, and 8 cylinders. We can use a one-way ANOVA to test this hypothesis.

To perform a one-way ANOVA select
Analyses; ANOVA; One-Way ANOVA



Note that options for other types of ANOVA including the non-parametric ANOVA are also available in jamovi.

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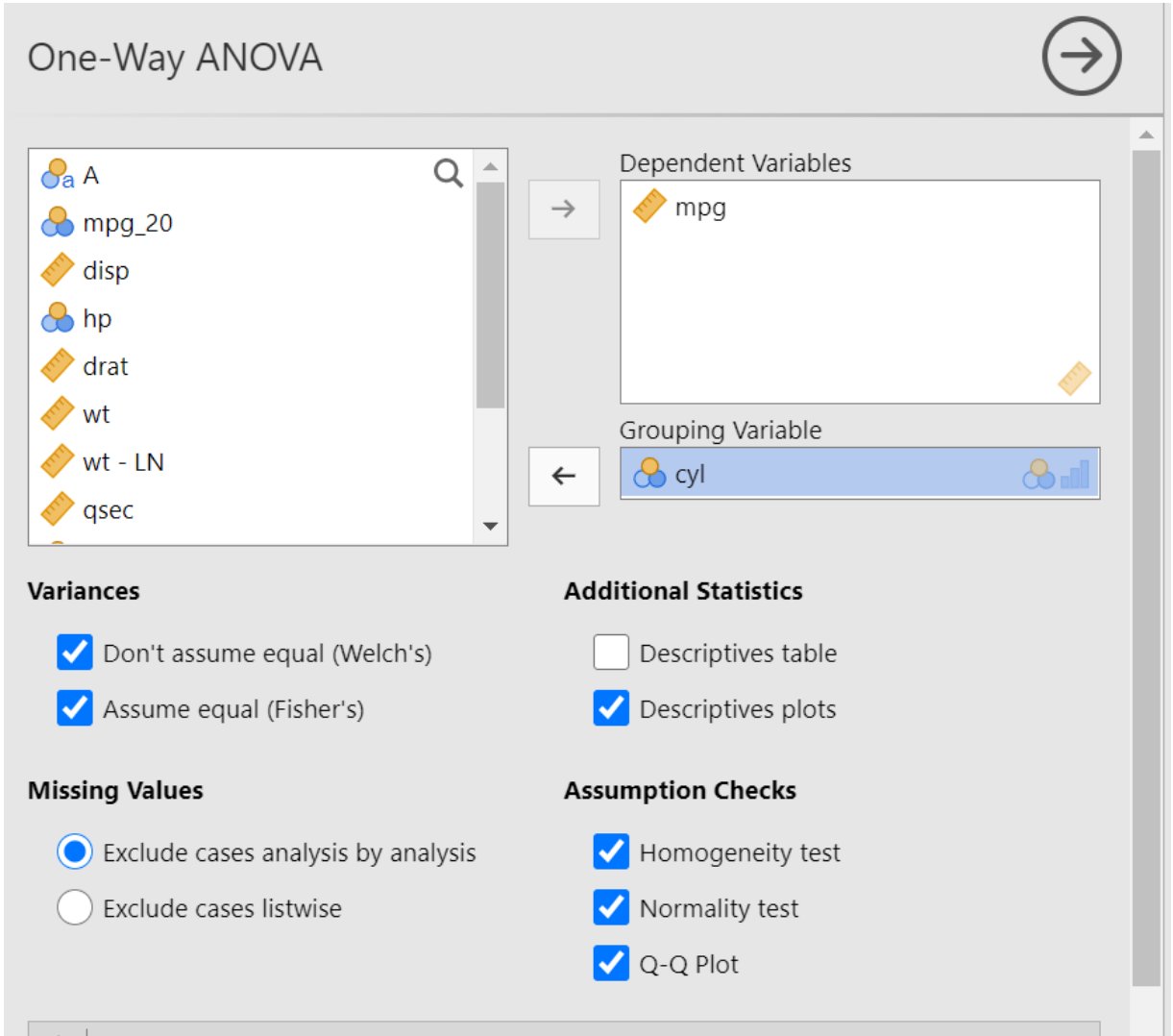
PERFORMING AN ANOVA

To calculate the ANOVA table, select mpg in the Dependent Variables list and cyl as the Grouping Variable.



One-Way ANOVA

One-Way ANOVA

		F	df1	df2	p
mpg	Welch's	31.6	2	18.0	< .001
	Fisher's	39.7	2	29	< .001

PERFORMING AN ANOVA

Assumption Check diagnostics are also outputted.

Assumption Checks

Normality Test (Shapiro-Wilk)

