Research Methods

Introduction to Statistics with JASP: Assumptions

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Assumptions

Parametric vs. non-parametric tests

There are parametric and non-parametric test alternatives for research designs. Both test the viability of the null hypothesis; however, they are used under different conditions and assumptions.

2

Assumptions

Parametric tests. Tests that are based on assumptions about population distributions and parameters.

Non-parametric tests. Tests that make no assumptions about population parameters or distributions.

3

Check the Assumptions

- The assumptions help to determine the most appropriate analysis method when deciding between parametric and nonparametric methods.
- If the assumptions are met, then we can use the parametric methods. If they are not met, then one of the nonparametric methods is appropriate.

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In General: Assumptions

- **Level of measurement**
  The scale of measurement for the variables for most techniques covered should be interval or ratio (continuous).
- **Random samples**
  Samples should be randomly drawn from the population.
- **Independence of observations**
  The observations that make up the data must be independent of each other. That is, each observation or measurement must not be influenced by any other observation or measurement. Violation of this assumption, according to Stevens (1996, p. 238), is very serious.
- **Normality**
  Scores on each variable should be normally distributed. This can be checked by inspecting the histograms of scores on each variable.
- **Linearity**
  The relationship between the two variables should be linear. This means that when you look at a scatterplot of scores you should see a straight line (roughly), not a curve.
- **Homogeneity of variance**
  The variance should be similar in each group. JASP will provide a measure of this in Levine's Test in producing the t-test or ANOVA output.

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Assumptions

Gender	Age	Method	PreTest	PostTest
Male	31	Method 1	15	15
Male	36	Method 1	16	16
Male	25	Method 1	21	16
Male	35	Method 1	17	17
Male	46	Method 1	18	18
Female	24	Method 2	18	18
Female	36	Method 2	17	18
Female	29	Method 2	16	19
Female	54	Method 2	18	19
Female	37	Method 2	15	19
Male	25	Method 2	17	20
Male	25	Method 2	21	20

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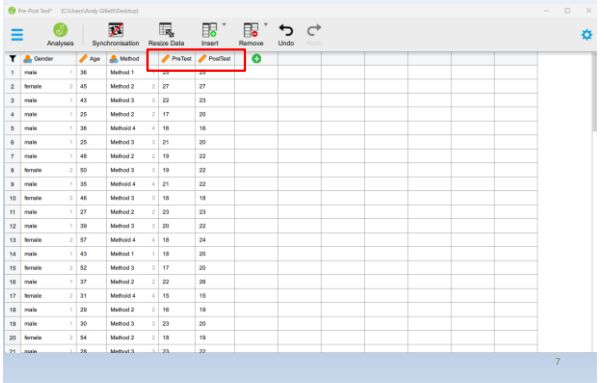
Checking Assumptions: Level Of Measurement



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Checking Assumptions: Level Of Measurement

	Gender	Age	Method	PreTest	PostTest
1	male 1	36	Method 1 1	25	25
2	female 2	45	Method 2 2	27	27
3	male 1	43	Method 3 3	22	23
4	male 1	25	Method 2 2	17	20

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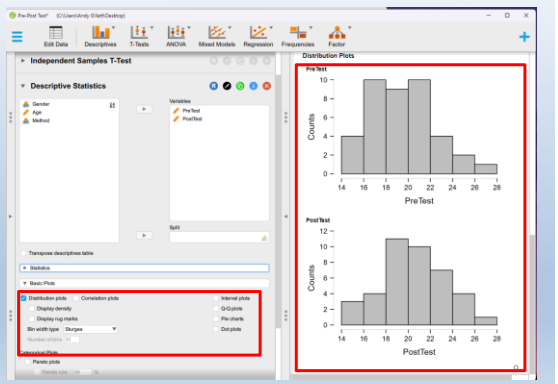
Checking Assumptions: Normality



