Statistical Treatments

Engineering Data Analysis

Polytechnic University of the Philippines

Levels of Measurement

According to Bobbitt (2020), we use data to answer interesting questions. But not all data is created equal. There are actually four different levels of measurement:

Nominal	Ordinal	Interval	Ratio
"Eye color"	"Level of satisfaction"	"Temperature"	"Height"
Named	Named	Named	Named
	Natural order	Natural order	Natural order
		Equal interval between variables	Equal interval between variables
			Has a "true zero" value, thus ratio between values can be calculated

Nominal Level

Definition. Nominal level is scale used to label variables that have no quantitative values.

- They have no natural order.
- Categories are mutually exclusive.
- The only number we can calculate for these variables are counts.
- The only measure of central tendency we can calculate is the mode.

Example

- **Gender:** Male, female
- **Pen color:** Blue, green, brown
- **Blood type:** O^-, O+, A^-, A+, B^-, B+, AB^-, AB+
- **Political Preference:** Republican, Democrat, Independent

Ordinal Level

Definition. Ordinal level is a scale used to label variables that have a natural order, but no quantifiable difference between values.

- They have a natural order.
- The difference between values can't be evaluated.
- The two measures of central tendency we can calculate for these variables are the mode and the median.

Example

- **Satisfaction:** Very unsatisfied, unsatisfied, satisfied, very satisfied
- **Socioeconomic status:** Low income, medium income, high income
- **Workplace status:** Entry Analyst, Analyst I, Analyst II, Lead Analyst
- **Educational Degree:** Bachelors, Masters, Doctorate

Interval Level

Definition. Interval level is a scale used to label variables that have a natural order and a quantifiable difference between values, but no "true zero" value.

- These variables have a natural order.
- We can measure the mean, median, mode, and standard deviation of these variables.
- These variables have an exact difference between values.
- These variables have no "true zero" value.

Example

- **Temperature:** Celcius and Farenheit
- **Time clock: 00:00, 14:00, 3:00.**

Ratio Level

Definition. Ratio level is used to label variables that have a natural order, a quantifiable difference between values, and a "true zero" value.

- These variables have a natural order.
- We can calculate the mean, median, mode, standard deviation, and a variety of other descriptive statistics for these variables.
- These variables have an exact difference between values.
- These variables have a "true zero" value.

Example

- Height, length, weight, speed, area, etc.

Ordinal Level

Definition.

Nominal level is scale used to label variables that have no quantitative values.

Example

- **Gender:** Male, female
- **Eye color:** Blue, green, brown
- **Hair color:** Blonde, black, brown, grey, other
- **Blood type:** O^-, O+, A^-, A+, B^-, B+, AB^-, AB+
- **Political Preference:** Republican, Democrat, Independent
- **Place you live:** City, suburbs, rural

Statistical Treatments

Definition.

Statistical treatments or tests are used in hypothesis testing such as determining whether a predictor variable has a statistically significant relationship with an outcome variable and estimate the difference between two or more groups (Bevans, 2020).

Definition.

The $p-$ value or probability value is a number, calculated from a statistical test, a very small $p-$value means that such an extreme observed outcome would be very unlikely under the null hypothesis.

Interpretation of p –values

Note.

- If the $p-$ value is less than your level of significance, then reject the null hypothesis. Meaning, there is a significant relationship, effect, or difference between your dependent and independent variables.
- If the $p-$ value is greater than or equal to your level of significance, then fail to reject the null hypothesis. Meaning, there is no significant relationship, effect, or difference between your dependent and independent variables.

Tests of Normality

Definition. A test of normality is a statistical test used to determine whether a data set is well-modeled by a normal distribution (Ram, 2024)

We have several tests of normality such as

- Shapiro-Wilk test
- Kolmogorov-Smirnov test
- Anderson-Darling test
- D'Agostino-Pearson test