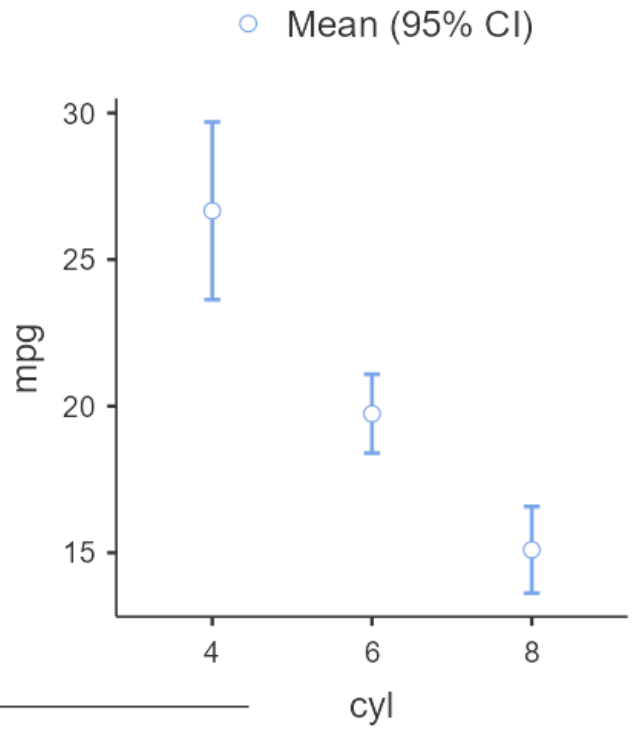
	W	p
mpg	0.971	0.538

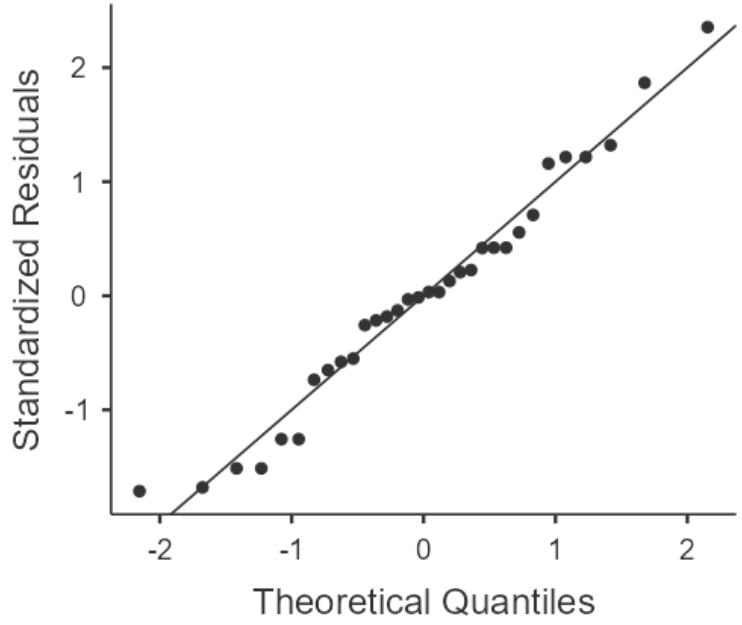
Note. A low p-value suggests a violation of the assumption of normality

Homogeneity of Variances Test (Levene's)

	F	df1	df2	p
mpg	6.48	2	29	0.005

[3]



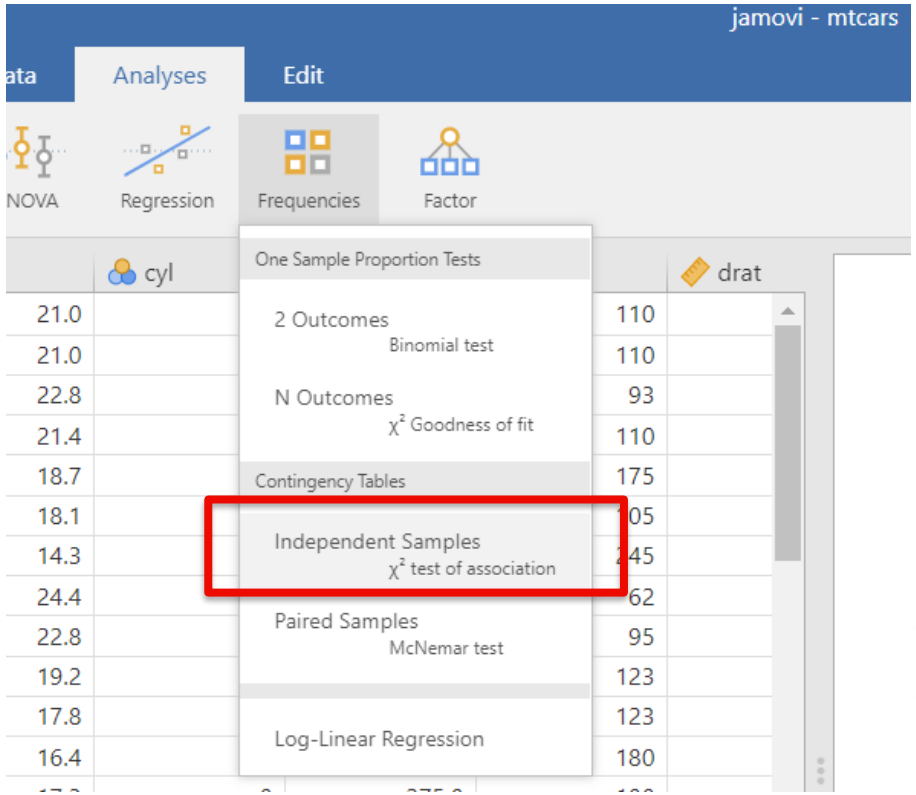


Based on the output we conclude that the Welch's test is the most appropriate statistic to consider and conclude there is a significant difference in fuel efficiency between cars with different numbers of cylinders.

TESTING ASSOCIATIONS WITH CHI-SQUARE

Suppose we wanted to test the association between number of gears (gears) and transmission type (am). Both variables are categorical, so we can use a **Chi-square test of independence** to test for an association.

To perform a Chi-square test of independence select Analyses; Frequencies; and under Contingency Tables select Independent Samples



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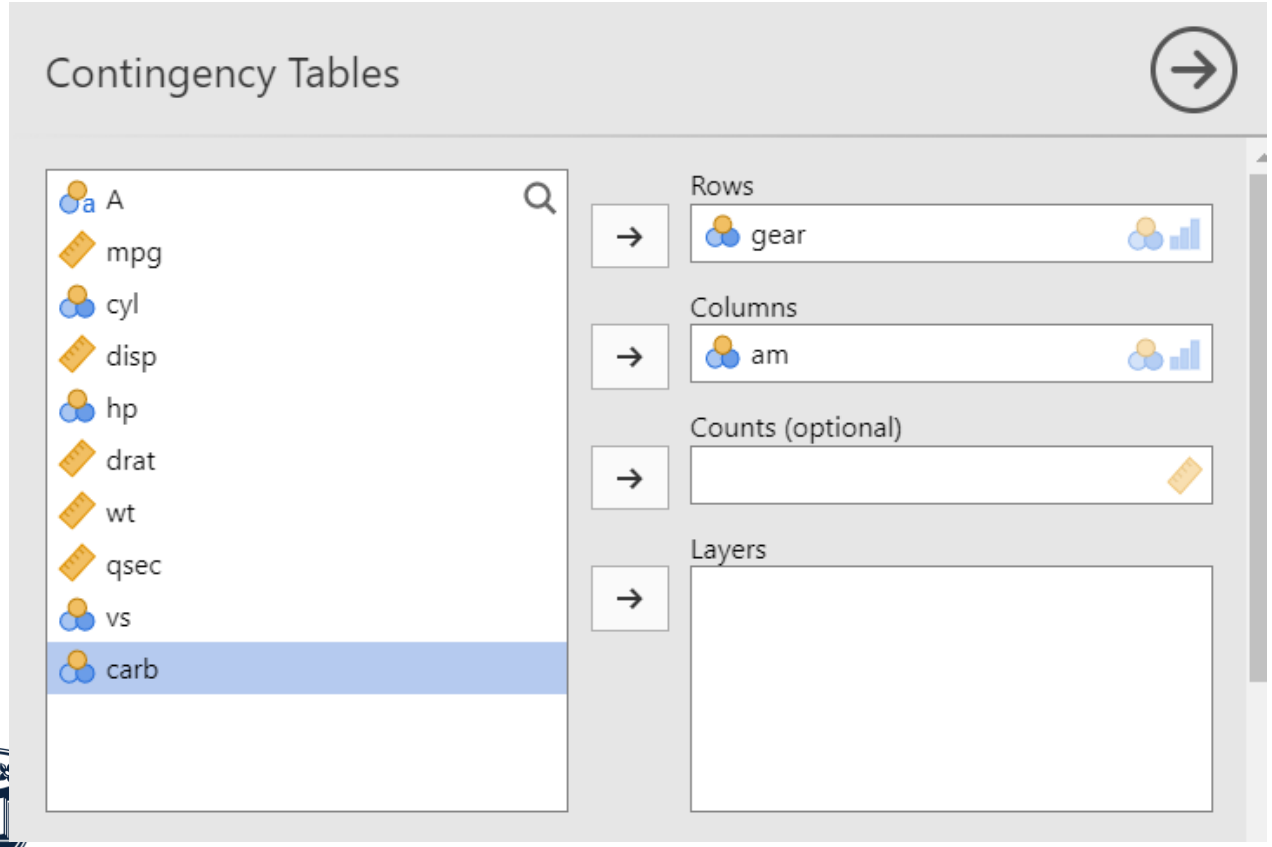
TESTING ASSOCIATIONS WITH CHI-SQUARE

