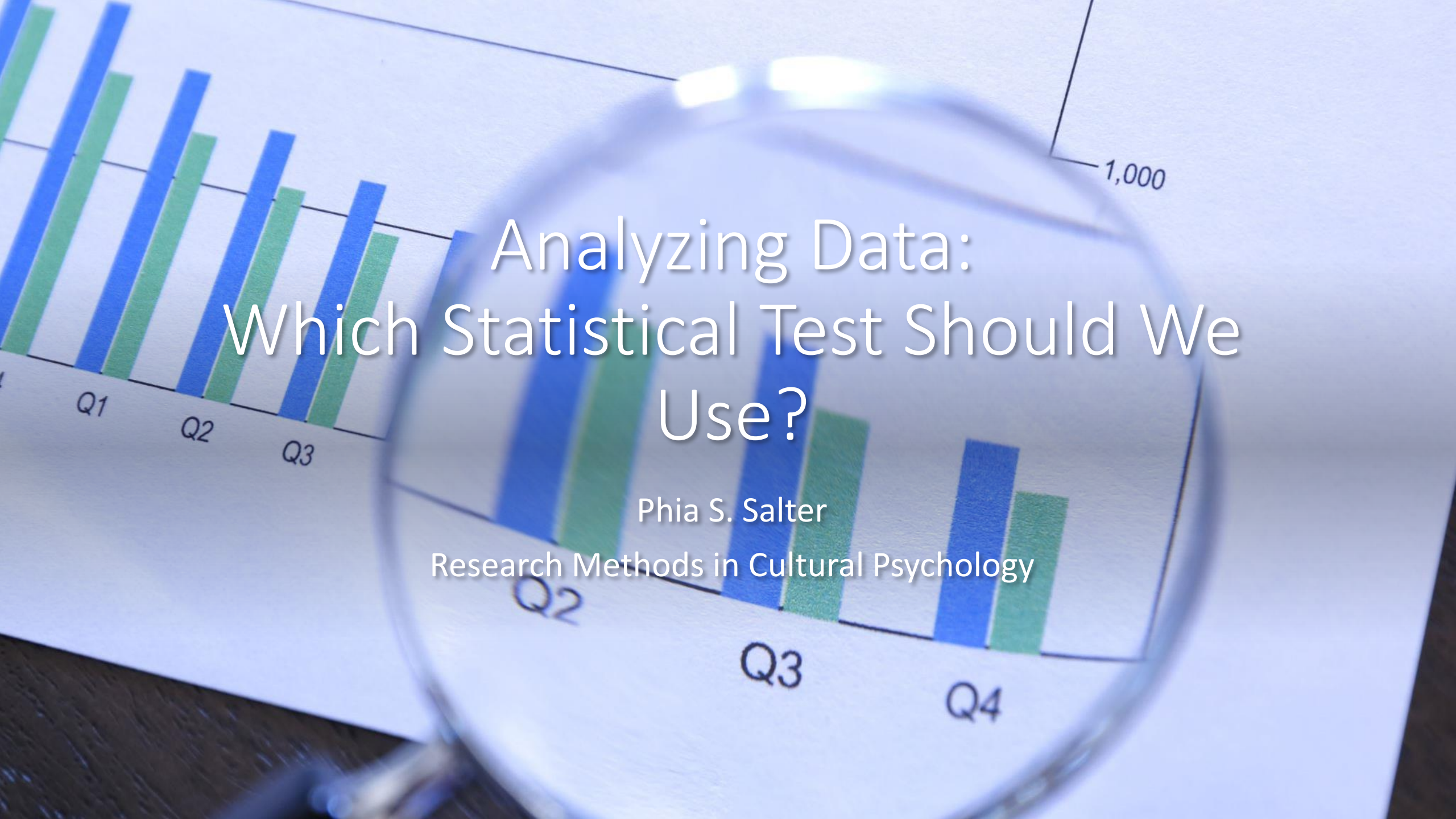


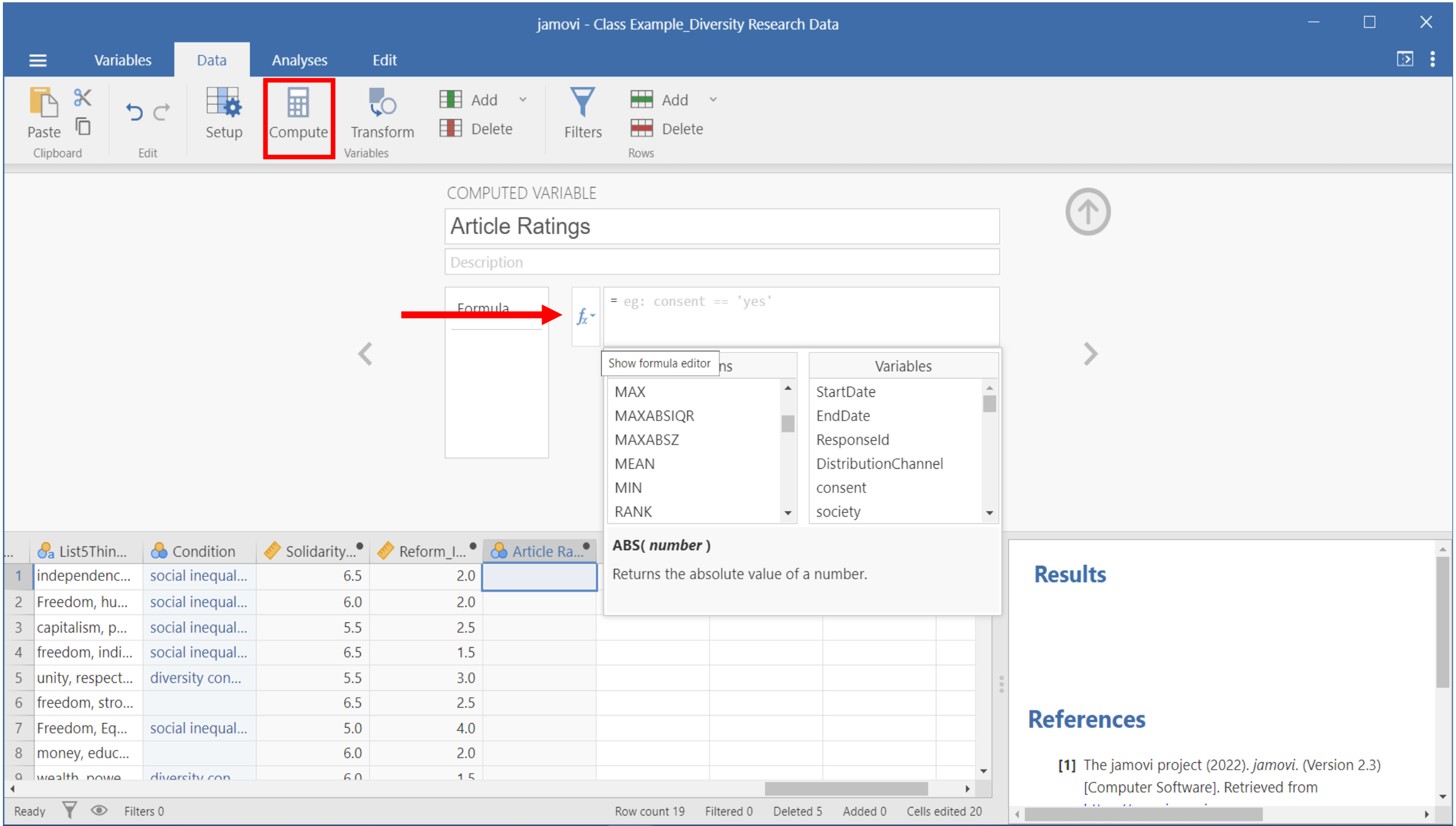
Analyzing Data: Which Statistical Test Should We Use?

Phia S. Salter

Research Methods in Cultural Psychology

What information do I need?

- What is my overarching research question?
- How did I operationalize my research question?
- What variables can help me answer the research question(s)?
- Do I need to clean my data?
  - Do I need to **compute** variables (e.g., take an average score of several items)?
  - Do I need to **recode** variables (e.g., convert text data to numerical data)?
  - Do I need to **reverse** code items?
  - Were there any participants who failed manipulation checks?