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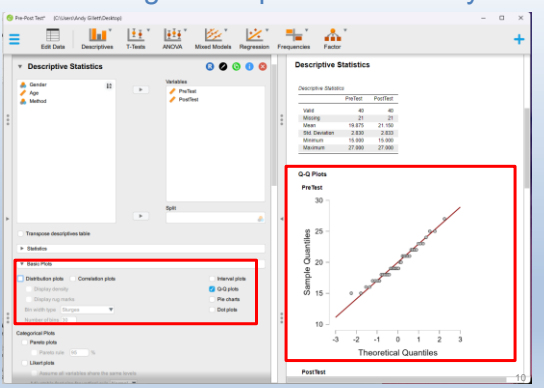
Checking Assumptions: Normality



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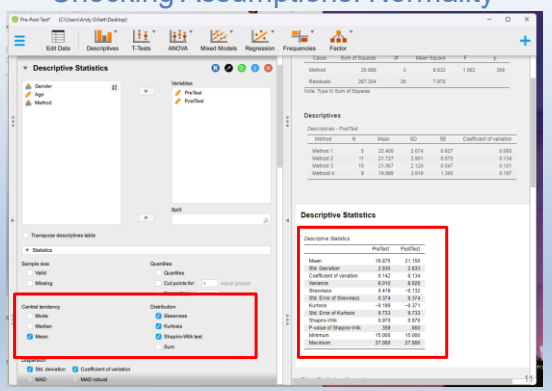
Checking Assumptions: Normality



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Checking Assumptions: Normality

Descriptive Statistics

	PreTest	PostTest
Mean	19.875	21.150
Std. Deviation	2.830	2.833
Coefficient of variation	0.142	0.134
Variance	8.010	8.028
Skewness	0.419	−0.132
Std. Error of Skewness	0.374	0.374
Kurtosis	−0.189	−0.371
Std. Error of Kurtosis	0.733	0.733
Shapiro-Wilk	0.970	0.979
P-value of Shapiro-Wilk	.359	.660
Minimum	15.000	15.000
Maximum	27.000	27.000

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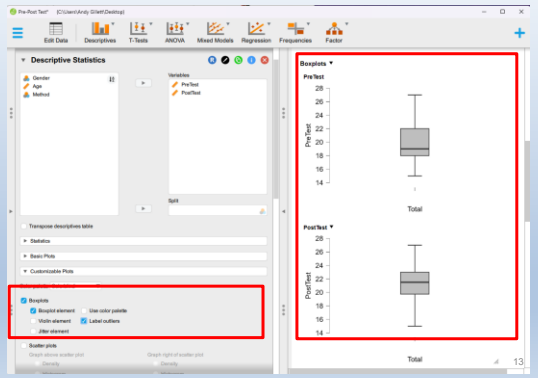
Checking Assumptions: Normality



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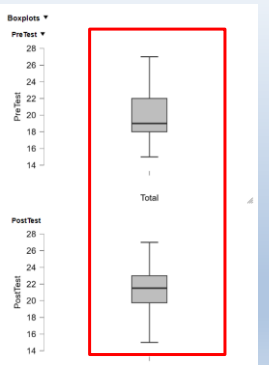
Checking Assumptions: Normality



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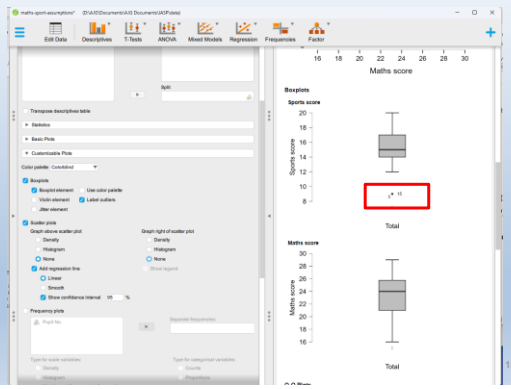

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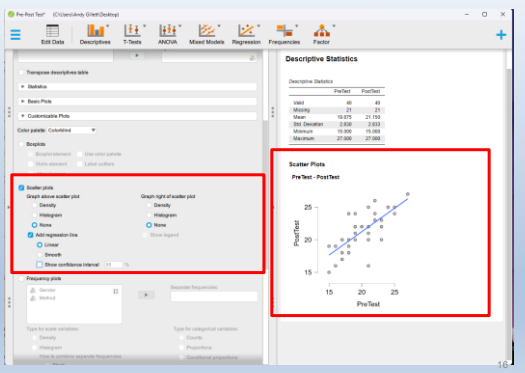
Checking Assumptions: Linearity