Place gear under Rows and am under Columns



Contingency Tables

Contingency Tables

gear	am		
	Automatic	Manual	Total
3	15	0	15
4	4	8	12
5	0	5	5
Total	19	13	32

χ^2 Tests

	Value	df	p
χ^2	20.9	2	< .001
N	32		

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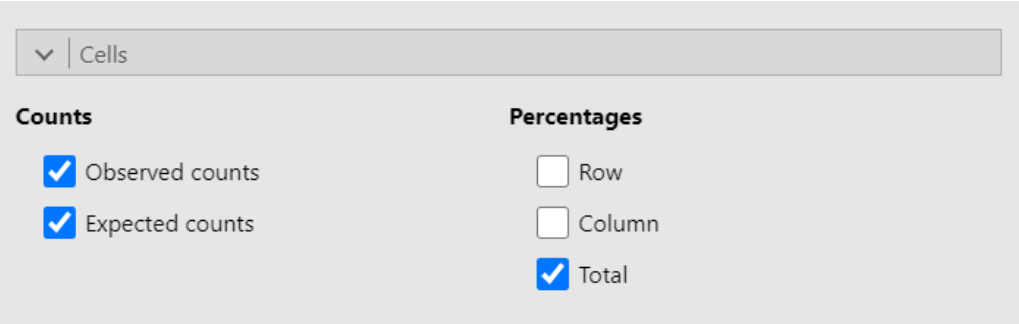
TESTING ASSOCIATIONS WITH CHI-SQUARE

To view expected counts and total percentages select the following under the Cells tab.



Contingency Tables

Contingency Tables

gear		am		
		Automatic	Manual	Total
3	Observed	15	0	15
	Expected	8.91	6.09	15.00
	% of total	46.9 %	0.0 %	46.9 %
4	Observed	4	8	12
	Expected	7.13	4.88	12.00
	% of total	12.5 %	25.0 %	37.5 %
5	Observed	0	5	5
	Expected	2.97	2.03	5.00
	% of total	0.0 %	15.6 %	15.6 %
Total	Observed	19	13	32
	Expected	19.00	13.00	32.00
	% of total	59.4 %	40.6 %	100.0 %

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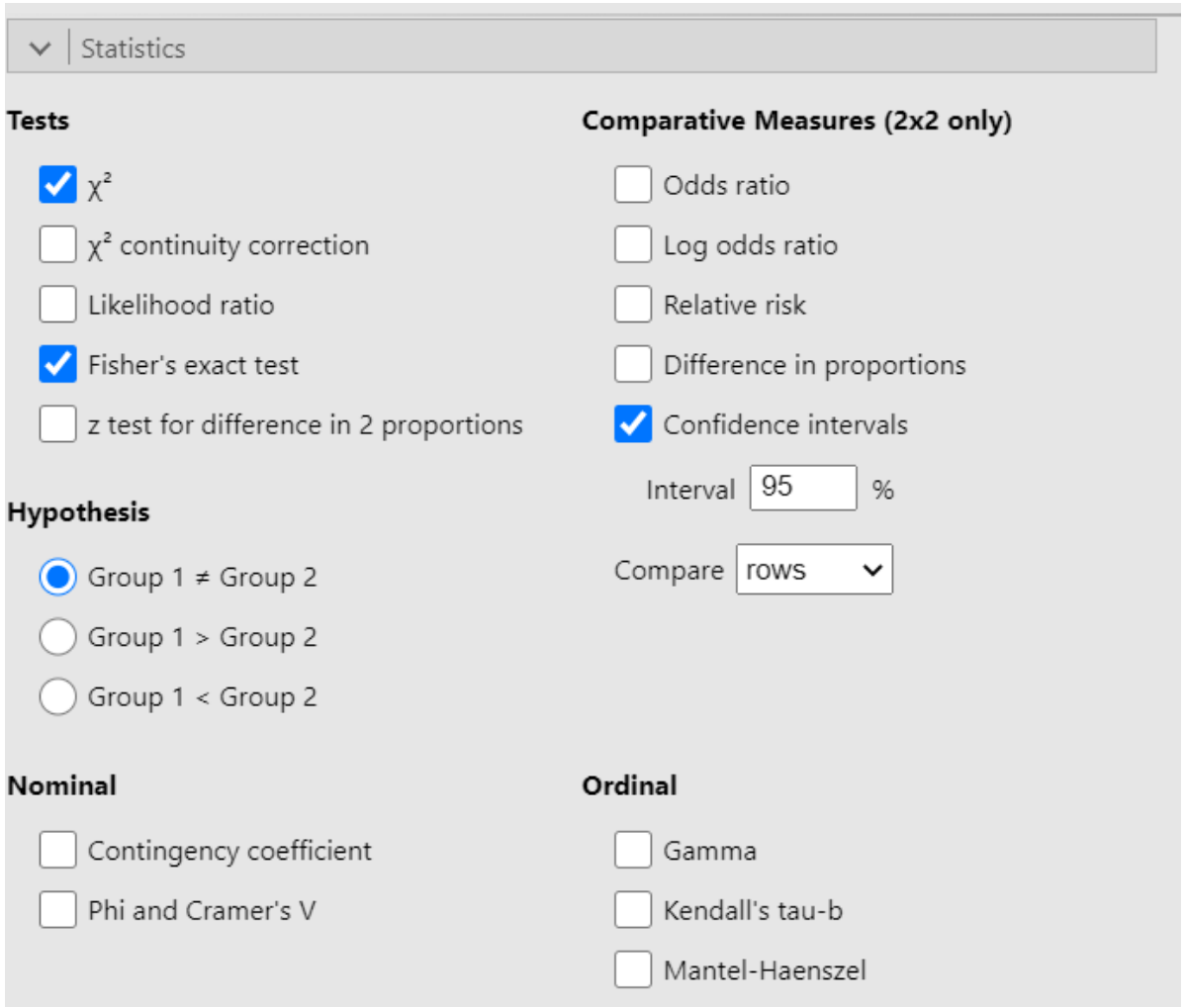
TESTING ASSOCIATIONS WITH CHI-SQUARE

To also calculate the Fishers exact statistic, select the option under the Statistics tab.

