Research Methods

Introduction to Statistics with SPSS: Assumptions

Andy Gillett

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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.

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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.

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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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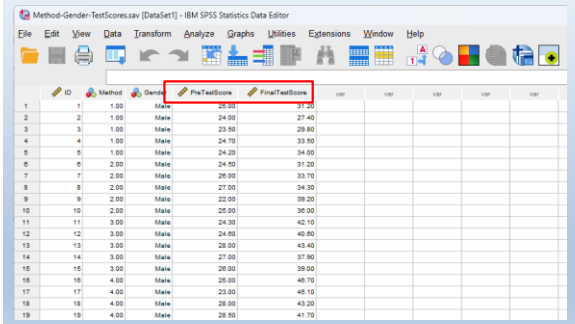
Checking Assumptions: Level Of Measurement



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Checking Assumptions: Level Of Measurement

	ID	Method	Gender	PreTestScore	FinalTestScore
1	1	1.00	Male	25.00	31.20
2	2	1.00	Male	24.00	27.40
3	3	1.00	Male	23.50	29.80
4	4	1.00	Male	24.70	33.50
5	5	1.00	Male	24.20	34.00

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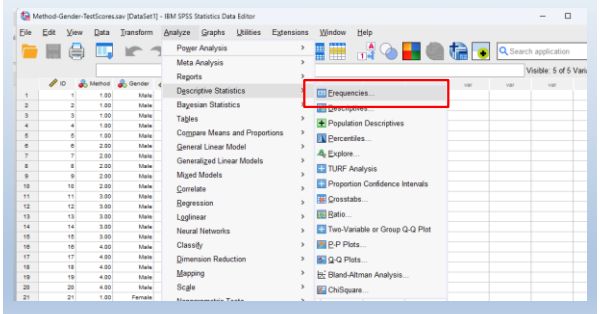
Checking Assumptions: Level Of Measurement



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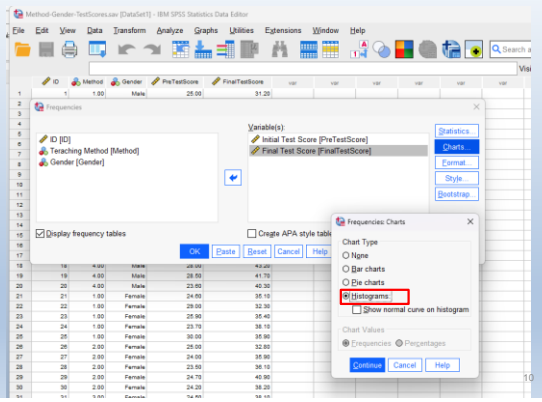
Checking Assumptions: Level Of Measurement



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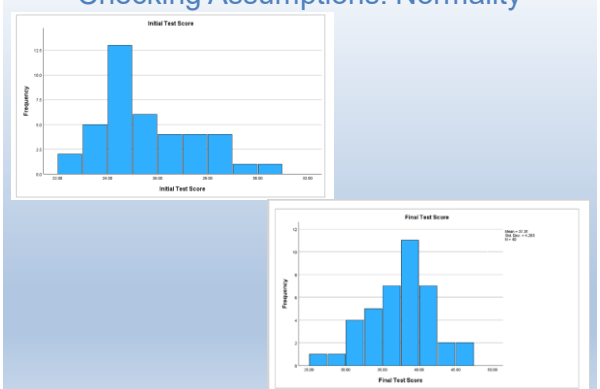
Checking Assumptions: Normality



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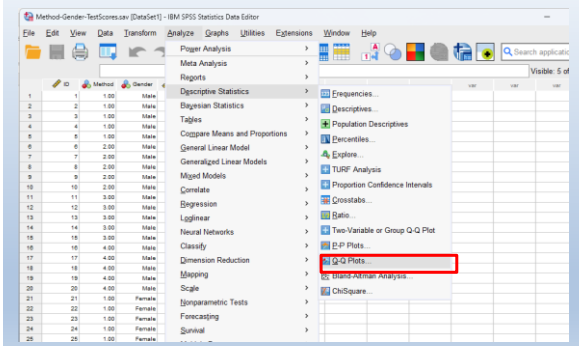