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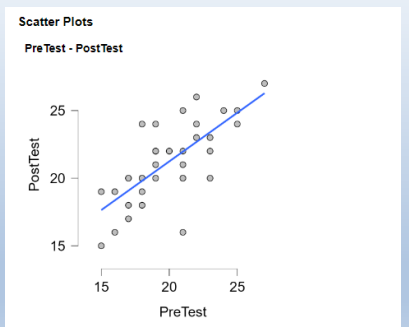
Checking Assumptions: Linearity



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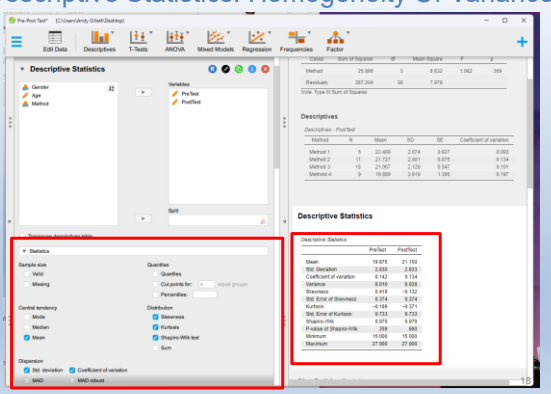
Descriptive Statistics: Homogeneity Of Variance



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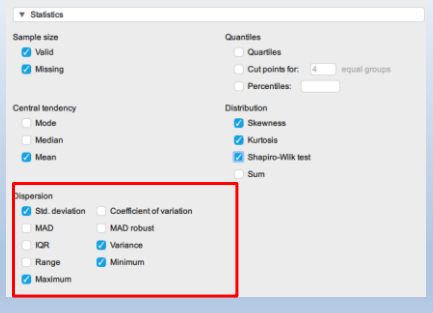
Descriptive Statistics: Homogeneity Of Variance



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Descriptive Statistics: Homogeneity Of Variance

Descriptive Statistics

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Checking Assumptions

Description

Inference

- ❑ Exploring Relationships
- ❑ Comparing Groups

"When an individual uses descriptive statistics, he talks about the data he has; but with inferential statistics, he talks about data he does not have."

(Popham & Sirotnik, 1973: 40)

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T-Test: Assumptions

The independent samples t-test has three main assumptions:

1) The observations within each sample must be independent.
2) The data has a generally normal distribution and
3) The data does not exhibit significant variation.

Student's t-Test is used to analyse parametric data. The assumption checks section of the settings allows us to verify these assumptions.

The Welch and Mann-Whitney t-Tests do not require these assumptions to be met.

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T-Test: Assumptions

Test of Normality (Shapiro-Wilk)

A p-value less than 0.05 indicates that the data varies significantly from normality and/or equal variance. Thus we would use the appropriate nonparametric test

If the p-values are greater than 0.05 then we can assume that the assumptions have been met and our data meets the requirements of normality and equal variance, allowing us to use Student's t-Test.

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T-Test: Assumptions

Test of Equality of Variances (Levene's)

If Levene's Test of Equality of Variances has a p-value greater than 0.05, it indicates that indicating that our data has equal variance and it is appropriate to use the Student's t-test for our analysis.