Tests of Normality

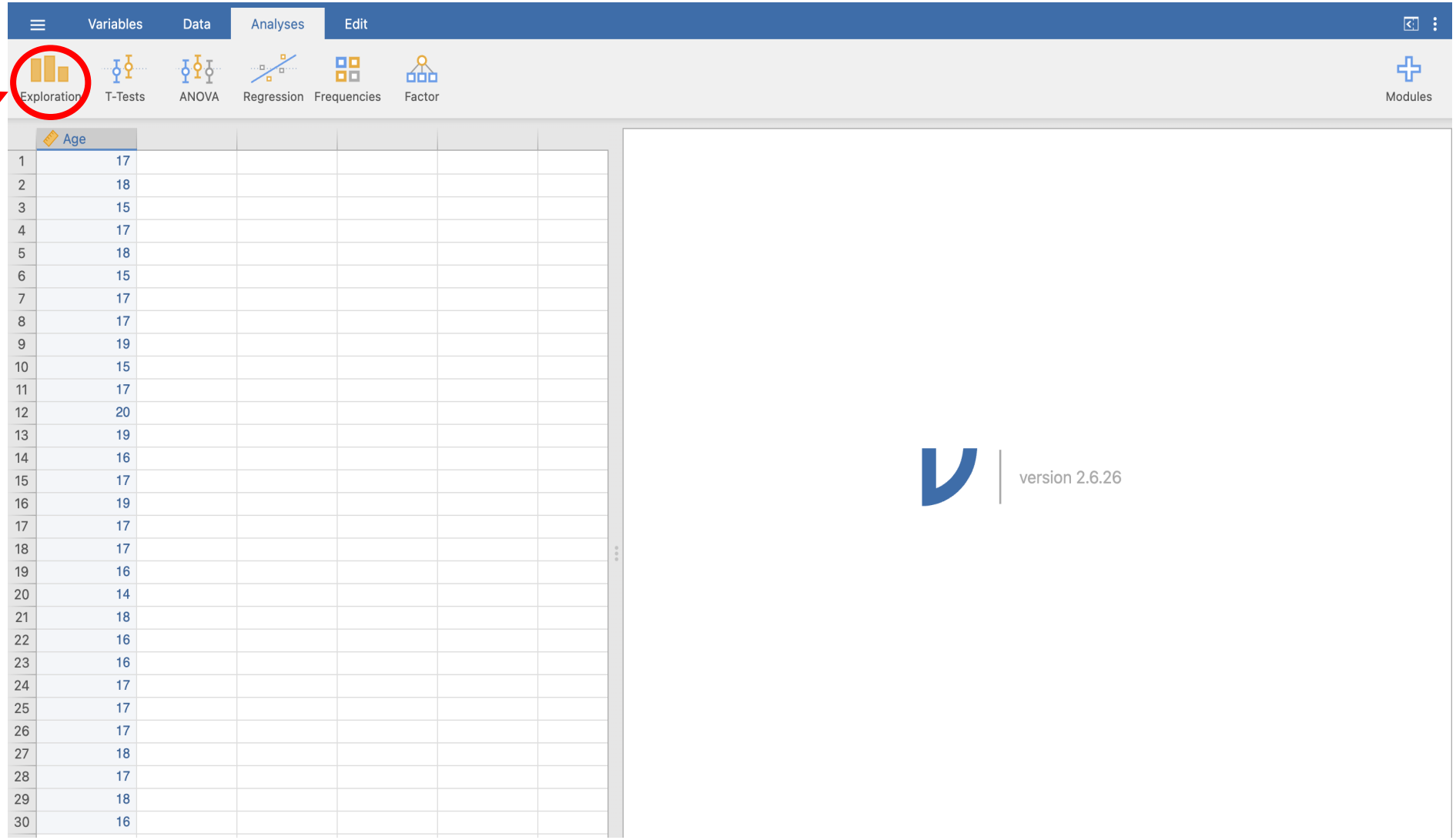
Definition. A test of normality is a statistical test used to determine whether a data set is well-modeled by a normal distribution (Ram, 2024)

If the p −value of the Shapiro-Wilk test is greater than or equal to the level of significance (typically 0.05), the data is normal. Otherwise, it is not normal.

Shapiro-Wilk $p-$ value	Interpretation
$p \geq 0.05$	Normal
$p < 0.05$	Not Normal