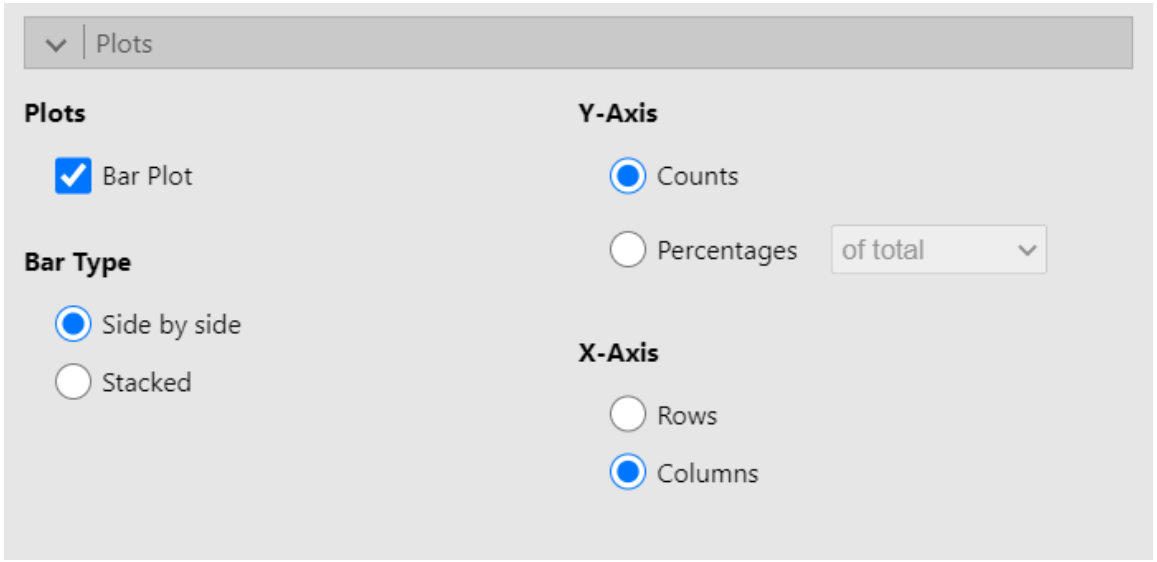


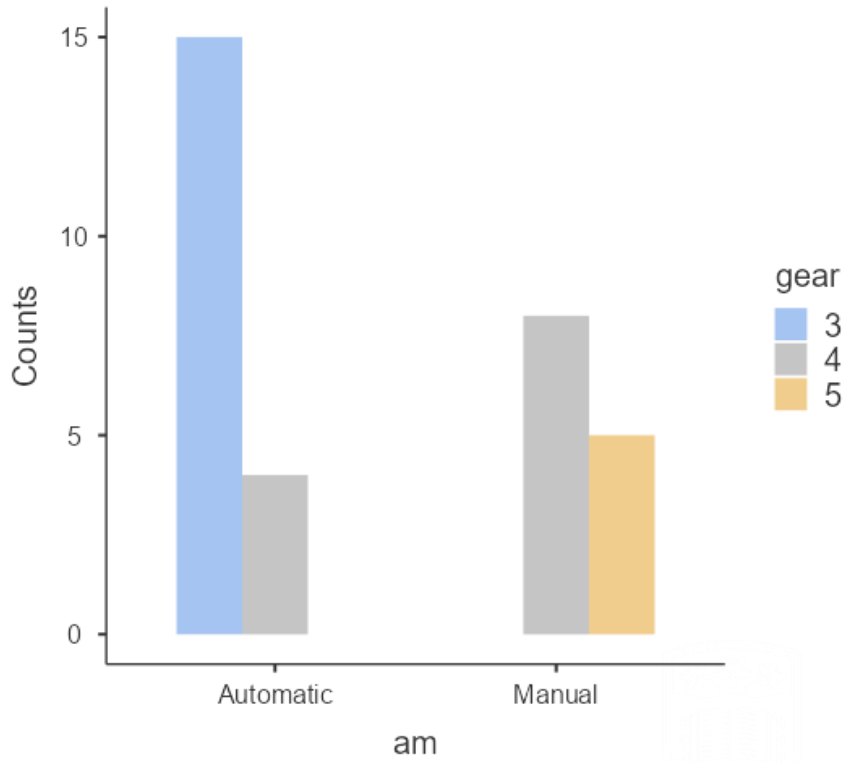
χ^2 Tests

	Value	df	p
χ^2	20.9	2	< .001
Fisher's exact test			< .001
N	32		

TESTING ASSOCIATIONS WITH CHI-SQUARE

Bar plots can also be generated under the Plots tab.





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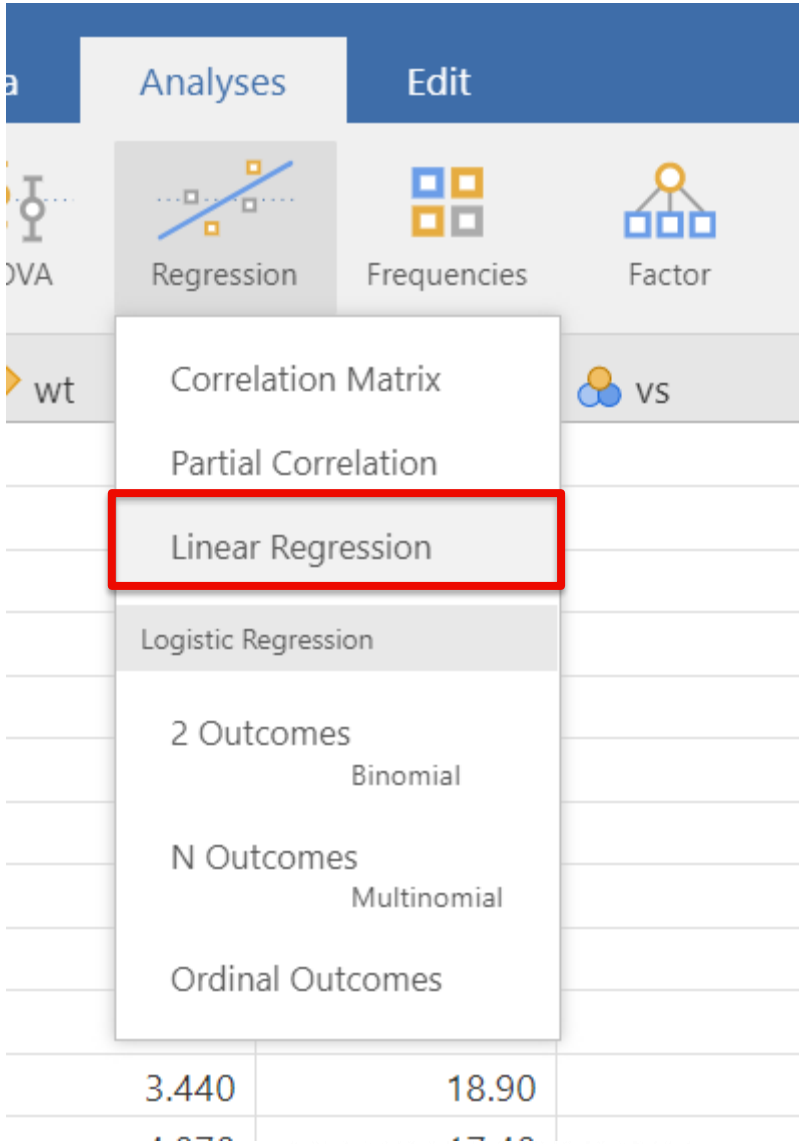
Regression Models