A p-value less than 0.05 indicates that the data varies significantly from normality and/or equal variance. Thus we would use the appropriate nonparametric test

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T-Test: Assumptions

Gender	Age	Method	PreTest	PostTest
Male	31	Method 1	15	15
Male	36	Method 1	16	16
Male	25	Method 1	21	16
Male	35	Method 1	17	17
Male	46	Method 1	18	18
Female	24	Method 2	18	18
Female	36	Method 2	17	18
Female	29	Method 2	16	19
Female	54	Method 2	18	19
Female	37	Method 2	15	19
Male	25	Method 2	17	20
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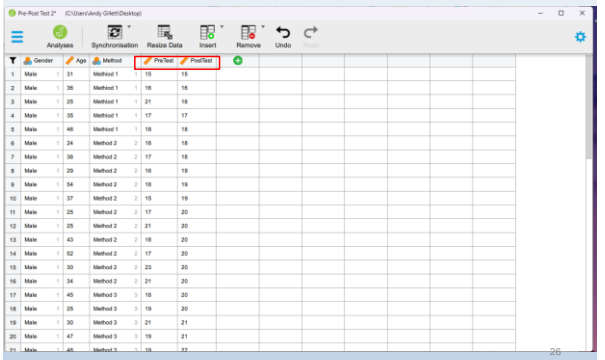
T-Test: Assumptions



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T-Test: Assumptions

	Gender	Age	Method	PreTest	PostTest
1	male 1	36	Method 1 1	25	25
2	female 2	45	Method 2 2	27	27
3	male 1	43	Method 3 3	22	23
4	male 1	25	Method 2 2	17	20

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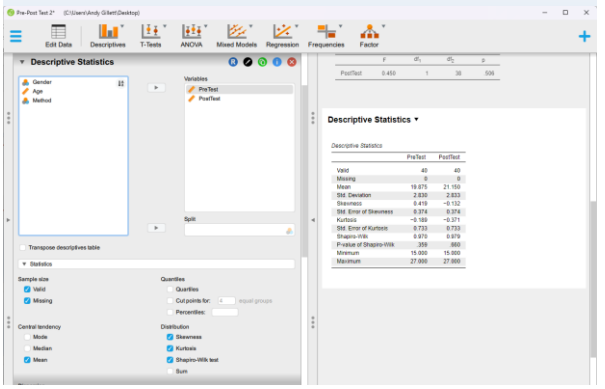
T-Test: Assumptions



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T-Test: Assumptions

Descriptive Statistics

	PreTest	PostTest
Valid	40	40
Missing	0	0
Mean	19.875	21.150
Std. Deviation	2.830	2.833
Skewness	0.419	−0.132
Std. Error of Skewness	0.374	0.374
Kurtosis	−0.189	−0.371
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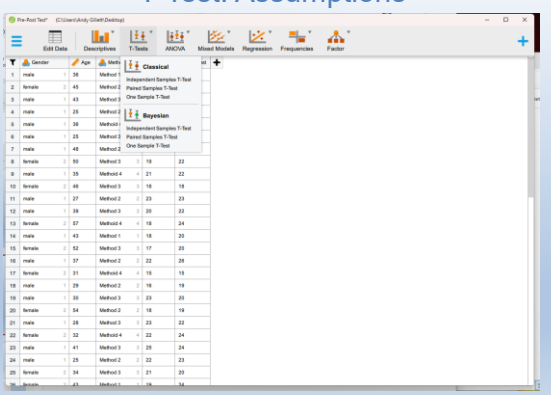
T-Test: Assumptions



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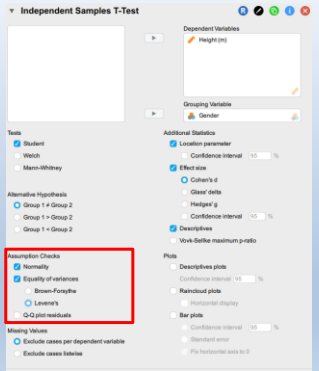
T-Test: Assumptions



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T-Test: Assumptions

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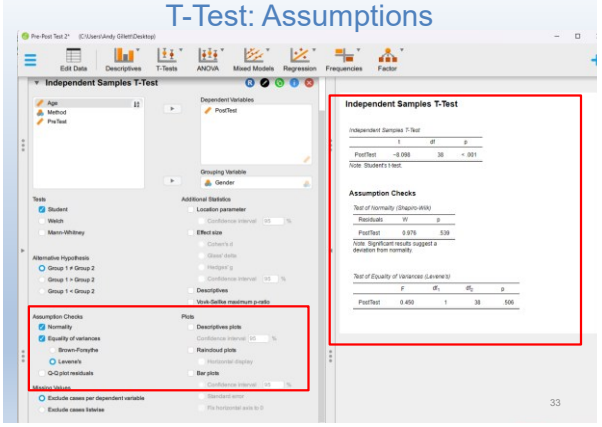
T-Test: Assumptions



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T-Test: Assumptions

Independent Samples T-Test

	t	df	p
PostTest	−8.098	38	< .001

Note. Student's t-test.