jamovi - Class Example_Diversity Research Data
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Analyses
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Clipboard
Edit
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Transform
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Filters
Add
Delete
Rows
COMPUTED VARIABLE
Article Ratings
Description
Formula
= eg: consent == 'yes'
Show formula editor
MAX
MAXABSIQR
MAXABSZ
MEAN
MIN
RANK
Variables
StartDate
EndDate
ResponseId
DistributionChannel
consent
society
ABS(number)
Returns the absolute value of a number.
List5Thin...
Condition
Solidarity...
Reform_I...
Article Ra...
1 independenc... social inequal... 6.5 2.0
2 Freedom, hu... social inequal... 6.0 2.0
3 capitalism, p... social inequal... 5.5 2.5
4 freedom, indi... social inequal... 6.5 1.5
5 unity, respect... diversity con... 5.5 3.0
6 freedom, stro... 6.5 2.5
7 Freedom, Eq... social inequal... 5.0 4.0
8 money, educ... 6.0 2.0
Results
References
[1] The jamovi project (2022). jamovi. (Version 2.3) [Computer Software]. Retrieved from
Ready
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Added 0
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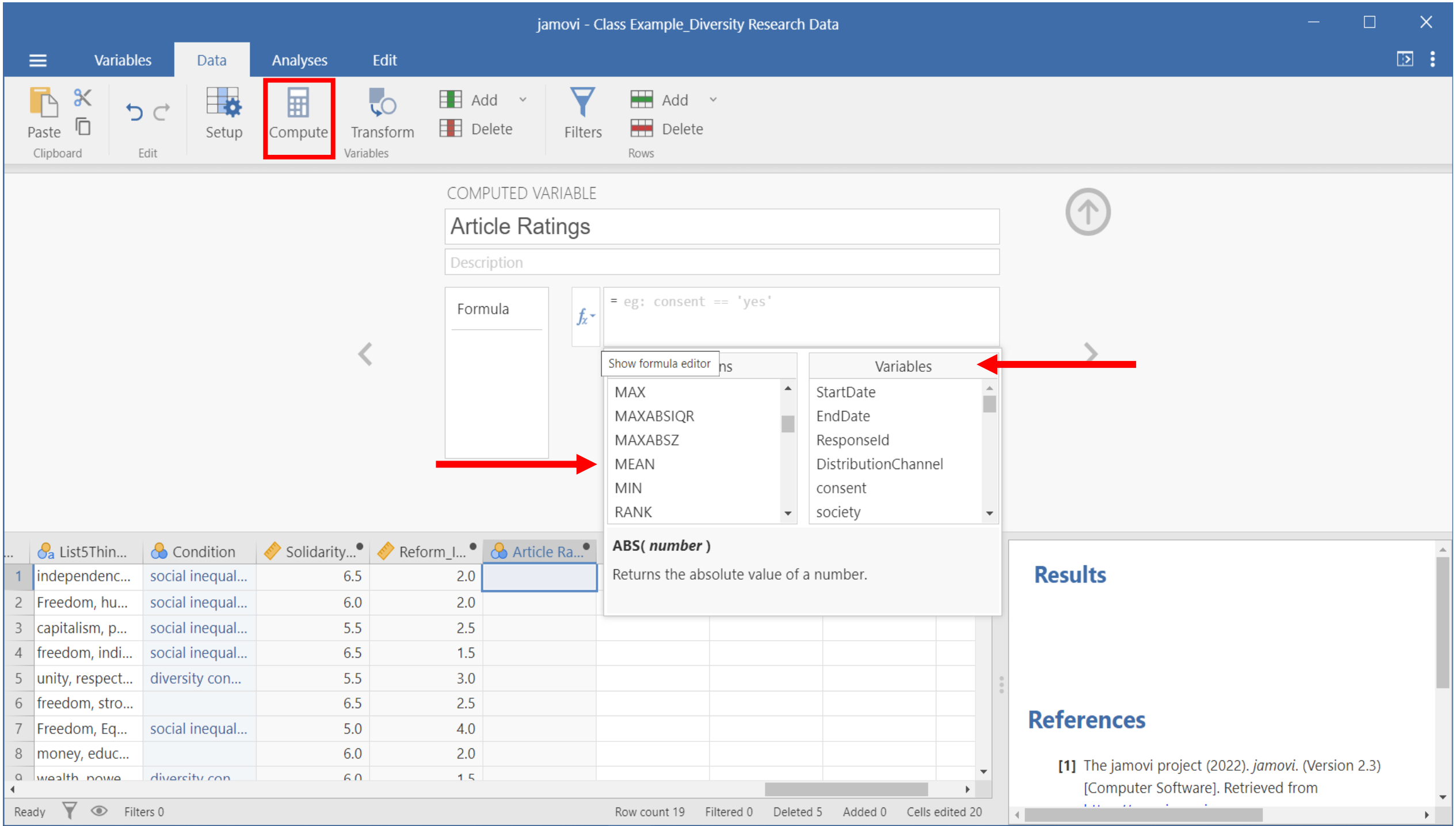
jamovi - Class Example_Diversity Research Data
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Article Ratings
Description
Formula
= eg: consent == 'yes'
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4 freedom, indi... social inequal... 6.5 1.5
5 unity, respect... diversity con... 5.5 3.0
6 freedom, stro... 6.5 2.5
7 Freedom, Eq... social inequal... 5.0 4.0
8 money, educ... 6.0 2.0
Results
References
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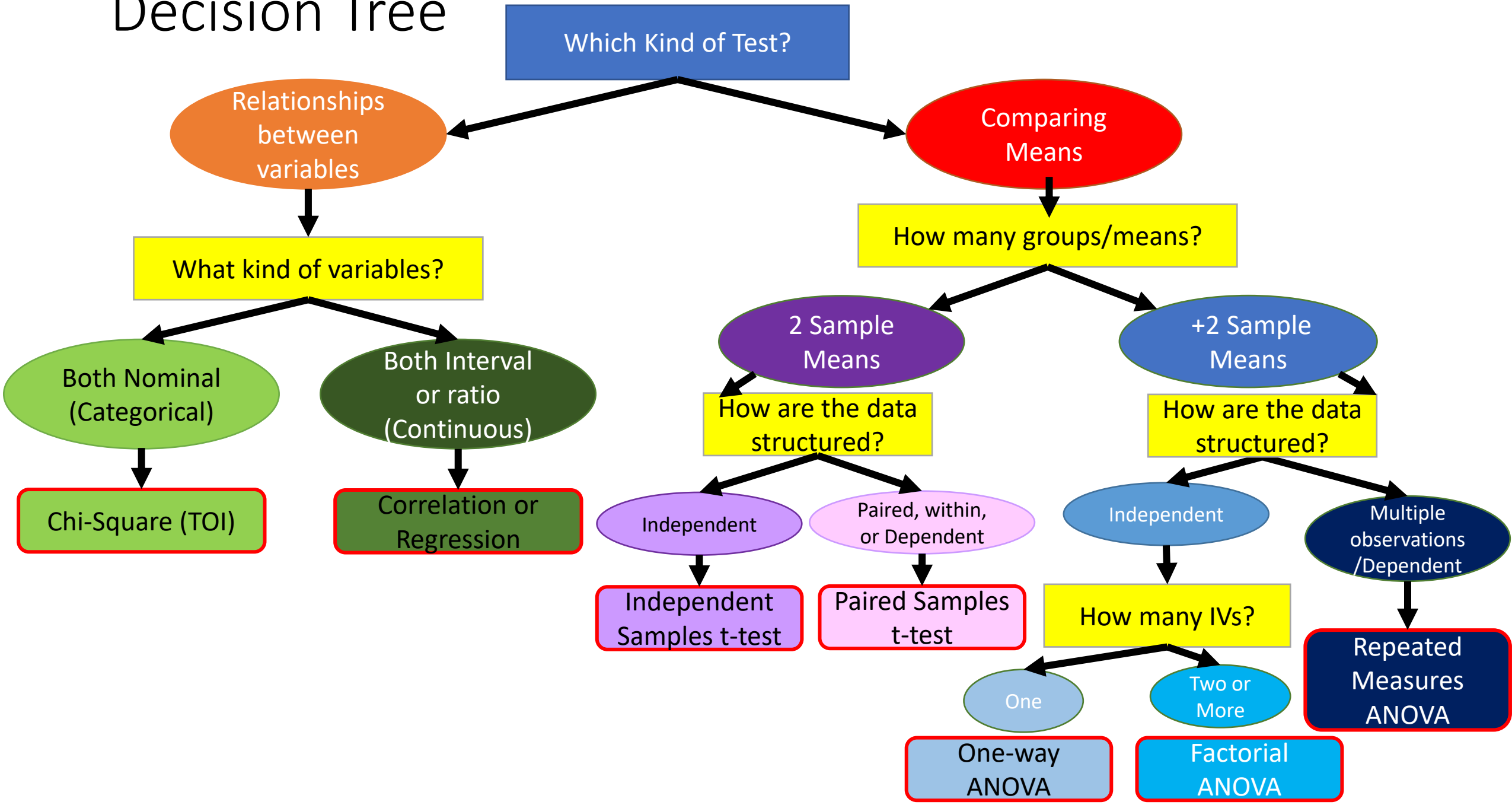
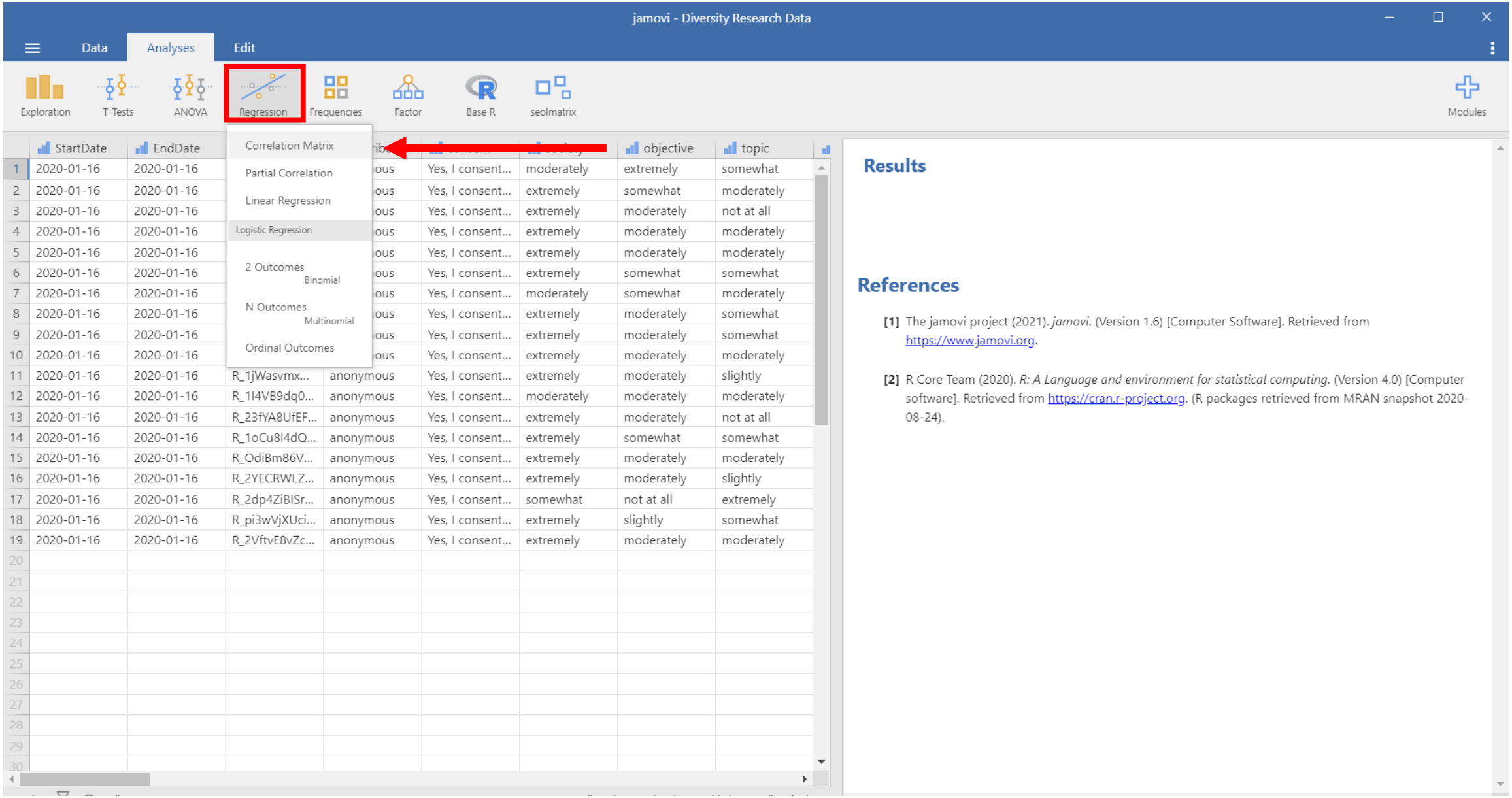
Deleted 5
Added 0
Cells edited 20