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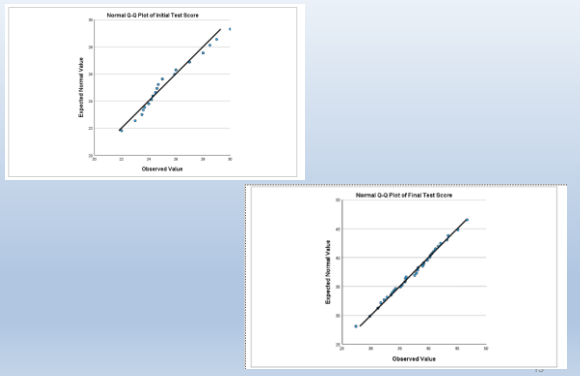

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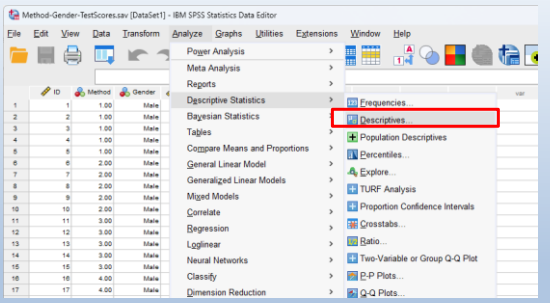

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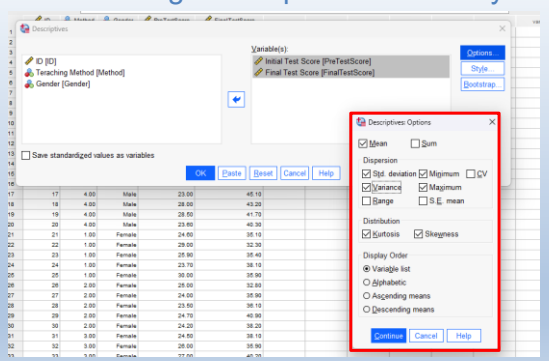

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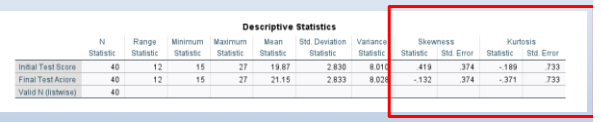

Descriptive Statistics

	N	Range	Minimum	Maximum	Mean	Std. Deviation	Variance	Skewness		Kurtosis	
	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Statistic	Std. Error	Statistic	Std. Error
Initial Test Score	40	12	15	27	19.87	2.830	8.010	.419	.374	-.189	.733
Final Test Aciore	40	12	15	27	21.15	2.833	8.028	-.132	.374	-.371	.733
Valid N (listwise)	40										

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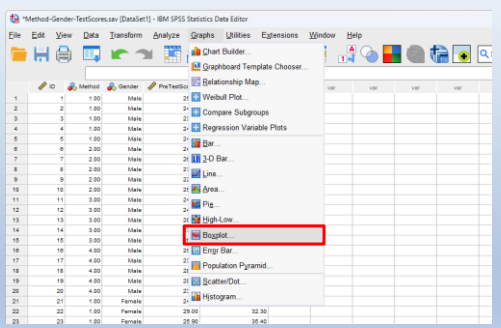
Checking Assumptions: Normality



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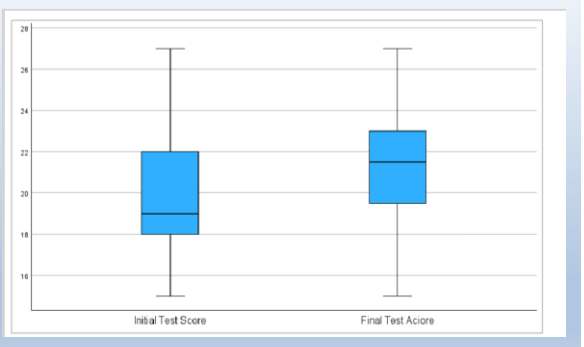

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Checking Assumptions: Normality

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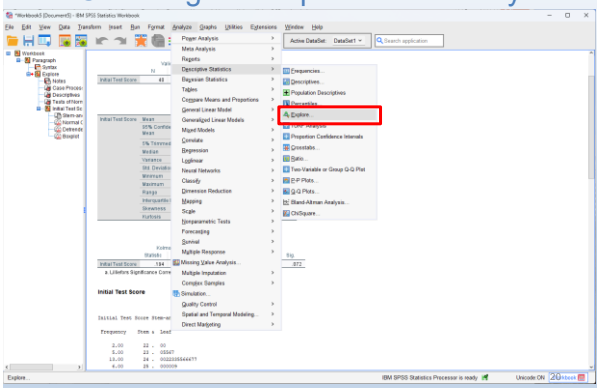
Checking Assumptions: Normality