Assumption Checks ▼

Test of Normality (Shapiro-Wilk)

Residuals	W	p
PostTest	0.976	.539

Note. Significant results suggest a deviation from normality.

Test of Equality of Variances (Levene's)

	F	df_1	df_2	p
PostTest	0.450	1	38	.506

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T-Test: Assumptions

Test of Normality (Shapiro-Wilk)

Residuals	W	p
Height (m)	0.978	.949

Note. Significant results suggest a deviation from normality.

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T-Test: Assumptions

Test of Equality of Variances (Levene's) ▼

	F	df_1	df_2	p
PostTest	0.450	1	38	.506

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Comparing Groups (3 groups or more)

Gender	Age	Method	PreTest	PostTest
Male	31	Method 1	15	15
Male	36	Method 1	16	16
Male	25	Method 1	21	16
Male	35	Method 1	17	17
Male	46	Method 1	18	18
Female	24	Method 2	18	18
Female	36	Method 2	17	18
Female	29	Method 2	16	19
Female	54	Method 2	18	19
Female	37	Method 2	15	19
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Comparing Groups: Assumptions

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Male	35	Method 1	17	17
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Female	24	Method 2	18	18
Female	36	Method 2	17	18
Female	29	Method 2	16	19
Female	54	Method 2	18	19
Female	37	Method 2	15	19
Male	25	Method 2	17	20
Male	25	Method 2	21	20

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Comparing Groups: Assumptions

The independent-measures ANOVA requires the same assumptions that were necessary for the independent-measures t-test:

1. The observations within each sample must be independent.
2. The populations from which the samples are selected must be normal.
3. The populations from which the samples are selected must have equal variances (homogeneity of variance).

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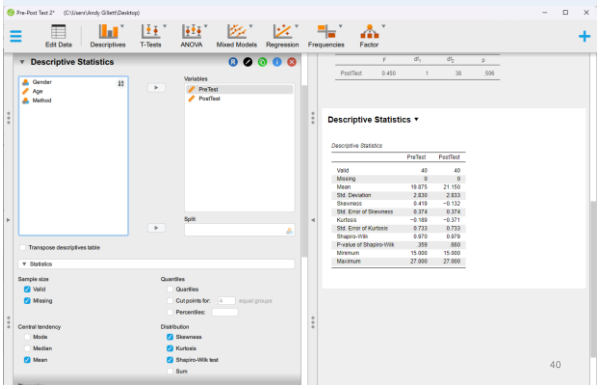
Assumption Checks: ANOVA



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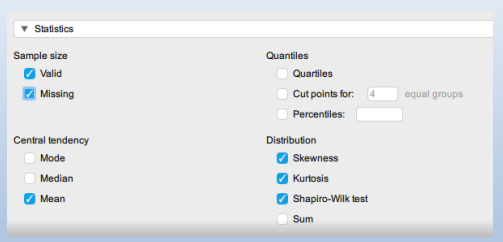
Assumption Checks: ANOVA



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ANOVA: Assumptions

Descriptive Statistics

	PreTest	PostTest
Valid	40	40
Missing	0	0
Mean	19.875	21.150
Std. Deviation	2.830	2.833
Skewness	0.419	−0.132
Std. Error of Skewness	0.374	0.374
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Shapiro-Wilk	0.970	0.979
P-value of Shapiro-Wilk	.359	.660
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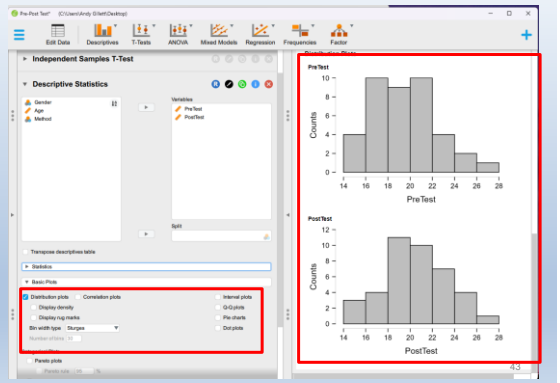
Checking Assumptions: Normality