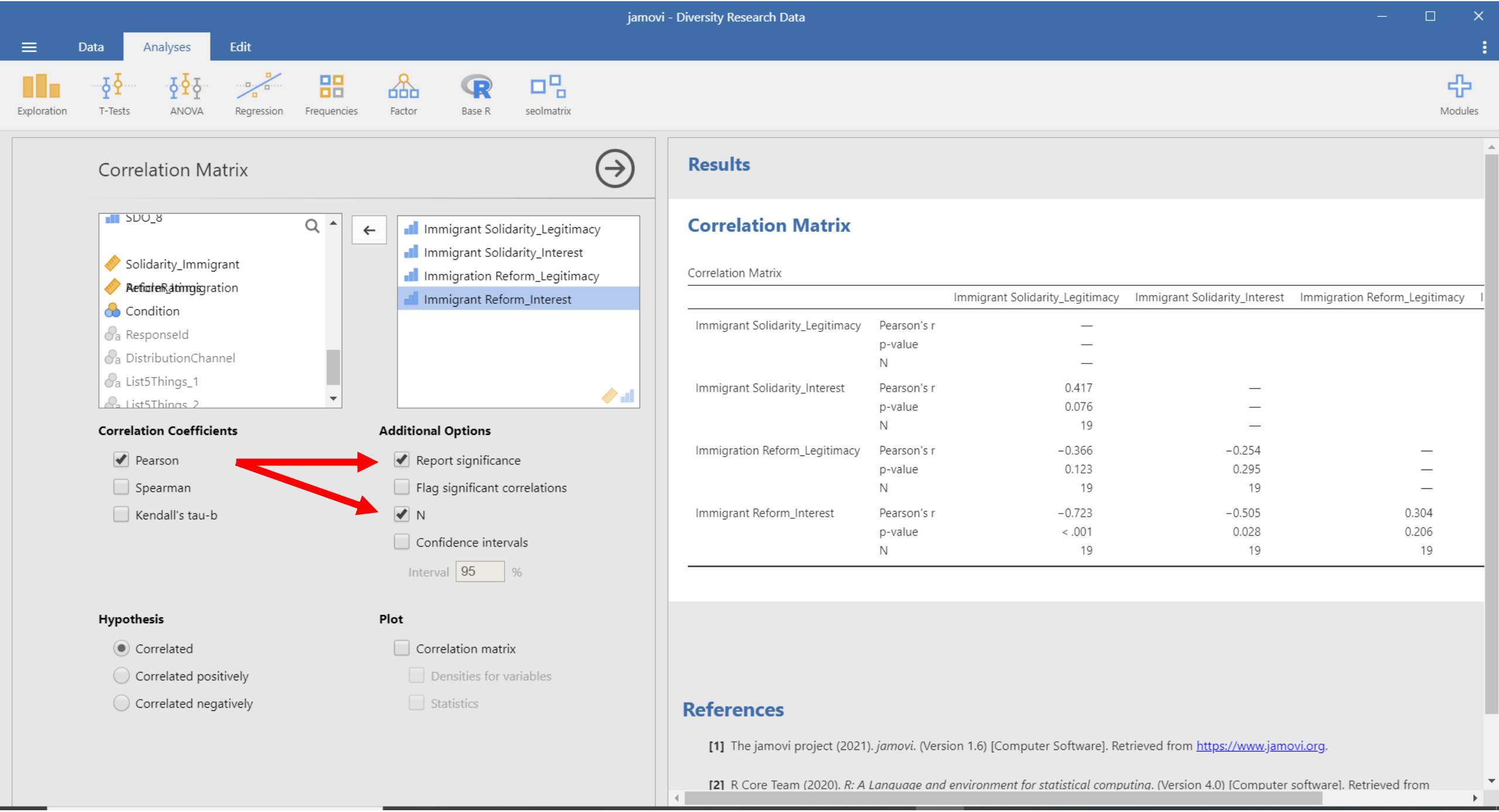
Switching over to Jamovi to Demonstrate…

Decision Tree



Correlations




jamovi - Diversity Research Data
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Correlation Matrix
SDO_8
Solidarity_Immigrant
Condition
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DistributionChannel
List5Things_1
Immigrant Solidarity_Legitimacy
Immigrant Solidarity_Interest
Immigration Reform_Legitimacy
Immigrant Reform_Interest
Correlation Coefficients
Pearson
Spearman
Kendall's tau-b
Additional Options
Report significance
Flag significant correlations
N
Confidence intervals
Interval
95
%
Hypothesis
Correlated
Correlated positively
Correlated negatively
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Correlation Matrix
Immigrant Solidarity_Legitimacy
Immigrant Solidarity_Interest
Immigration Reform_Legitimacy
Immigrant Reform_Interest
Pearson's r
p-value
N
0.417
0.076
19
−0.366
0.123
−0.254
0.295
−0.723
< .001
−0.505
0.028
0.304
0.206
References
[1] The jamovi project (2021). jamovi. (Version 1.6) [Computer Software]. Retrieved from https://www.jamovi.org.
[2] R Core Team (2020). R: A Language and environment for statistical computing. (Version 4.0) [Computer software]. Retrieved from

jamovi - Diversity Research Data

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Exploration | T-Tests | ANOVA | Regression | Frequencies | Factor | Base R | seolmatrix | Modules

Correlation Matrix

SDO_8
Solidarity_Immigrant
Reform_Immigration
Condition
ResponseId
DistributionChannel
List5Things_1
List5Things_2

Immigrant Solidarity_Legitimacy
Immigrant Solidarity_Interest
Immigration Reform_Legitimacy
Immigrant Reform_Interest

Correlation Coefficients

- [x] Pearson
- [ ] Spearman
- [ ] Kendall's tau-b

Additional Options

- [x] Report significance
- [ ] Flag significant correlations
- [x] N
- [ ] Confidence intervals

Interval 95 %

Hypothesis

- (•) Correlated
- ( ) Correlated positively
- ( ) Correlated negatively

Plot

- [ ] Correlation matrix
  - [ ] Densities for variables
  - [ ] Statistics

Results

Correlation Matrix

Correlation Matrix

		Immigrant Solidarity_Legitimacy	Immigrant Solidarity_Interest	Immigration Reform_Legitimacy
Immigrant Solidarity_Legitimacy	Pearson's r	—		
	p-value	—		
	N	—		
Immigrant Solidarity_Interest	Pearson's r	0.417	—	
	p-value	0.076	—	
	N	19	—	
Immigration Reform_Legitimacy	Pearson's r	−0.366	−0.254	—
	p-value	0.123	0.295	—
	N	19	19	—
Immigrant Reform_Interest	Pearson's r	−0.723	−0.505	0.304
	p-value	< .001	0.028	0.206
	N	19	19	19