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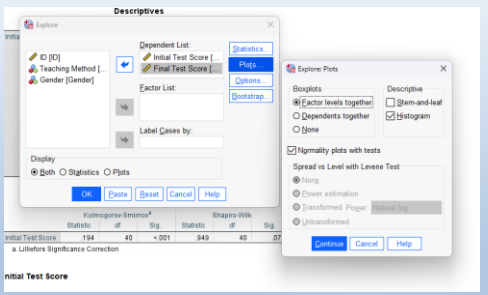

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Checking Assumptions: Normality

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Initial Test Score	.146	40	.031	.970	40	.359
Final Test Aciore	.118	40	.171	.979	40	.660

a. Lilliefors Significance Correction

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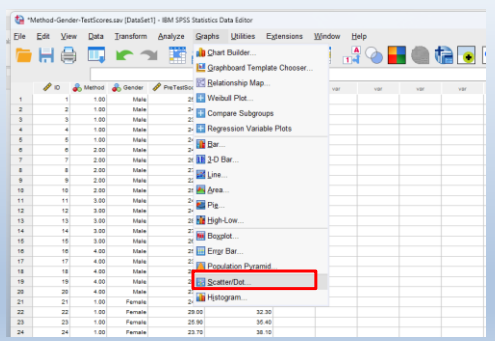
Checking Assumptions: Linearity



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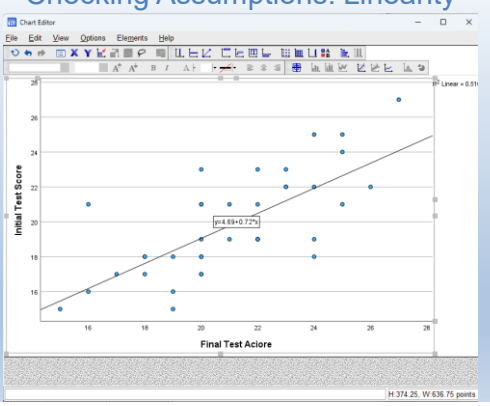
Checking Assumptions: Linearity



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Descriptive Statistics: Homogeneity Of Variance

Tests of Homogeneity of Variances

		Levene Statistic	df1	df2	Sig.
Initial Test Score	Based on Mean	.387	1	38	.538
	Based on Median	.433	1	38	.514
	Based on Median and with adjusted df	.433	1	37.723	.514
	Based on trimmed mean	.447	1	38	.508
Final Test Aciore	Based on Mean	.450	1	38	.506
	Based on Median	.111	1	38	.741
	Based on Median and with adjusted df	.111	1	29.978	.741
	Based on trimmed mean	.417	1	38	.522

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Descriptive Statistics: Homogeneity Of Variance

Descriptive Statistics

	N Statistic	Range Statistic	Minimum Statistic	Maximum Statistic	Mean Statistic	Std. Deviation Statistic	Variance Statistic	Skewness Statistic	Skewness Std. Error	Kurtosis Statistic	Kurtosis Std. Error
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Valid N (listwise)	40										

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Descriptive Statistics: Homogeneity Of Variance

Descriptive Statistics

	N	Range	Minimum	Maximum	Mean	Std. Deviation	Variance
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Final Test Aciore	40	12	15	27	21.15	2.833	8.028
Valid N (listwise)	40						

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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
Male	25	Method 2	21	20

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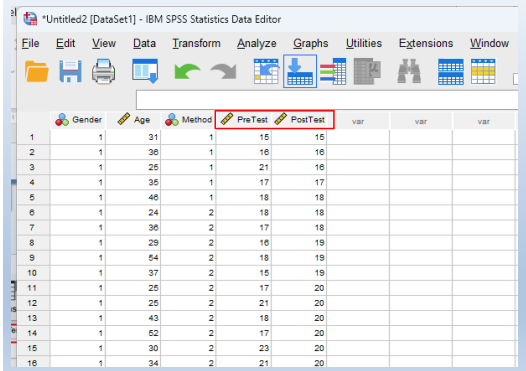
T-Test: Assumptions