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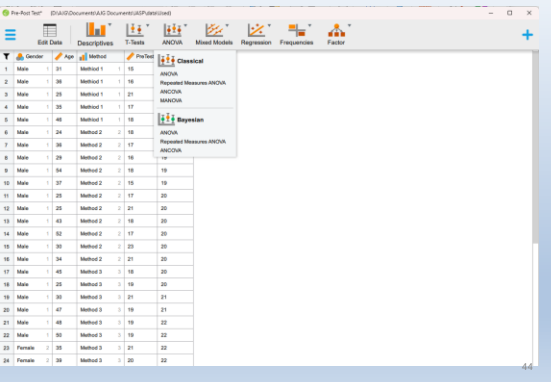
Checking Assumptions: Normality



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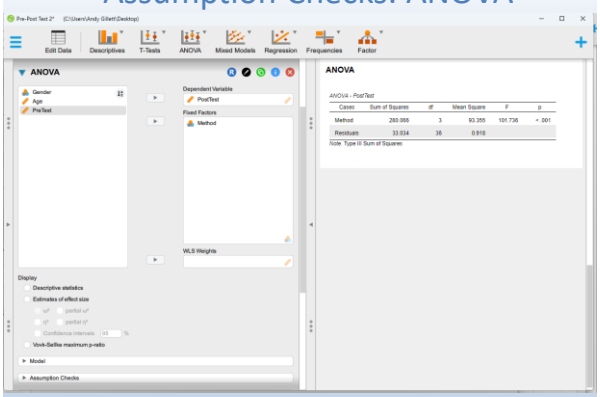
Assumption Checks: ANOVA



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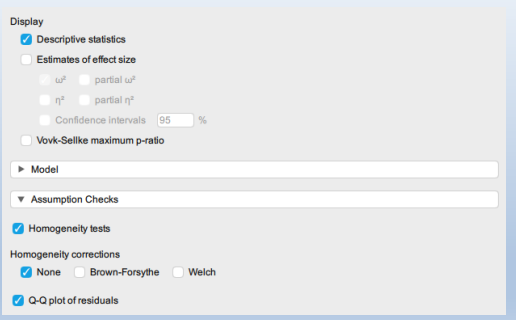
Assumption Checks: ANOVA



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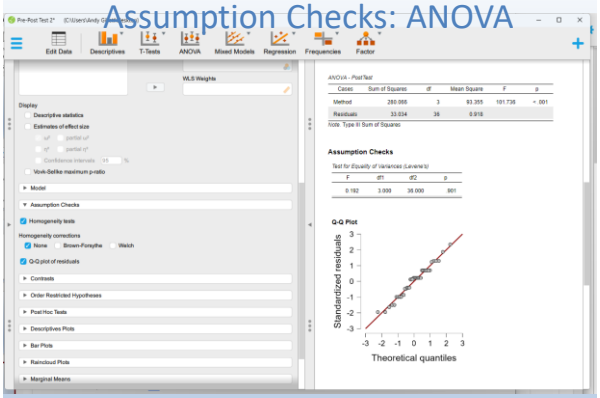
Assumption Checks: ANOVA



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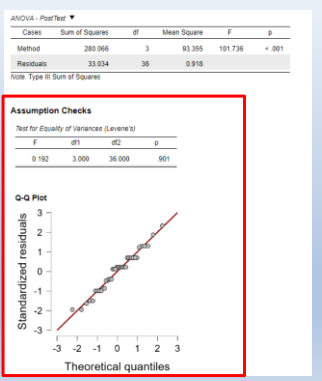
Assumption Checks: ANOVA