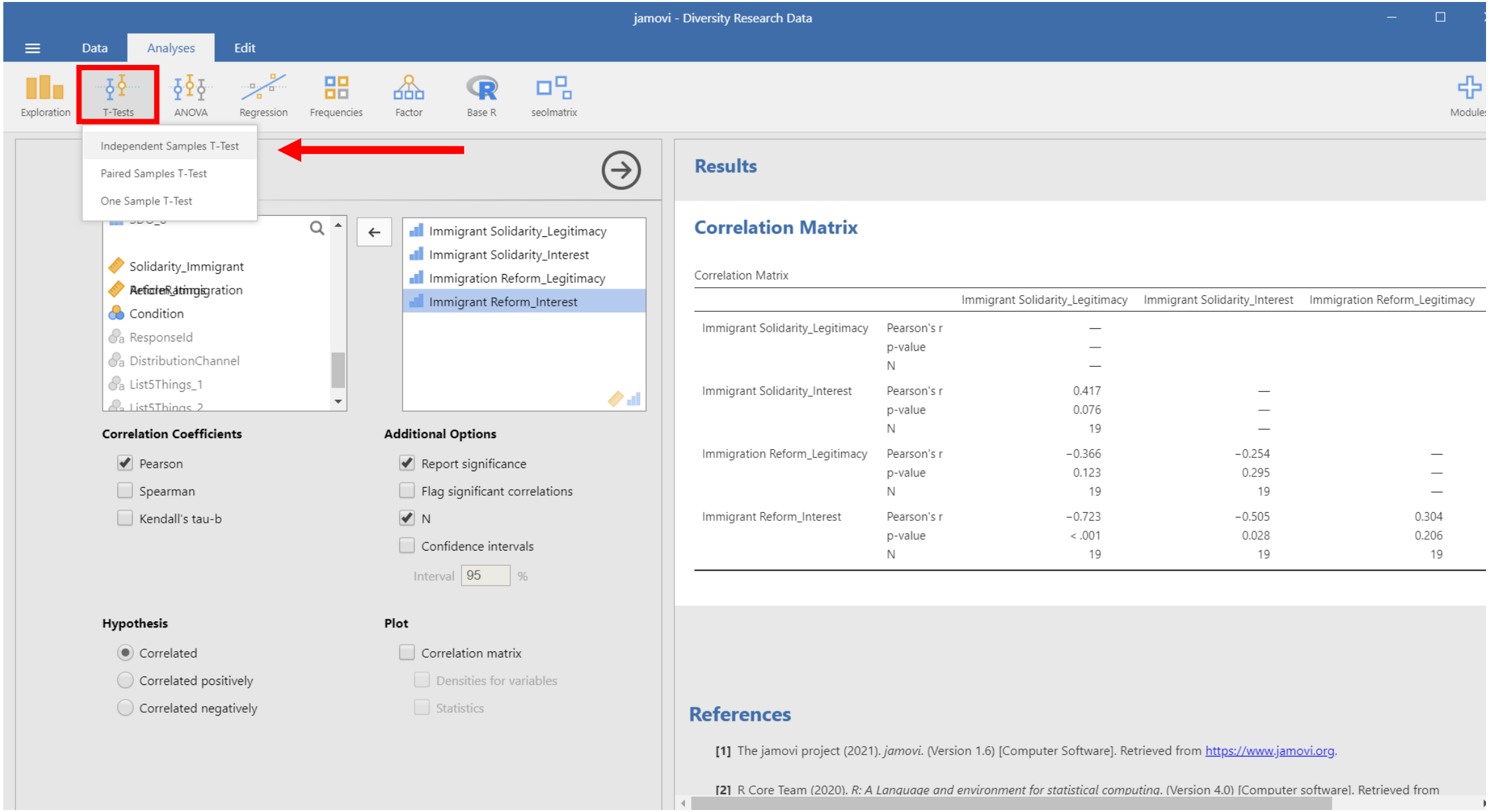
"Interest immigration solidarity organizations and immigration reform organizations are negatively correlated, Pearson's $r(19) = -.51$, $p = .028$."

References

[1] The jamovi project (2021). *jamovi*. (Version 1.6) [Computer Software]. Retrieved from https://www.jamovi.org.

[2] R Core Team (2020). *R: A Language and environment for statistical computing*. (Version 4.0) [Computer software]. Retrieved from

T-Tests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ResponseId
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Immigrant Solidarity_Interest
Immigration Reform_Legitimacy
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Pearson
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Correlated negatively
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Immigrant Solidarity_Interest
Immigration Reform_Legitimacy
Pearson's r
p-value
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0.076
19
−0.366
0.123
−0.254
0.295
−0.723
< .001
0.028
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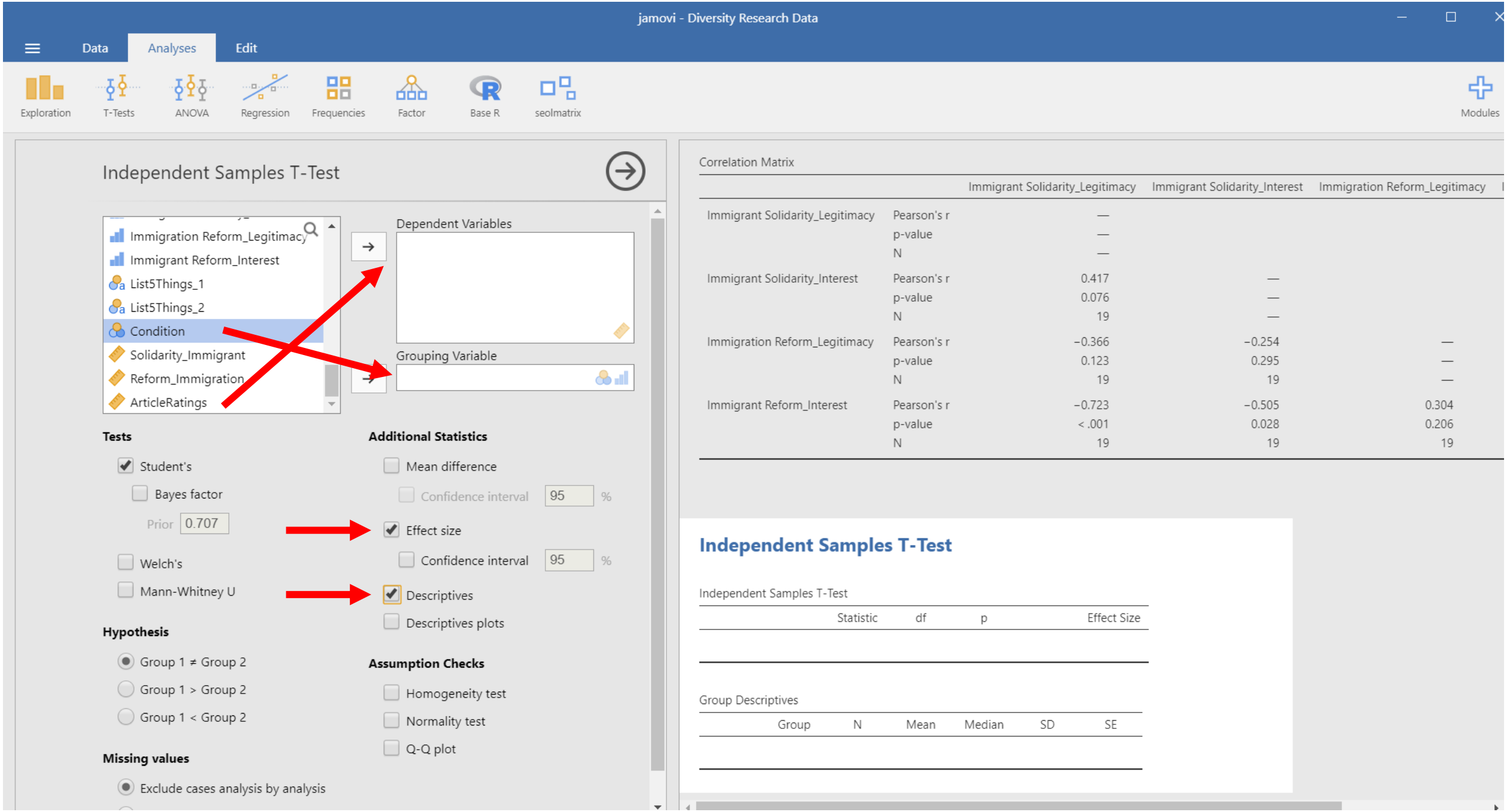
References
[1] The jamovi project (2021). jamovi. (Version 1.6) [Computer Software]. Retrieved from https://www.jamovi.org.
[2] R Core Team (2020). R: A Language and environment for statistical computing. (Version 4.0) [Computer software]. Retrieved from


jamovi - Diversity Research Data
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Immigrant Reform_Interest
List5Things_1
List5Things_2
Condition
Solidarity_Immigrant
Reform_Immigration
ArticleRatings
Dependent Variables
Grouping Variable
Tests
Student's
Bayes factor
Prior 0.707
Welch's
Mann-Whitney U
Additional Statistics
Mean difference
Confidence interval 95 %
Effect size
Confidence interval 95 %
Descriptives
Descriptives plots
Hypothesis
Group 1 ≠ Group 2
Group 1 > Group 2
Group 1 < Group 2
Assumption Checks
Homogeneity test
Normality test
Q-Q plot
Missing values
Exclude cases analysis by analysis
Correlation Matrix
Immigrant Solidarity_Legitimacy
Immigrant Solidarity_Interest
Immigration Reform_Legitimacy
Immigrant Solidarity_Legitimacy Pearson's r — p-value — N —
Immigrant Solidarity_Interest Pearson's r 0.417 — p-value 0.076 — N 19 —
Immigration Reform_Legitimacy Pearson's r −0.366 −0.254 — p-value 0.123 0.295 — N 19 19 —
Immigrant Reform_Interest Pearson's r −0.723 −0.505 0.304 p-value < .001 0.028 0.206 N 19 19 19
Independent Samples T-Test
Independent Samples T-Test
Statistic df p Effect Size
Group Descriptives
Group N Mean Median SD SE

Independent Samples T-Test

Immigrant Solidarity_Interest
Immigration Reform_Legitimacy
Immigrant Reform_Interest
List5Things_1
List5Things_2
List5Things_3
Reform_Immigration

Dependent Variables: ArticleRatings

Grouping Variable: Condition

Tests

- [x] Student's
  - [ ] Bayes factor
    - Prior 0.707
- [ ] Welch's
- [ ] Mann-Whitney U

Hypothesis

- (•) Group 1 ≠ Group 2
- ( ) Group 1 > Group 2
- ( ) Group 1 < Group 2

Missing values

- (•) Exclude cases analysis by analysis

Additional Statistics

- [ ] Mean difference
  - [ ] Confidence interval 95 %
- [x] Effect size
  - [ ] Confidence interval 95 %
- [x] Descriptives
- [ ] Descriptives plots

Assumption Checks

- [ ] Homogeneity test
- [ ] Normality test
- [ ] Q-Q plot

Immigrant Reform_Interest	Pearson's r	−0.723	−0.505	0.304
	p-value	< .001	0.028	0.206
	N	19	19	19

Independent Samples T-Test

Independent Samples T-Test

		Statistic	df	p		Effect Size
ArticleRatings	Student's t	−1.22	15.0	0.242	Cohen's d	−0.592

Group Descriptives

	Group	N	Mean	Median	SD	SE
ArticleRatings	diversity condition	8	3.85	4.10	0.812	0.287
	social inequality condition	9	4.22	4.20	0.406	0.135

References

[1] The jamovi project (2021). *jamovi*. (Version 1.6) [Computer Software]. Retrieved from https://www.jamovi.org.