Various regression and correlation options are available in the Regression module.

Suppose we wanted to model fuel efficiency (mpg) with respect to horsepower (hp), weight (wt), and transmission type (am).

We can fit a linear regression model by selecting:

Analyses; Regression; Linear Regression.



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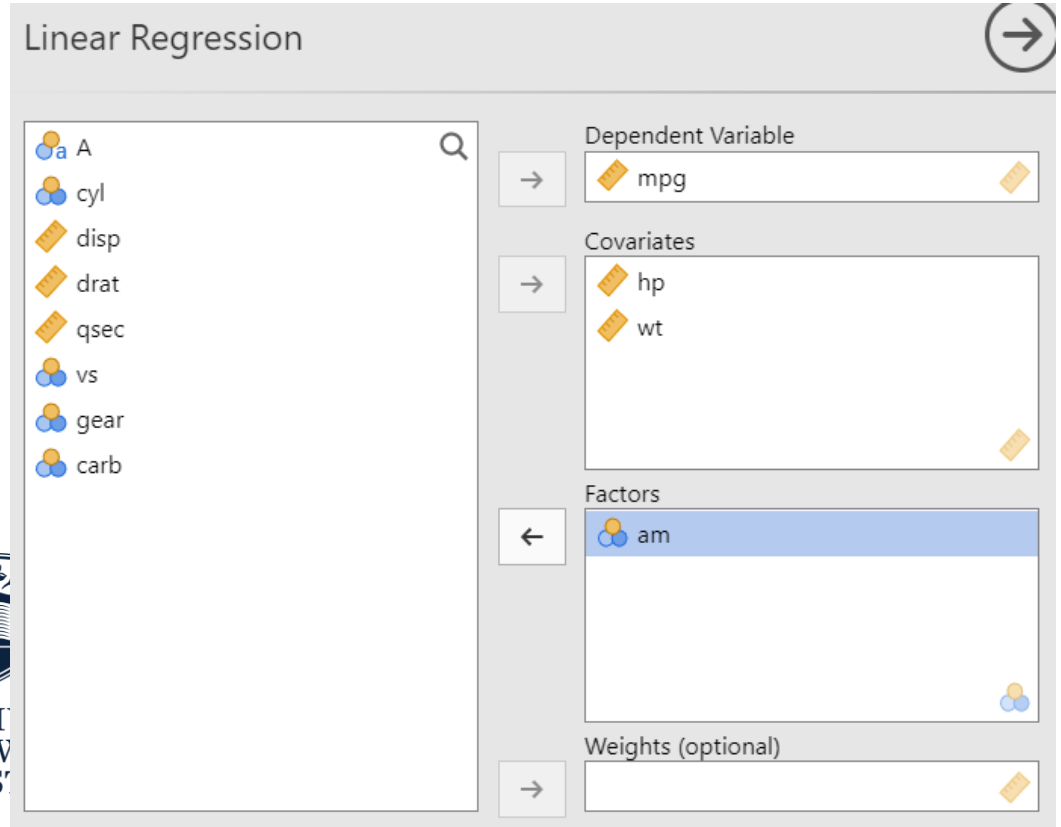
FITTING A LINEAR REGRESSION MODEL

Suppose we wanted to model fuel efficiency (mpg) with respect to horsepower (hp), weight (wt), and transmission type (am).

Place mpg as the Dependent Variable, hp and wt under Covariates and am under Factors



Linear Regression

Model Fit Measures

Model	R	R^2
1	0.916	0.840

Model Coefficients - mpg

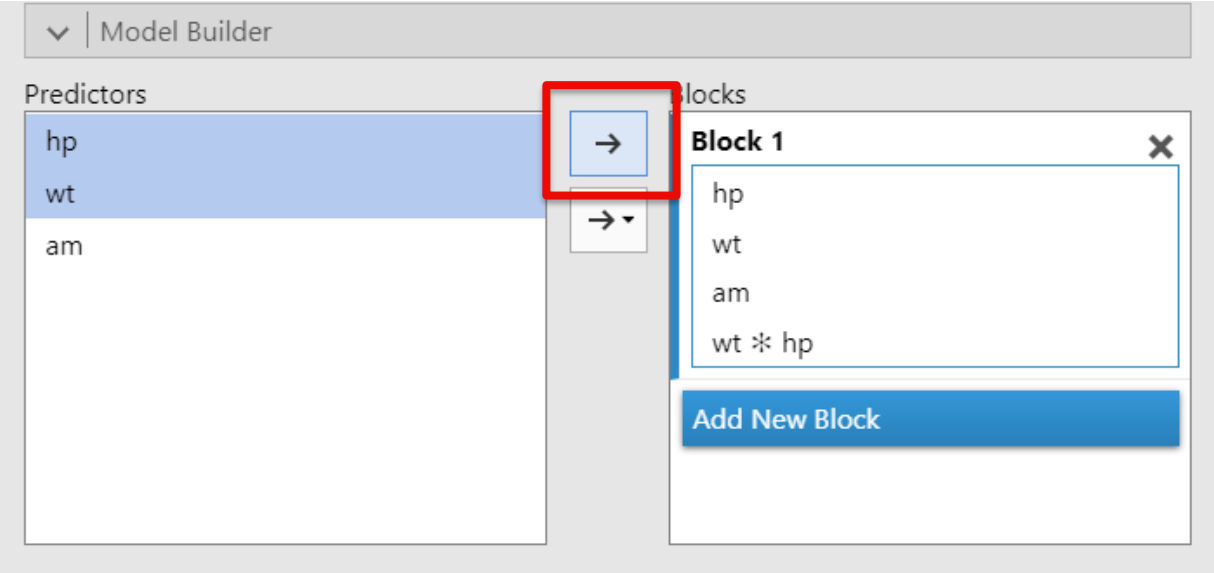
Predictor	Estimate	SE	t	p
Intercept [a]	34.0029	2.64266	12.87	< .001
hp	−0.0375	0.00961	−3.90	< .001
wt	−2.8786	0.90497	−3.18	0.004
am:				
Manual – Automatic	2.0837	1.37642	1.51	0.141

[a] Represents reference level

FITTING A LINEAR REGRESSION MODEL

We can add interaction terms by selecting multiple variables under the Model Builder tab and arrowing them across.