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Correlation

Gender	Age	Method	PreTest	PostTest
Male	31	Method 1	15	15
Male	36	Method 1	16	16
Male	25	Method 1	21	16
Male	35	Method 1	17	17
Male	46	Method 1	18	18
Female	24	Method 2	18	18
Female	36	Method 2	17	18
Female	29	Method 2	16	19
Female	54	Method 2	18	19
Female	37	Method 2	15	19
Male	25	Method 2	17	20
Male	25	Method 2	21	20

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Correlation: Assumptions

Pearson's r assumes that the data generally has a normal distribution. Spearman's rho does not require this assumption to be met.

The Shapiro-Wilk Test of normality will help determine the appropriate correlation coefficient to use.

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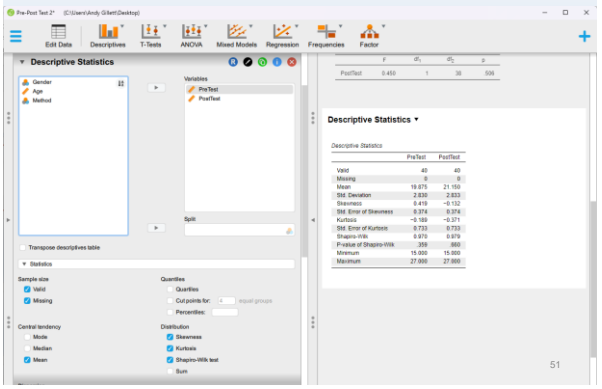
Assumption Checks: Correlation



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Assumption Checks: Correlation

Descriptive Statistics

	PreTest	PostTest
Valid	40	40
Missing	0	0
Mean	19.875	21.150
Std. Deviation	2.830	2.833
Skewness	0.419	−0.132
Std. Error of Skewness	0.374	0.374
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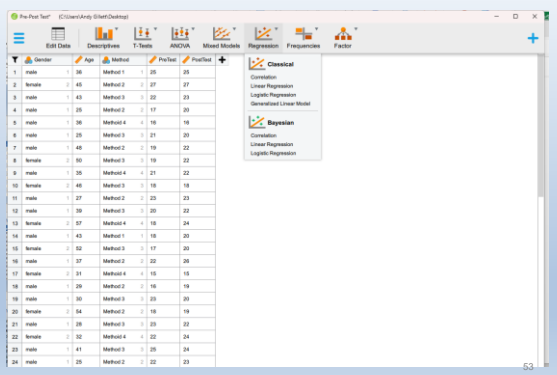

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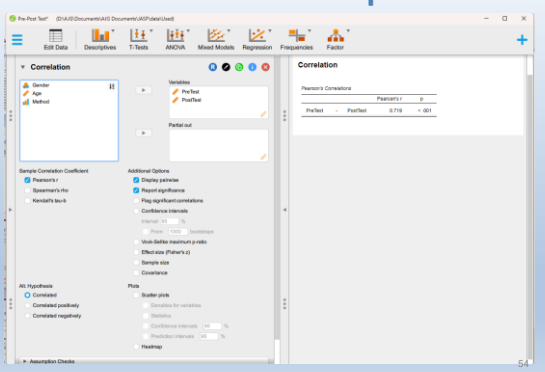

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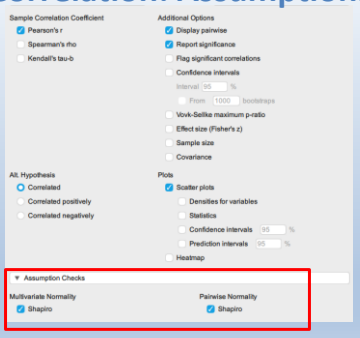
Correlation: Assumptions