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T-Test: Assumptions

Gender	Age	Method	PreTest	PostTest
1	31	1	15	15
1	36	1	16	16
1	25	1	21	16

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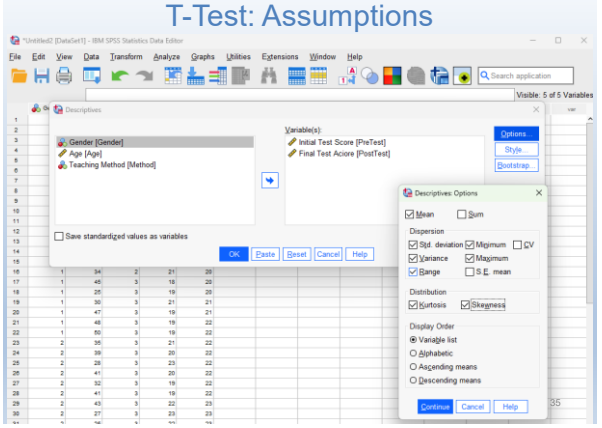
T-Test: Assumptions



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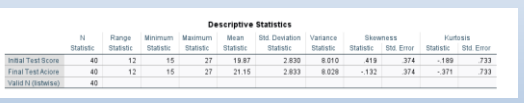
T-Test: Assumptions



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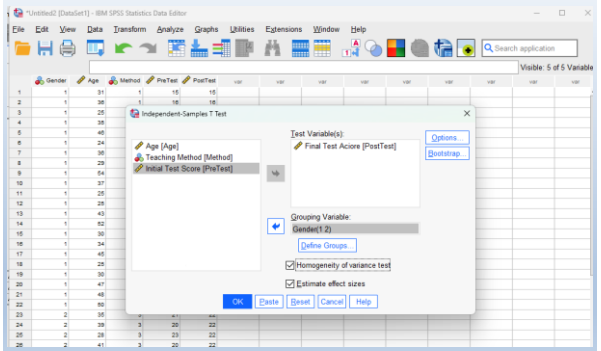
T-Test: Assumptions



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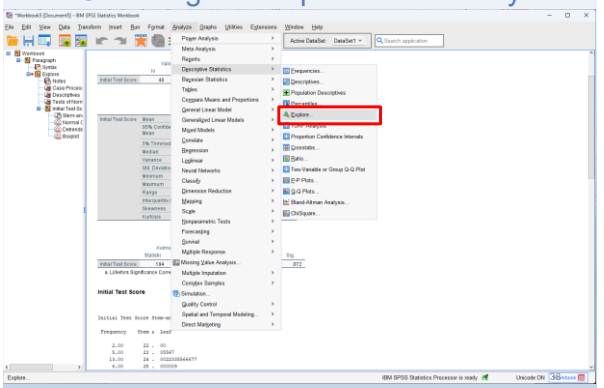
Checking Assumptions: Normality



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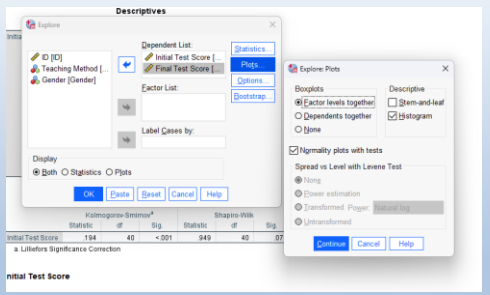
Checking Assumptions: Normality



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Checking Assumptions: Normality

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Initial Test Score	.146	40	.031	.970	40	.359
Final Test Aciore	.118	40	.171	.979	40	.660

a. Lilliefors Significance Correction

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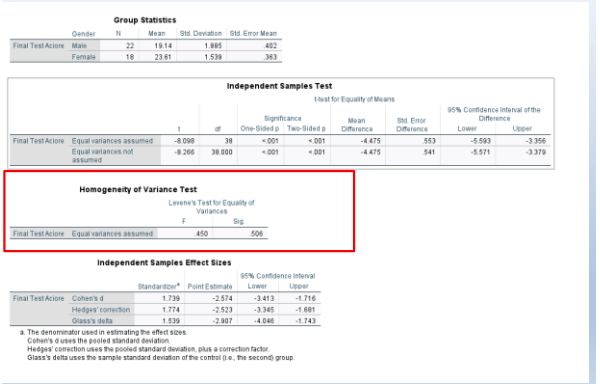
T-Test: Assumptions



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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
Male	25	Method 2	17	20
Male	25	Method 2	21	20

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Comparing Groups: Assumptions

Gender	Age	Method	PreTest	PostTest
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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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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