Suppose we wanted to include a hp*wt interaction term.



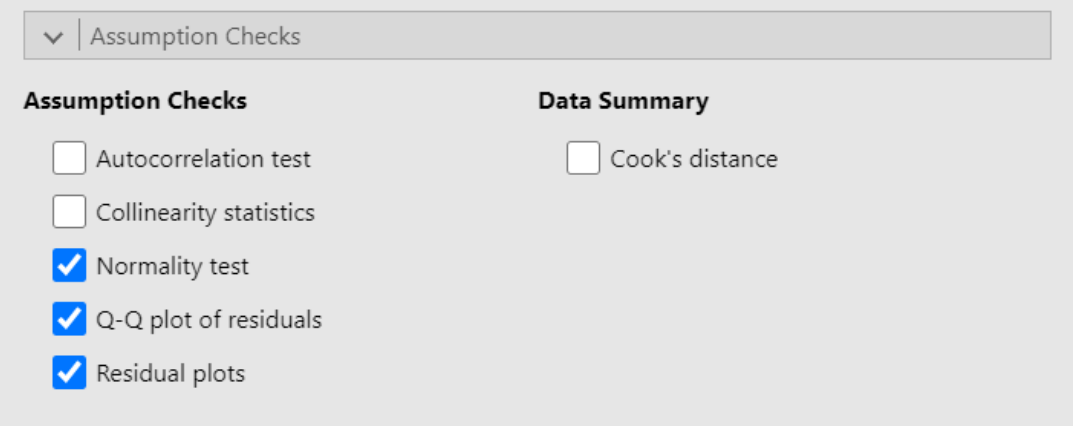
Model Coefficients - mpg

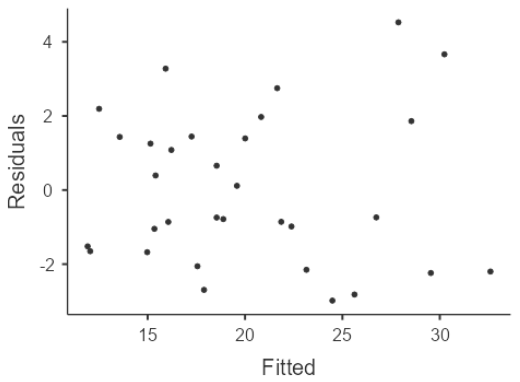
Predictor	Estimate	SE	t	p
Intercept ᵃ	49.4522	5.28073	9.3647	< .001
hp	−0.1193	0.02655	−4.4935	< .001
wt	−8.1006	1.78933	−4.5272	< .001
am:				
Manual – Automatic	0.1251	1.33343	0.0938	0.926
wt ✻ hp	0.0275	0.00847	3.2444	0.003

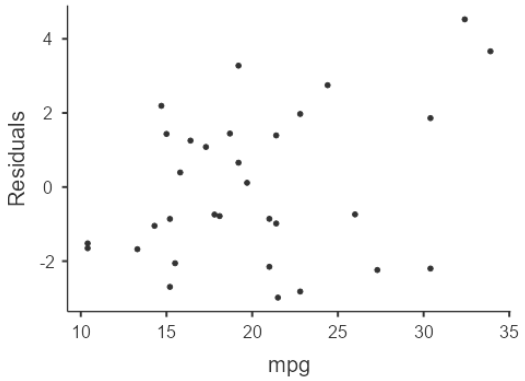
ᵃ Represents reference level

FITTING A LINEAR REGRESSION MODEL

Assumptions can also be checked with options under the Assumption Checks tab.