[2] R Core Team (2020). *R: A Language and environment for statistical computing*. (Version 4.0) [Computer software]. Retrieved from

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Data | Analyses | Edit

Exploration | T-Tests | ANOVA | Regression | Frequencies | Factor | Base R | seolmatrix | Modul

Independent Samples T-Test

Immigrant Solidarity_Interest
Immigration Reform_Legitimacy
Immigrant Reform_Interest
List5Things_1
List5Things_2
List5Things_3
Solidarity_Immigrant
Reform_Immigration

Dependent Variables: ArticleRatings

Grouping Variable: Condition

Tests

- [x] Student's
- [ ] Bayes factor
  - Prior: 0.707
- [ ] Welch's
- [ ] Mann-Whitney U

Hypothesis

- (•) Group 1 ≠ Group 2
- ( ) Group 1 > Group 2
- ( ) Group 1 < Group 2

Missing values

- (•) Exclude cases analysis by analysis

Additional Statistics

- [ ] Mean difference
  - [ ] Confidence interval 95 %
- [x] Effect size
  - [ ] Confidence interval 95 %
- [x] Descriptives
- [ ] Descriptives plots

Assumption Checks

- [ ] Homogeneity test
- [ ] Normality test
- [ ] Q-Q plot

Immigrant Reform_Interest	Pearson's r	−0.723	−0.505	0.304
	p-value	< .001	0.028	0.206
	N	19	19	19

Independent Samples T-Test

Independent Samples T-Test

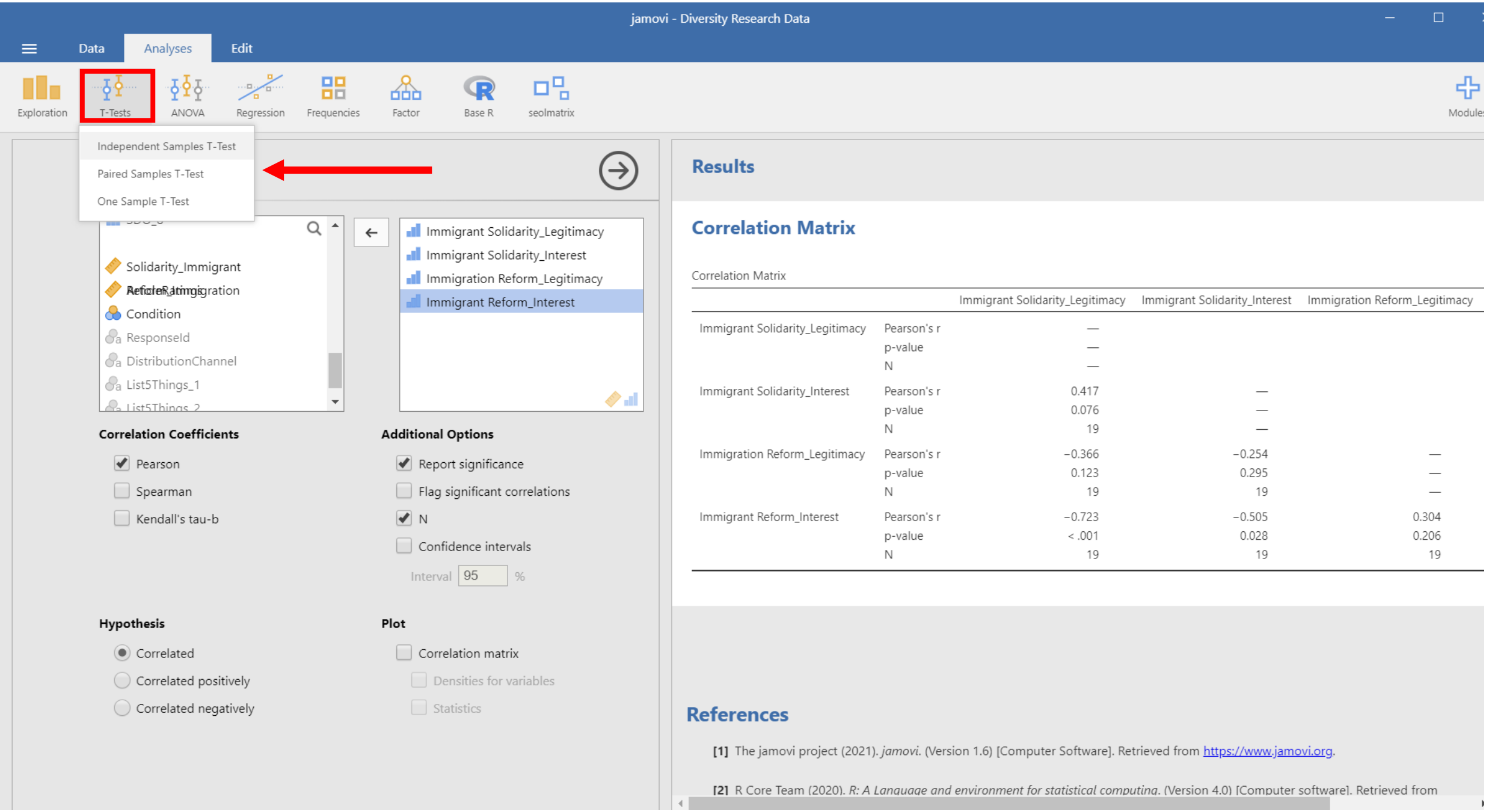
		Statistic	df	p		Effect Size
ArticleRatings	Student's t	−1.22	15.0	0.242	Cohen's d	−0.592

Group Descriptives

	Group	N	Mean	Median	SD	SE
ArticleRatings	diversity condition	8	3.85	4.10	0.812	0.287
	social inequality condition	9	4.22	4.20	0.406	0.135

"There were no significant differences across the article types, $t(15) = -1.22$, $p = .24$, $d = -.59$. Participants rated the organization framed to address "diversity" ($M = 3.85$, $SD = 0.81$) similarly to the organization framed to address "social inequality" ($M = 4.22$, $SD = 0.41$).

[2] R Core Team (2020). *R: A Language and environment for statistical computing*. (Version 4.0) [Computer software]. Retrieved from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Immigrant Reform_Interest
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[2] R Core Team (2020). R: A Language and environment for statistical computing. (Version 4.0) [Computer software]. Retrieved from

Paired Samples T-Test

SDO_7
SDO_8
Immigrant Solidarity_Legitimacy
Immigrant Solidarity_Interest
Immigration Reform_Legitimacy
Immigrant Reform_Interest
Condition
ResponseId

Paired Variables

Tests

- [x] Student's
- [ ] Bayes factor
  - Prior 0.707
- [ ] Wilcoxon rank

Hypothesis

- (•) Measure 1 ≠ Measure 2
- ( ) Measure 1 > Measure 2
- ( ) Measure 1 < Measure 2

Missing values

- (•) Exclude cases analysis by analysis
- ( ) Exclude cases listwise

Additional Statistics

- [ ] Mean difference
  - [ ] Confidence interval 95 %
- [x] Effect size
  - [ ] Confidence interval 95 %
- [ ] Descriptives
- [ ] Descriptives plots

Assumption Checks

- [ ] Normality test
- [ ] Q-Q Plot

Immigrant Reform_Interest	Pearson's r	−0.723	−0.505	0.304
	p-value	< .001	0.028	0.206
	N	19	19	19

Independent Samples T-Test

Independent Samples T-Test

		Statistic	df	p		Effect Size
ArticleRatings	Student's t	−1.22	15.0	0.242	Cohen's d	−0.592

Group Descriptives

	Group	N	Mean	Median	SD	SE
ArticleRatings	diversity condition	8	3.85	4.10	0.812	0.287
	social inequality condition	9	4.22	4.20	0.406	0.135

Paired Samples T-Test

Paired Samples T-Test

		statistic	df	p	Effect Size

Paired Samples T-Test

SDO_7
SDO_8
Immigrant Solidarity_Legitimacy
Immigrant Solidarity_Interest
Immigration Reform_Legitimacy
Immigrant Reform_Interest
Condition
ResponseId

Paired Variables

Immigrant Sol...	Immigration ...

Tests

- [x] Student's
  - [ ] Bayes factor
    - Prior 0.707
- [ ] Wilcoxon rank

Hypothesis

- (•) Measure 1 ≠ Measure 2
- ( ) Measure 1 > Measure 2
- ( ) Measure 1 < Measure 2

Missing values

- (•) Exclude cases analysis by analysis
- ( ) Exclude cases listwise

Additional Statistics

- [ ] Mean difference
  - [ ] Confidence interval 95 %
- [x] Effect size
  - [ ] Confidence interval 95 %
- [x] Descriptives
- [ ] Descriptives plots

Assumption Checks

- [ ] Normality test
- [ ] Q-Q Plot

ArticleRatings	Student's t	−1.22	15.0	0.242	Cohen's d	−0.592

Group Descriptives

	Group	N	Mean	Median	SD	SE
ArticleRatings	diversity condition	8	3.85	4.10	0.812	0.287
	social inequality condition	9	4.22	4.20	0.406	0.135