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Correlation: Assumptions

Pearson's Correlations

			Pearson's r	p
PreTest	-	PostTest	0.719	< .001

Assumption checks

Shapiro-Wilk Test for Multivariate Normality

Shapiro-Wilk	p
0.970	.369

Shapiro-Wilk Test for Bivariate Normality

			Shapiro-Wilk	p
PreTest	-	PostTest	0.970	.369

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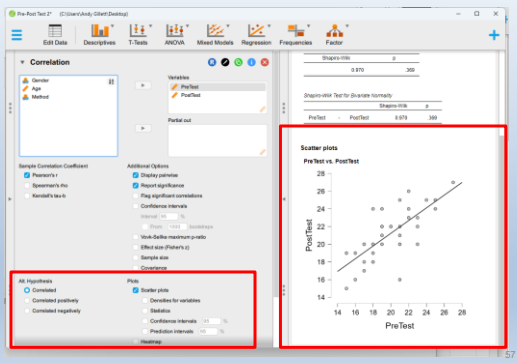
Correlation: Assumptions



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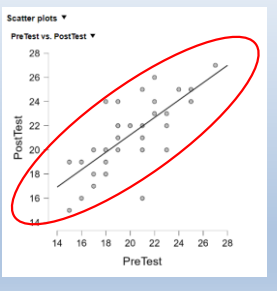

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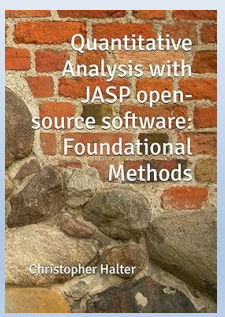
Reading



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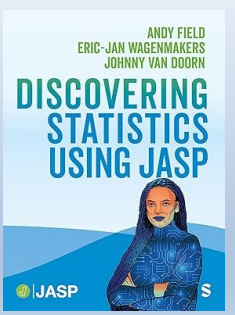

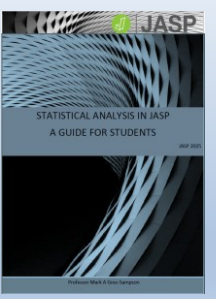

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References & Further Reading

Brown, J. D. & Rogers, T. S. (2002). *Doing second language research*. Oxford: Oxford University Press.

Cohen, J. (1988). *Statistical power analysis for the behavioral sciences.* New York: Routledge

Dörnyei, Z. (2007). *Research methods in applied linguistics.* Oxford: Oxford University Press.

De Winter, J. C. F. & Dodou, D. (2012). Five point Likert items: t-test versus Mann-Whitney-Wilcoxon. *Practical Assessment, Research and Evaluation, 15*(11).

Field, A., van Doorn, J. & Wagenmakers, E.-J. (2025*). Discovering statistics using JASP*. London: Sage.

Hand, D. J. (2008) *Statistics: A very short introduction*. Oxford: Oxford University Press.

Halter, C. P. (2024). *Quantitative Analysis with JASP open-source software: Foundational Methods*. Author

Hatch, E. & Lazaraton, A. (1991). *The research manual: Design and statistics for applied linguistics*. Boston, MA: Heinle & Heinle.

Lowie, W. & Seton, B. (2013). *Essential statistics for applied linguistics*. London: Palgrave Macmillan.

Navarro, D.J., Foxcroft, D.R., & Faulkenberry, T.J. (2025*). Learning Statistics with JASP: A Tutorial for Psychology Students and Other Beginners.* (Version 2.0). https://learnstatswithjasp.com

Popham, W. J. , & Sirotnik, K. A. (1973). *Educational statistics: Use and interpretation* (2nd ed.). New York: Harper & Row

Salkind, N. J. (2011). *Statistics for people who (think they) hate statistics* (4th ed.). London: Sage.

Saunders, M. & Lewis, P. (2012). *Doing research in business and management*. London: FT/Prentice Hall.

Saunders, M., Lewis, P. & Thornhill, A. (2016). *Research methods for business students* (7th ed.). London: FT/Prentice Hall.

Shavelson, R. (1988). *Statistical reasoning for the behavioral sciences*. Boston: Allyn and Bacon.

Speigelhalter, D. (2020). *The art of statistics: Learning from data*. London: Pelican.

Statistical Services and Consultancy Unit (2016). *Statistics with SPSS* (Statistics Version 23). Hatfield: University of Hertfordshire.

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