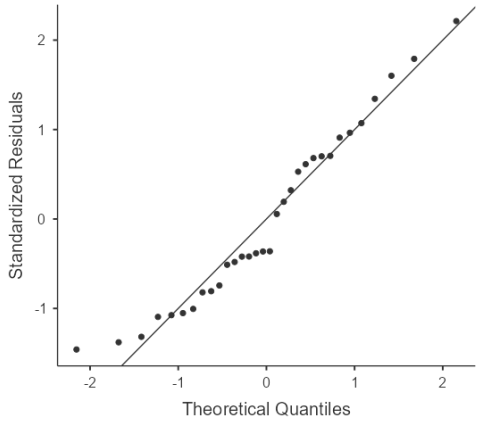


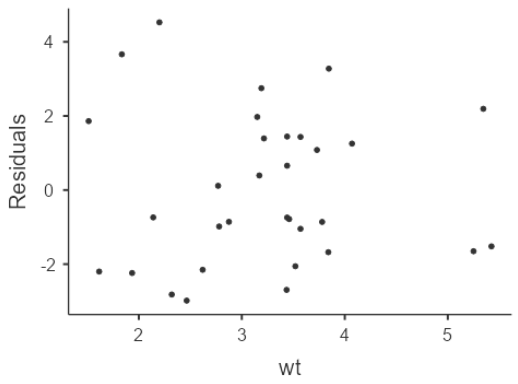


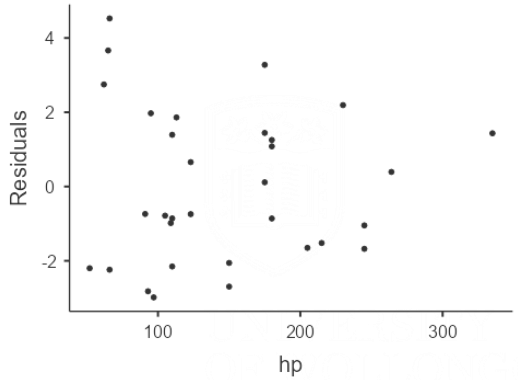


Assumption Checks

Normality Test (Shapiro-Wilk)	
Statistic	p
0.951	0.157







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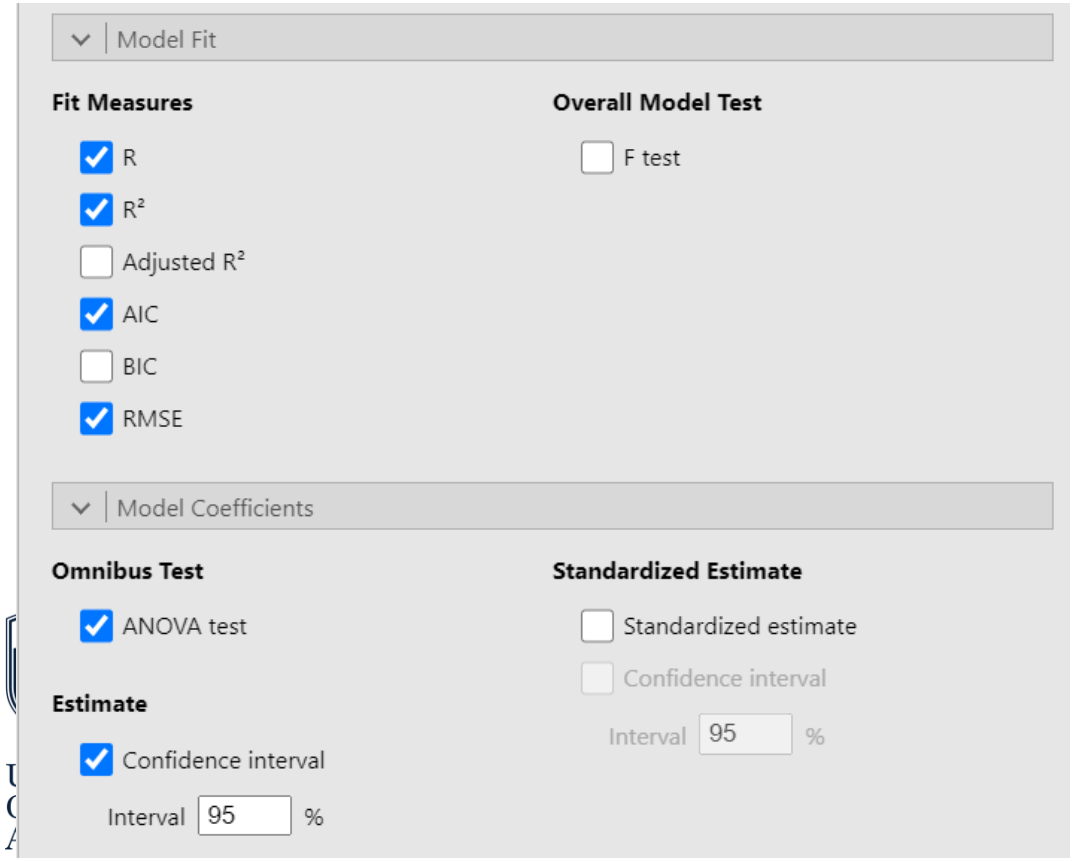
FITTING A LINEAR REGRESSION MODEL

Model fit measures and more detail for the model coefficients can be obtained under the Model Fit and Model Coefficients tabs respectively



Linear Regression

Model Fit Measures

Model	R	R^2	AIC	RMSE
1	0.941	0.885	148	2.01

Omnibus ANOVA Test

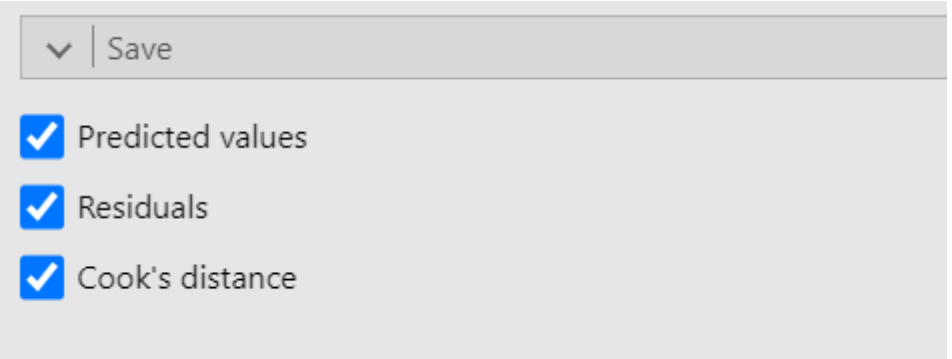
	Sum of Squares	df	Mean Square	F	p
hp	97.0098	1	97.0098	20.19181	< .001
wt	98.4672	1	98.4672	20.49516	< .001
am	0.0423	1	0.0423	0.00880	0.926
wt ✻ hp	50.5719	1	50.5719	10.52612	0.003
Residuals	129.7192	27	4.8044		

Note. Type 3 sum of squares

[3]

FITTING A LINEAR REGRESSION MODEL

Predicted values, Residuals and Cooks Distances can all be outputted under the Save tab for further analysis.



Predicted ...	Residuals	Cook's dis...
	-2.153	0.032
	-0.858	0.009
	-2.820	0.036
	1.393	0.008
	1.444	0.008
	-0.784	0.003
	-1.047	0.015
	2.749	0.060
	1.972	0.018
	0.657	0.002
	-0.743	0.002
	1.254	0.005
	1.082	0.003
	-0.861	0.002
	-1.651	0.050

Programming with R in jamovi

- **All calculations and outputs produced by jamovi are actually produced by R code.**
- **This mean ALL analysis in jamovi can be reproduced in R.**
- **R code can be called from within jamovi.**
- **You can load in data to R directly from jamovi using the jmvconnect package.**

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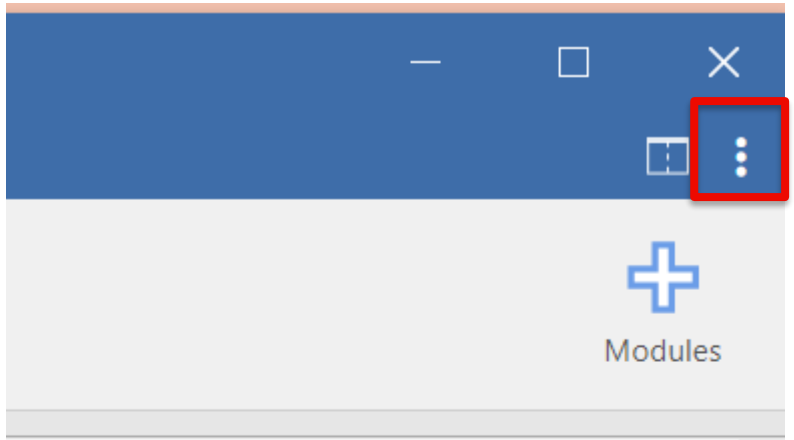
To see the R code used to produce the jamovi output select the three vertical dots in the top right corner of the window and select **Syntax mode**



Results

Descriptives

R code to produce the descriptives table.

```
jmv::descriptives(
    data = data,
    vars = mpg,
    hist = TRUE,
    dens = TRUE,
    box = TRUE,
    violin = TRUE,
    dot = TRUE,
    boxMean = TRUE)
```

Descriptives

	mpg
N	32
Missing	0
Mean	20.1
Median	19.2
Standard deviation	6.03
Minimum	10.4
Maximum	33.9

Zoom – 100% +

Results

Number format: 3 sf

p-value format: 3 dp

References: Visible

Syntax mode ☑

Plots

Plot theme: Default

Color palette: jmv

Import

Default missings: NA

Language: System default

Developer mode ☐

To load data directly into R from jamovi use the jmvconnect commands below.

```
> jmvconnect::what()
```

Available Data Sets

	Title	Rows	Cols
1	mtcars	32	12

```
> data <- jmvconnect::read(1)
```

Then you can run code directly from the syntax.