Paired Samples T-Test

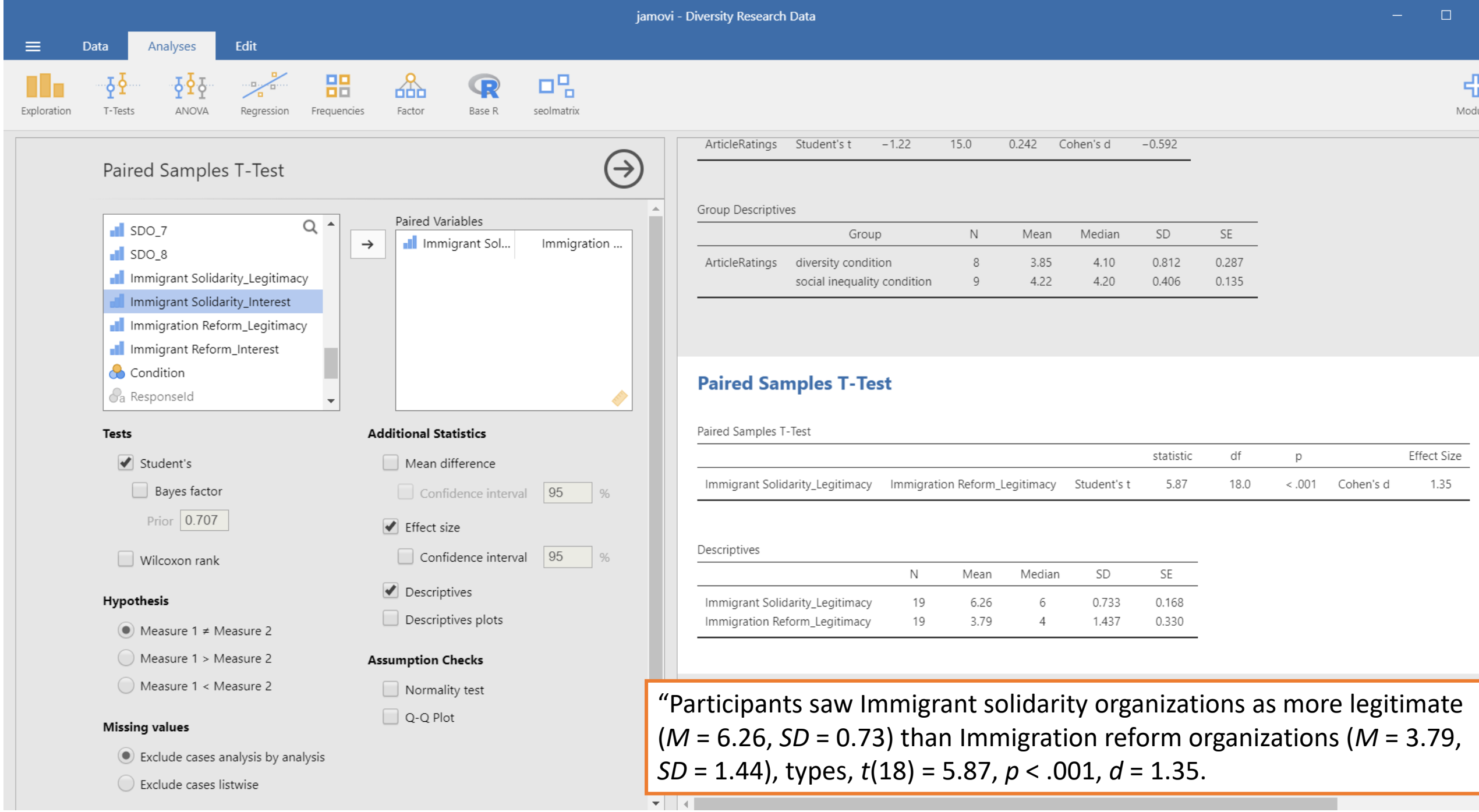
Paired Samples T-Test

			statistic	df	p		Effect Size
Immigrant Solidarity_Legitimacy	Immigration Reform_Legitimacy	Student's t	5.87	18.0	< .001	Cohen's d	1.35

Descriptives

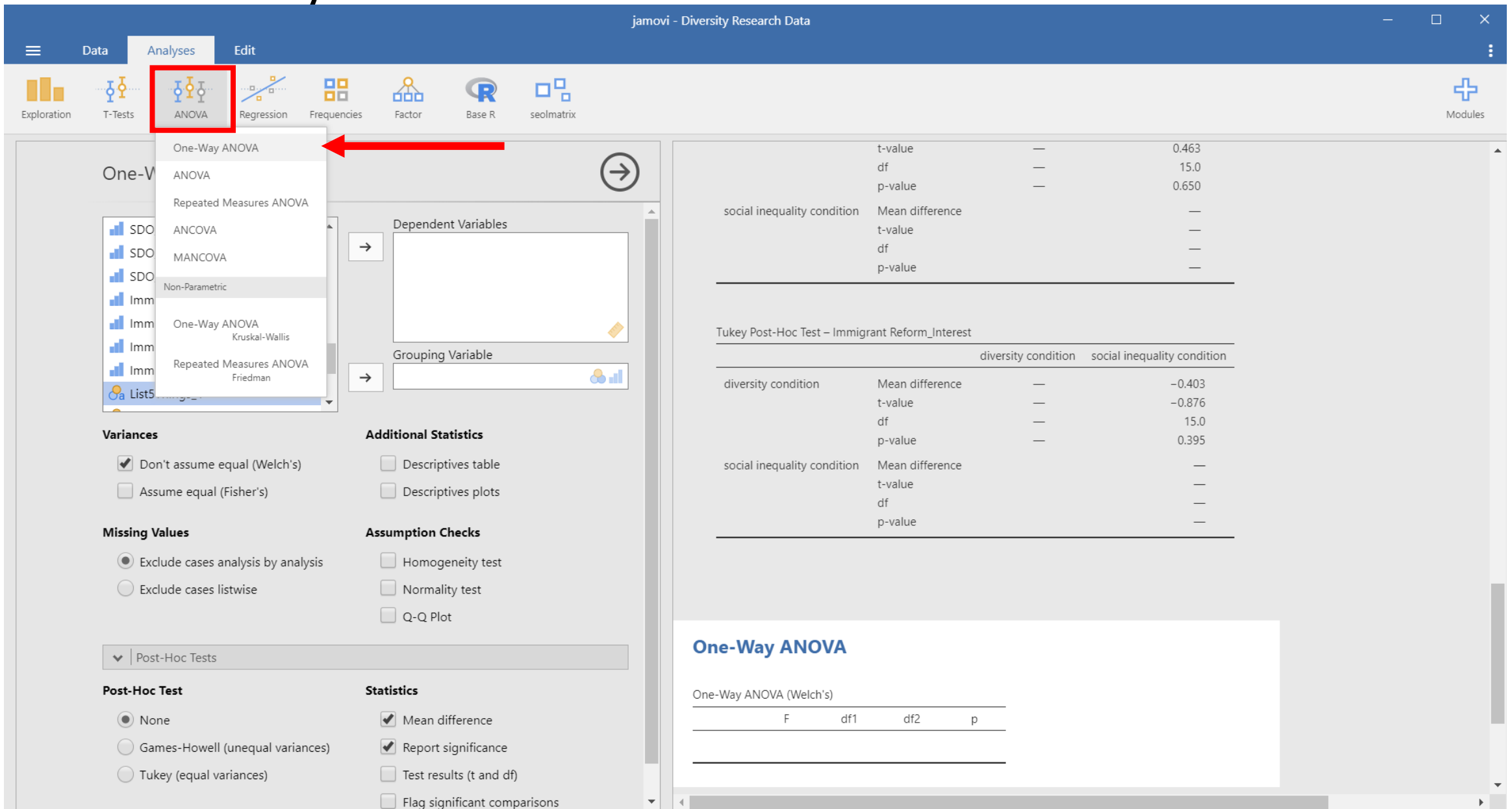
	N	Mean	Median	SD	SE
Immigrant Solidarity_Legitimacy	19	6.26	6	0.733	0.168
Immigration Reform_Legitimacy	19	3.79	4	1.437	0.330