Descriptive Statistics

	N Statistic	Range Statistic	Minimum Statistic	Maximum Statistic	Mean Statistic	Std. Deviation Statistic	Variance Statistic	Skewness Statistic	Skewness Std. Error	Kurtosis Statistic	Kurtosis Std. Error
Initial Test Score	40	12	15	27	19.87	2.830	8.010	.419	.374	-.189	.733
Final Test Aciore	40	12	15	27	21.15	2.833	8.028	-.132	.374	-.371	.733
Valid N (listwise)	40										

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ANOVA: Assumptions

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Initial Test Score	.146	40	.031	.970	40	.359
Final Test Aciore	.118	40	.171	.979	40	.660

a. Lilliefors Significance Correction

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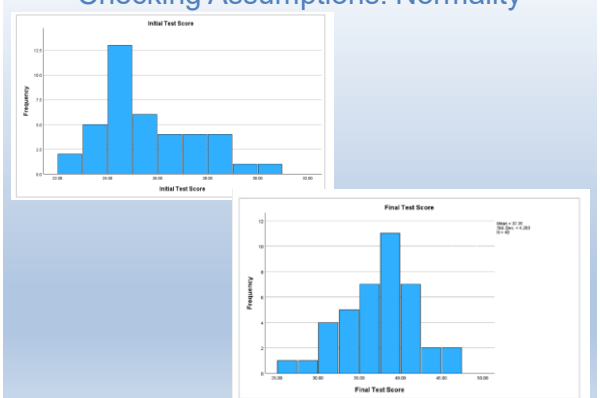
Checking Assumptions: Normality



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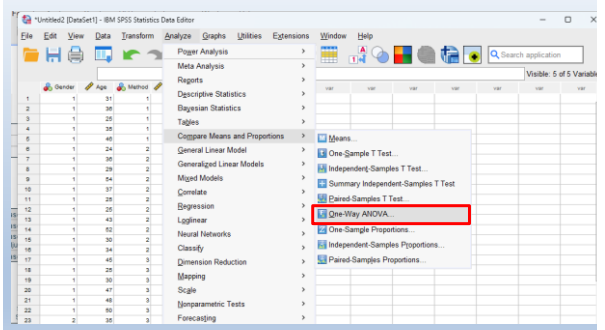
Checking Assumptions: Normality



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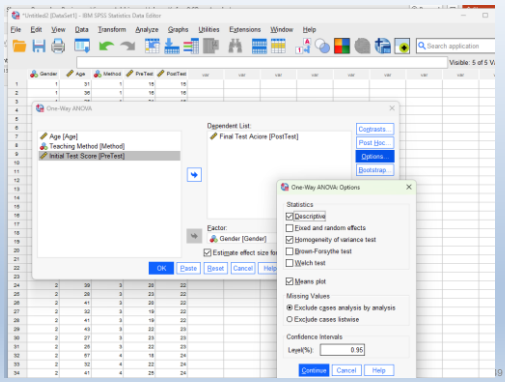
Checking Assumptions: Normality



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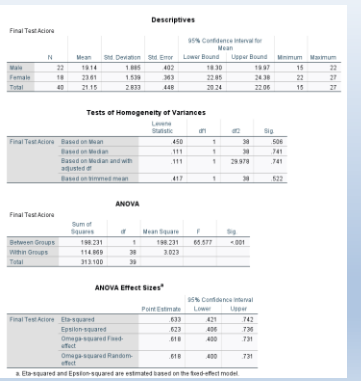
Assumption Checks: ANOVA



Descriptives

Final Test Aciore

	N	Mean	Std. Deviation	Std. Error	95% Confidence Interval for Mean Lower Bound	95% Confidence Interval for Mean Upper Bound	Minimum	Maximum
Male	22	19.14	1.885	.402	18.30	19.97	15	22
Female	18	23.61	1.539	.363	22.85	24.38	22	27
Total	40	21.15	2.833	.448	20.24	22.06	15	27

Tests of Homogeneity of Variances

		Levene Statistic	df1	df2	Sig.
Final Test Aciore	Based on Mean	.450	1	38	.506
	Based on Median	.111	1	38	.741
	Based on Median and with adjusted df	.111	1	29.978	.741
	Based on trimmed mean	.417	1	38	.522

ANOVA

Final Test Aciore

	Sum of Squares	df	Mean Square	F	Sig.
Between Groups	198.231	1	198.231	65.577	< .001
Within Groups	114.869	38	3.023		
Total	313.100	39			

ANOVA Effect Sizes[a]

		Point Estimate	95% Confidence Interval Lower	95% Confidence Interval Upper
Final Test Aciore	Eta-squared	.633	.421	.742
	Epsilon-squared	.623	.406	.736
	Omega-squared Fixed-effect	.618	.400	.731
	Omega-squared Random-effect	.618	.400	.731

a. Eta-squared and Epsilon-squared are estimated based on the fixed-effect model.