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```
> jmv::descriptives(
+   data = data,
+   vars = mpg,
+   hist = TRUE,
+   dens = TRUE,
+   box = TRUE,
+   violin = TRUE,
+   dot = TRUE,
+   boxMean = TRUE)
```

DESCRIPTIVES

Descriptives

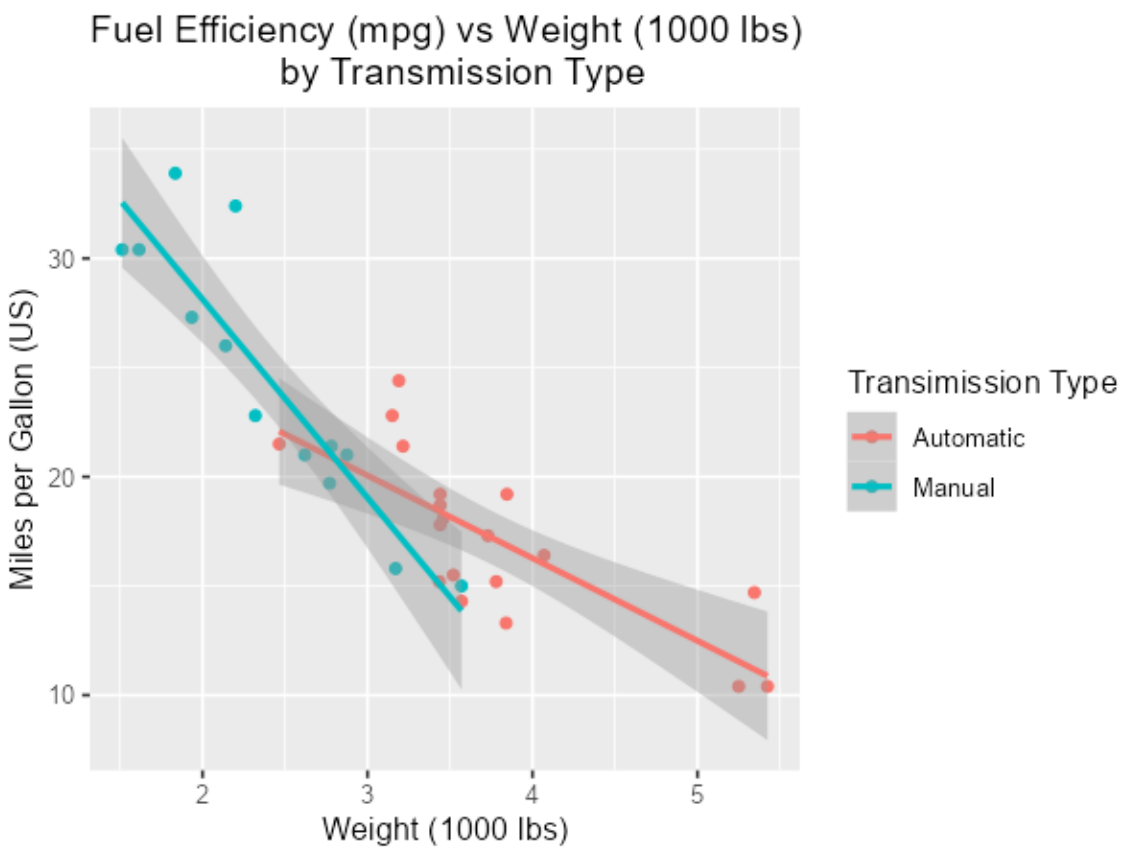
	mpg
N	32
Missing	0
Mean	20.09062
Median	19.20000
Standard deviation	6.026948
Minimum	10.40000
Maximum	33.90000

To run R code in jamovi, you need to add the Rj Editor Module

Rj Editor

```
1
2  # summary(data[1:3])
3  library(ggplot2)
4  ggplot(data)+
5      geom_point(aes(x=wt,y=mpg,col=am))+
6      geom_smooth(aes(x=wt,y=mpg,group=am,col=am),
7                  formula = 'y~x',method="lm")+
8      labs(title = "Fuel Efficiency (mpg) vs Weight (1000 lbs)
9                    by Transmission Type",
10     x="Weight (1000 lbs)", y="Miles per Gallon (US)",
11     col="Transimission Type")
```

Here we have used R code to produce a better plot



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Other Useful Modules

- **gamlj –** general analysis for linear models (includes mixed modeling and GAMs).
- **walrus –** robust statistical methods.
- **deathwatch** or **jsurvival** – survival analysis software.
- **jpower** – power calculations.
- **semlj – SEM** – structural equation modelling.
- **jsq –** Bayesian modelling
- **MAJOR** – meta-analysis software.
- **snowCluster –** clustering software.
- **MORE ….**

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Where to from here…

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Where to from here: Short courses

- Introduction to R/Rstudio online:
- Introduction to JAMOVI:
- Advertised in Universe $100 and on our website https://www.uow.edu.au/niasra/
- Introduction to Data Science and Machine Learning for Health and Social Sciences: 2 days $220
- GRS Seminars

1. Introduction to Methods – **Tuesday 30th August**
2. Common Mistakes in Statistics – **Tuesday 20th September**

- Statistical Consulting Centre (individual advice on your needs)
- https://www.uow.edu.au/niasra/

- Introduction to Jamovi
  - https://www.linkedin.com/learning/introduction-to-jamovi/introduction-to-jamovi

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A BIT ABOUT THE STATISTICAL CONSULTING CENTRE…

Prof. Marijka Batterham
- **Director**

Brad Wakefield
- **Consultant**

Aim

The service aims to improve the statistical content of research carried out by members of the University. Researchers from all disciplines may use the Centre. Priority is currently given to staff members and postgraduate students undertaking research for Doctor of Philosophy or Masters' degrees.

How we can help

Currently the Statistical Consulting Centre provides each researcher with a free initial consultation. Up to ten hours per calendar year of consulting time is provided without charge if research funding is not available. When researchers require more consulting time, or receive external funding, a service charge may be necessary.

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To learn more or book an appointment

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