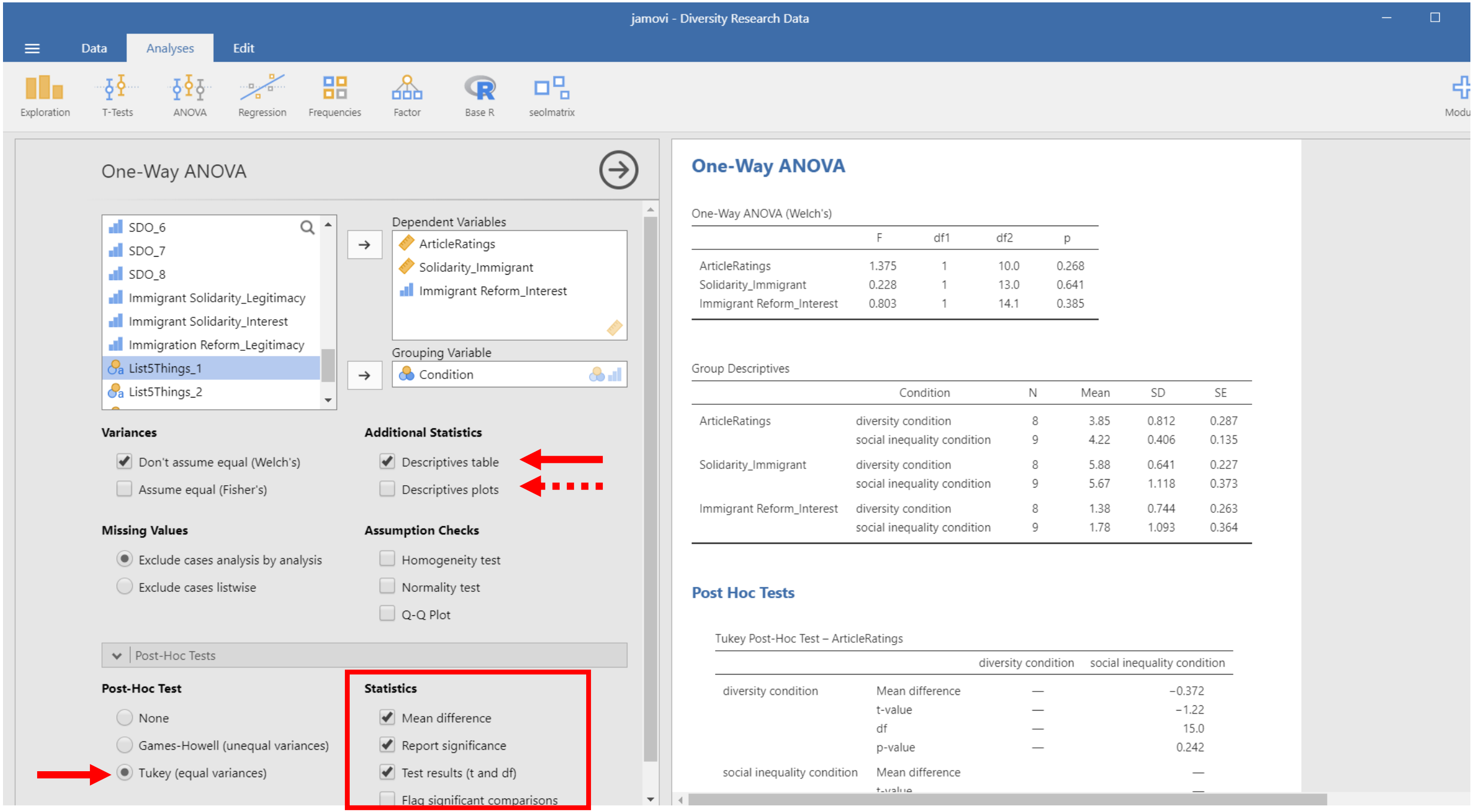
References



"Participants saw Immigrant solidarity organizations as more legitimate (M = 6.26, SD = 0.73) than Immigration reform organizations (M = 3.79, SD = 1.44), types, $t(18) = 5.87$, $p < .001$, $d = 1.35$.

One-Way ANOVA

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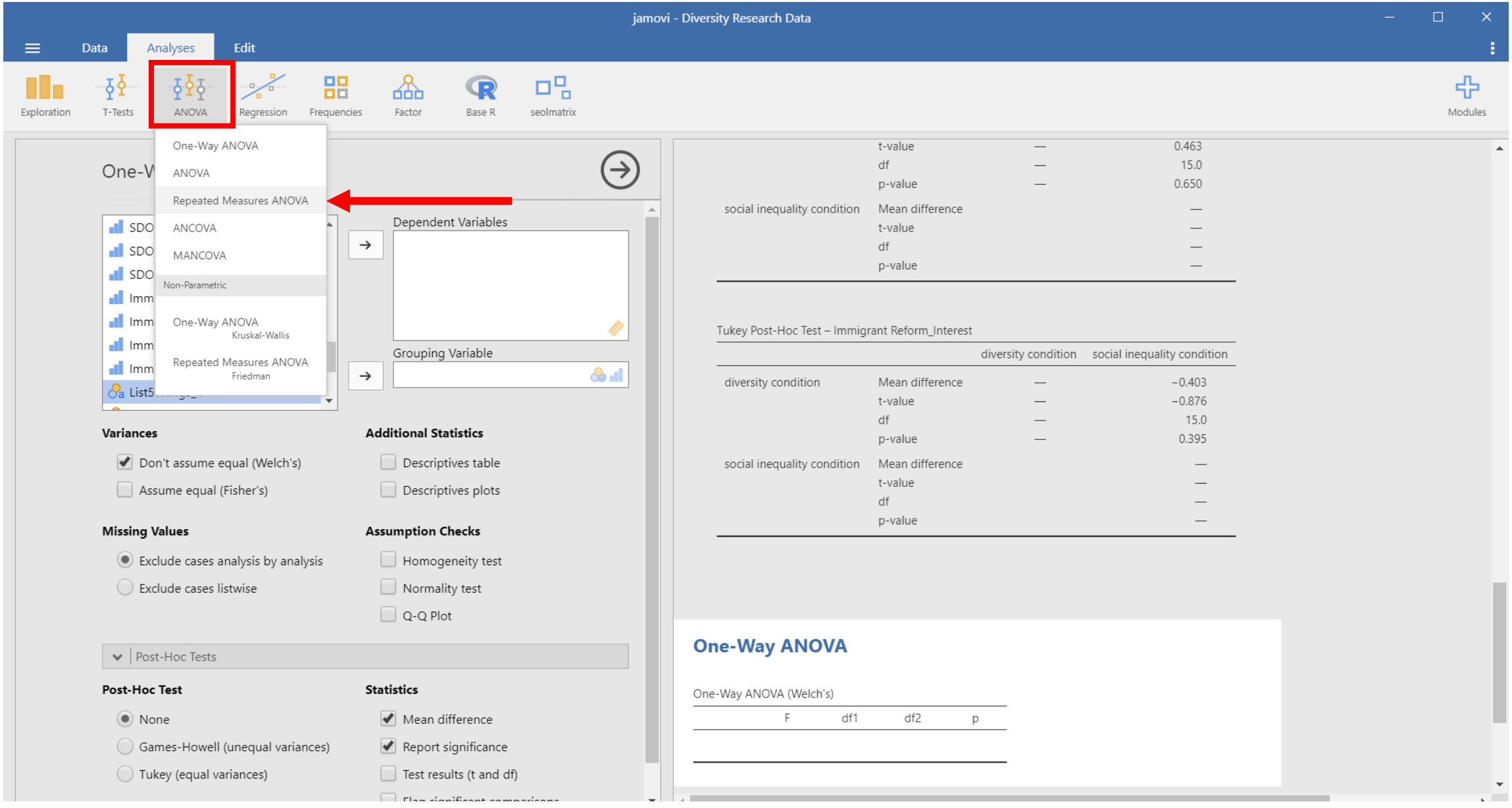
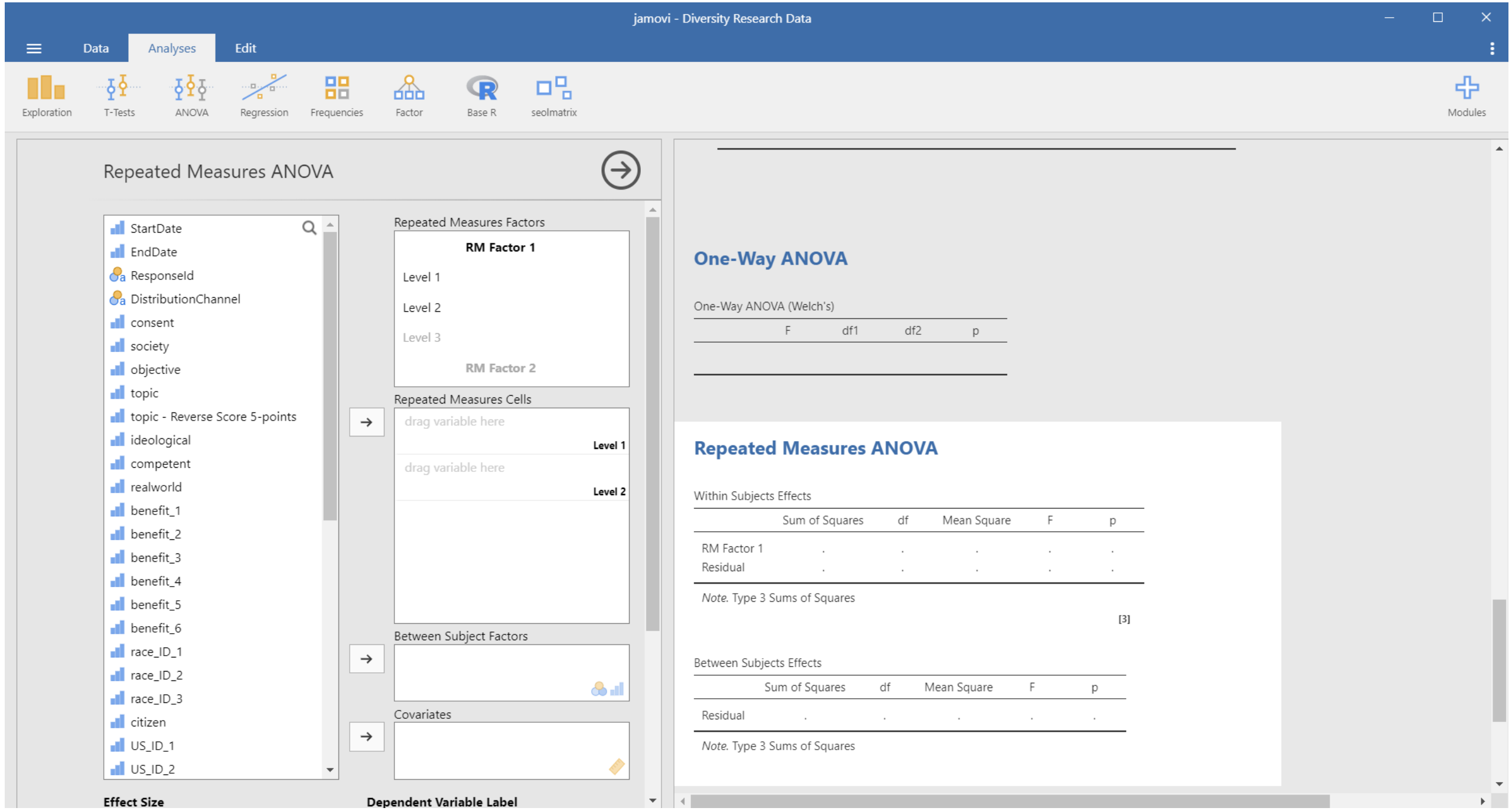
SDO_6
SDO_7
SDO_8
Immigrant Solidarity_Legitimacy
Immigrant Solidarity_Interest
Immigration Reform_Legitimacy
List5Things_1
List5Things_2
Dependent Variables
ArticleRatings
Solidarity_Immigrant
Immigrant Reform_Interest
Grouping Variable
Condition
Variances
Don't assume equal (Welch's)
Assume equal (Fisher's)
Additional Statistics
Descriptives table
Descriptives plots
Missing Values
Exclude cases analysis by analysis
Exclude cases listwise
Assumption Checks
Homogeneity test
Normality test
Q-Q Plot
Post-Hoc Tests
Post-Hoc Test
None
Games-Howell (unequal variances)
Tukey (equal variances)
Statistics
Mean difference
Report significance
Test results (t and df)
Flag significant comparisons
One-Way ANOVA
One-Way ANOVA (Welch's)
F df1 df2 p
ArticleRatings 1.375 1 10.0 0.268
Solidarity_Immigrant 0.228 1 13.0 0.641
Immigrant Reform_Interest 0.803 1 14.1 0.385
Group Descriptives
Condition N Mean SD SE
ArticleRatings diversity condition 8 3.85 0.812 0.287
social inequality condition 9 4.22 0.406 0.135
Solidarity_Immigrant diversity condition 8 5.88 0.641 0.227
social inequality condition 9 5.67 1.118 0.373
Immigrant Reform_Interest diversity condition 8 1.38 0.744 0.263
social inequality condition 9 1.78 1.093 0.364
Post Hoc Tests
Tukey Post-Hoc Test – ArticleRatings
diversity condition social inequality condition
diversity condition Mean difference — −0.372
t-value — −1.22
df — 15.0
p-value — 0.242
social inequality condition Mean difference —