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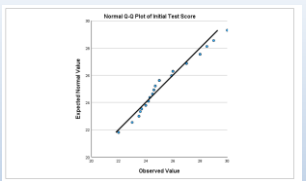
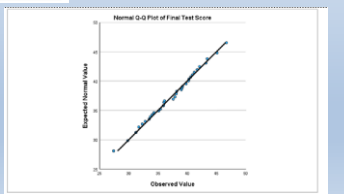
Checking Assumptions: Normality





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Correlation

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Male	46	Method 1	18	18
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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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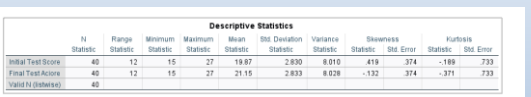
Assumption Checks: Correlation



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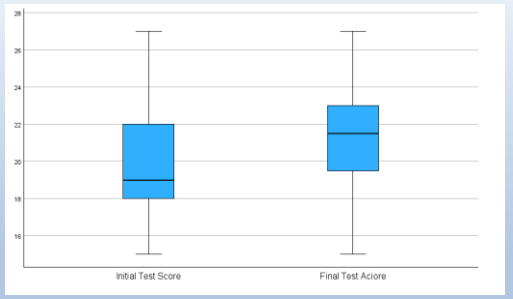

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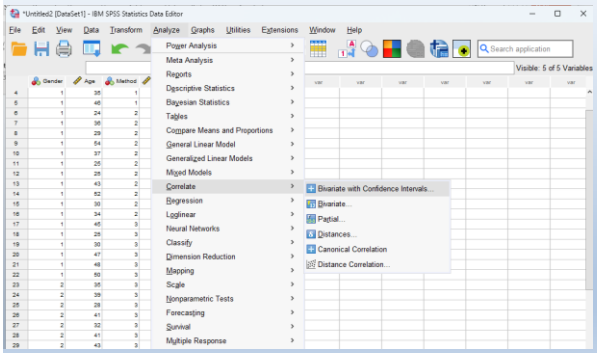
Assumption Checks: Correlation



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Checking Assumptions: Normality

Tests of Normality

	Kolmogorov-Smirnov[a]			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Initial Test Score	.146	40	.031	.970	40	.359
Final Test Aciore	.118	40	.171	.979	40	.660

a. Lilliefors Significance Correction

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Correlation: Assumptions

Correlations

				Statistic	
Variable	Variable2	Correlation	Count	Lower C.I.	Upper C.I.	Notes
Final Test Aciore	Initial Test Score	.719	40	.525	.842	
	Final Test Aciore	1.000	40	--	--	
Initial Test Score	Initial Test Score	1.000	40	--	--	
	Final Test Aciore	.719	40	.525	.842	

Missing value handling: PAIRWISE, EXCLUDE. C.I. Level: 95.0

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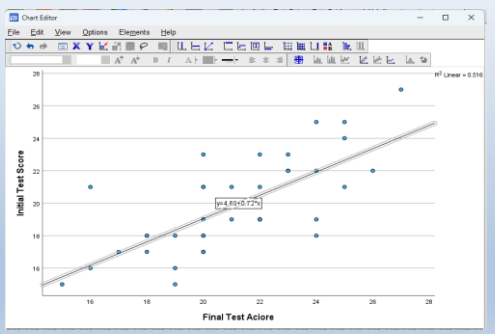
Correlation: Assumptions



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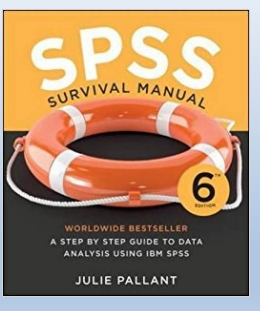
Reading



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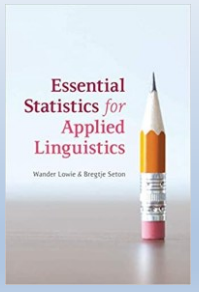
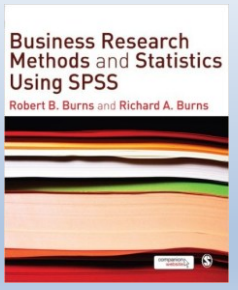
Reading





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