Example of significant ANOVA results

- Analysis of variance (ANOVA) showed a main effect of Poster Type on mood, $F(2, 1279) = 6.15$, $p = .002$, $\eta_p^2 = .010$. Posthoc analyses using Tukey's HSD indicated that positive mood was lower when viewing Black History Month posters than when viewing Hispanic Heritage Month Posters ($p = .014$) or Asian and Pacific Islander Awareness posters ($p = .004$), but mood did not differ significantly between participants who viewed Hispanic Heritage Month and Pacific Islander Awareness posters ($p = .82$), see Table 1.

Repeated Measures ANOVA

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Base R
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Modules
Repeated Measures ANOVA
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EndDate
ResponseId
DistributionChannel
consent
society
objective
topic
topic - Reverse Score 5-points
ideological
competent
realworld
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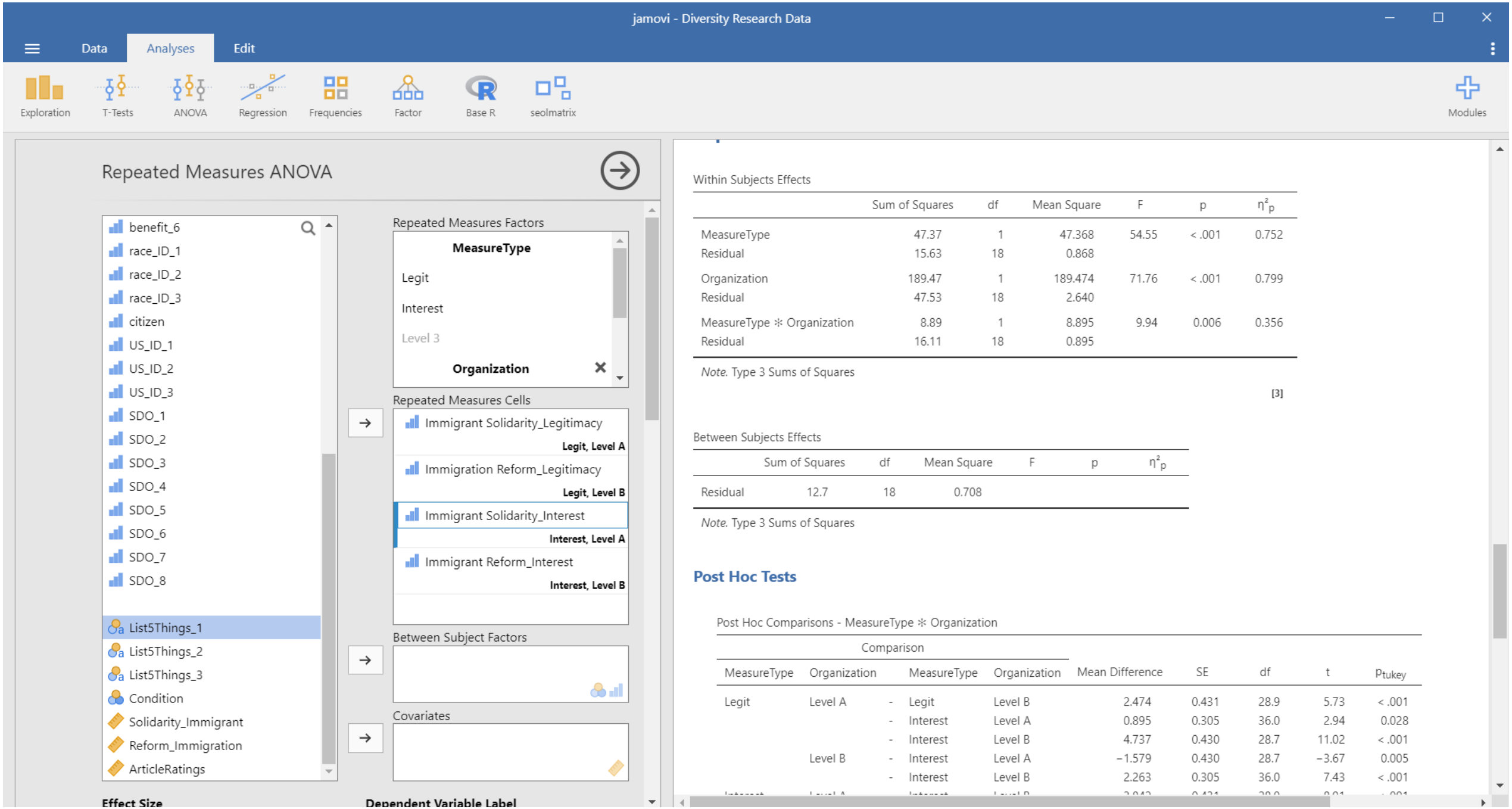
benefit_2
benefit_3
benefit_4
benefit_5
benefit_6
race_ID_1
race_ID_2
race_ID_3
citizen
US_ID_1
US_ID_2
Repeated Measures Factors
RM Factor 1
Level 1
Level 2
Level 3
RM Factor 2
Repeated Measures Cells
drag variable here
Level 1
drag variable here
Level 2
Between Subject Factors
Covariates
Effect Size
Dependent Variable Label
One-Way ANOVA
One-Way ANOVA (Welch's)
F
df1
df2
p
Repeated Measures ANOVA
Within Subjects Effects
Sum of Squares
df
Mean Square
F
p
RM Factor 1
Residual
Note. Type 3 Sums of Squares
[3]
Between Subjects Effects
Sum of Squares
df
Mean Square
F
p
Residual
Note. Type 3 Sums of Squares



Within Subjects Effects

	Sum of Squares	df	Mean Square	F	p	η^2_p
MeasureType	47.37	1	47.368	54.55	< .001	0.752
Residual	15.63	18	0.868			
Organization	189.47	1	189.474	71.76	< .001	0.799
Residual	47.53	18	2.640			
MeasureType ✻ Organization	8.89	1	8.895	9.94	0.006	0.356
Residual	16.11	18	0.895			

Note. Type 3 Sums of Squares

[3]

Between Subjects Effects

	Sum of Squares	df	Mean Square	F	p	η^2_p
Residual	12.7	18	0.708			

Note. Type 3 Sums of Squares

Post Hoc Tests

Post Hoc Comparisons - MeasureType ✻ Organization

Comparison									
MeasureType	Organization		MeasureType	Organization	Mean Difference	SE	df	t	p_{tukey}
Legit	Level A	-	Legit	Level B	2.474	0.431	28.9	5.73	< .001
		-	Interest	Level A	0.895	0.305	36.0	2.94	0.028
		-	Interest	Level B	4.737	0.430	28.7	11.02	< .001
	Level B	-	Interest	Level A	−1.579	0.430	28.7	−3.67	0.005
		-	Interest	Level B	2.263	0.305	36.0	7.43	< .001

Switching over to Jamovi to Demonstrate…

Data Consultations

Which Statistical Test to Use?

Sample question	Independent variable is…	The dependent variable is…	Use this test
Are female students more likely to choose a psych major than male students?	Nominal/ordinal (Categorical)	Nominal/ordinal (Categorical)	Chi square test
Did the experimental group differ from control group in happiness? (2 groups)	Nominal/ordinal (Categorical)	Interval/Ratio (scale)	Independent samples *t*-test
Is there a sig difference in reading scores among 1st, 2nd, and 3rd graders?	Nominal/ordinal (Categorical)	Interval/Ratio (scale)	ANOVA test
Which soft drink do people rate as sweeter: diet or regular coke (everyone tastes both)?	Nominal/ordinal (Categorical)	Interval/Ratio (scale)	Pair-samples *t*-test (could be Chi-square if participants pick 1)
How sweet do people rate 4 soft drinks? (everyone tastes 4 drinks)	Nominal/ordinal (Categorical)	Interval/Ratio (scale)	Repeated measures ANOVA test

Which Statistical Test to Use?

Sample question	Independent variable is…	The dependent variable is…	Use this test
Does the effect of tasers depend on alcohol and body weight? (i.e., alcohol/placebo and heavy/light)	Two categorical independent variables	Interval/Ratio (scale)	Factorial ANOVA
Do people who study longer get better grades?	Interval/Ratio (scale)	Interval/Ratio (scale)	Correlation coefficient
Do people who study longer get better grades, even when their SAT score is taken into account?	Interval/Ratio (scale)	Interval/Ratio (scale)	Multiple regression
Do people in different class years differ in what form of transportation they use? (i.e., soph/jun/senior and car/bus/bike)	Nominal/ordinal (Categorical)	Nominal/ordinal (Categorical)	Chi square test