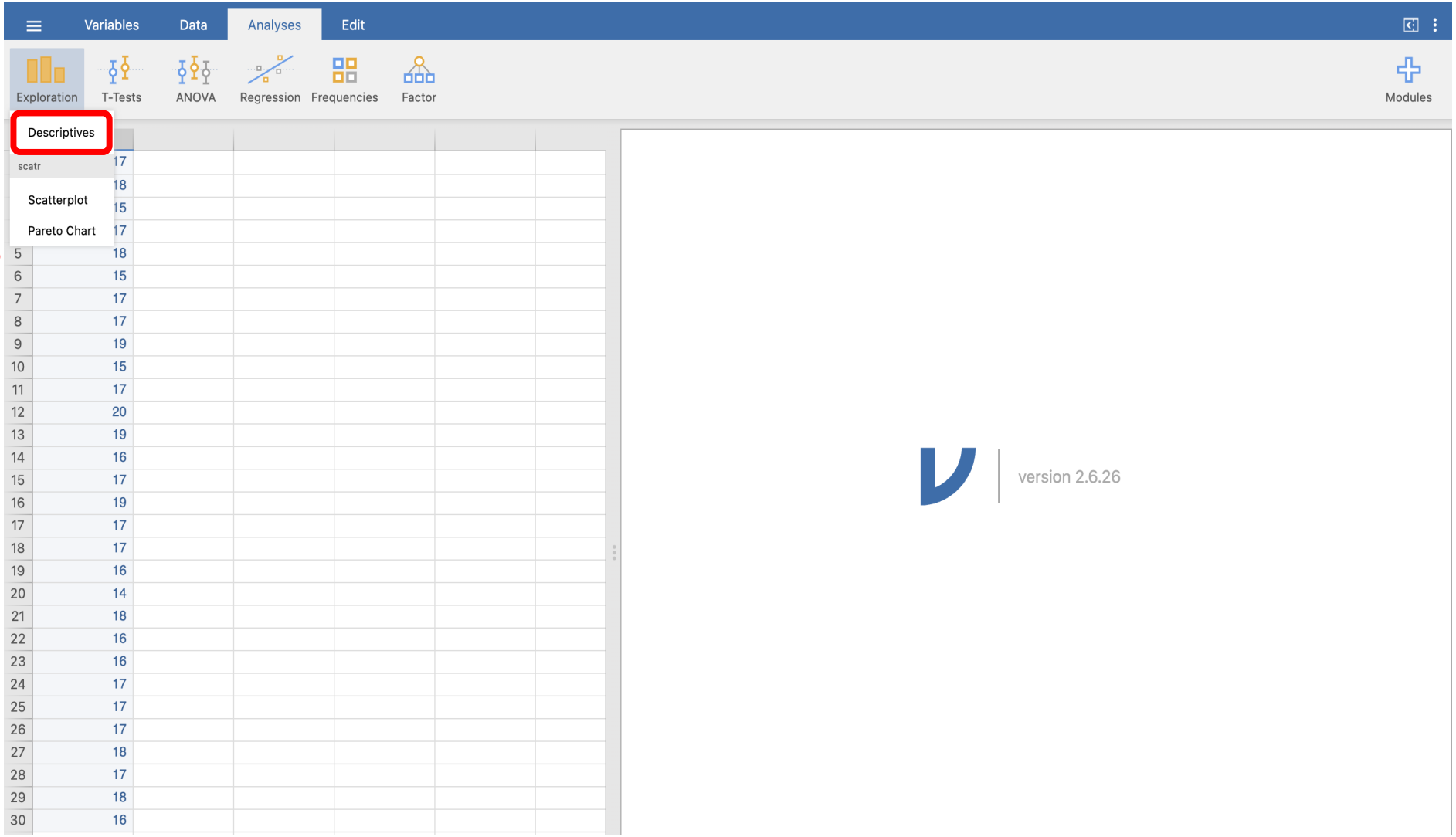
Tests of Normality

Click Exploration

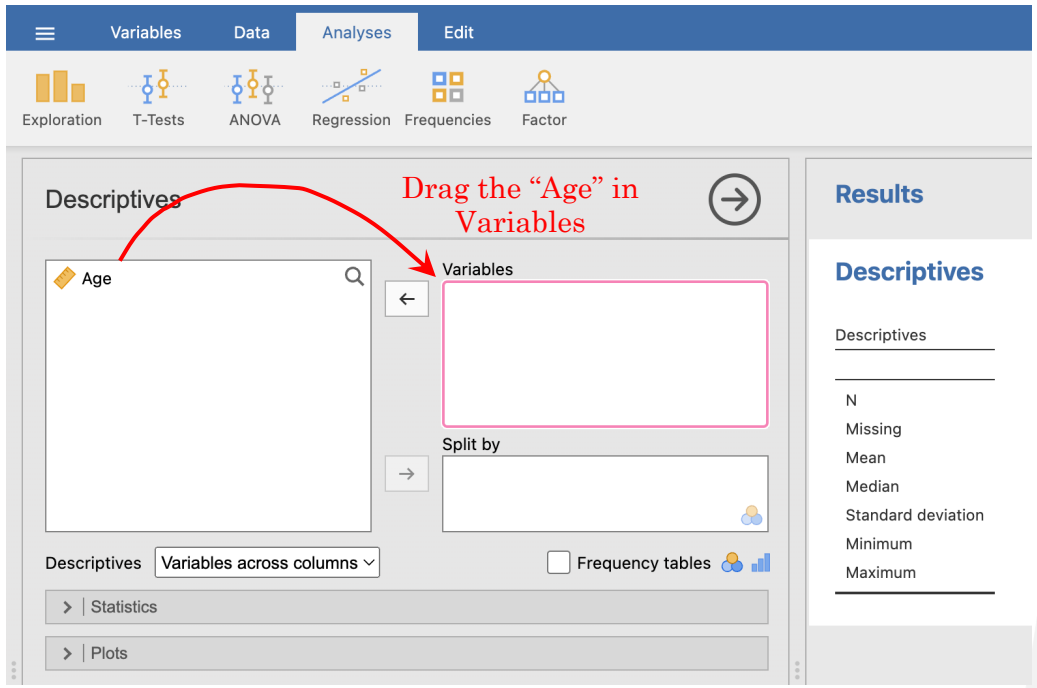


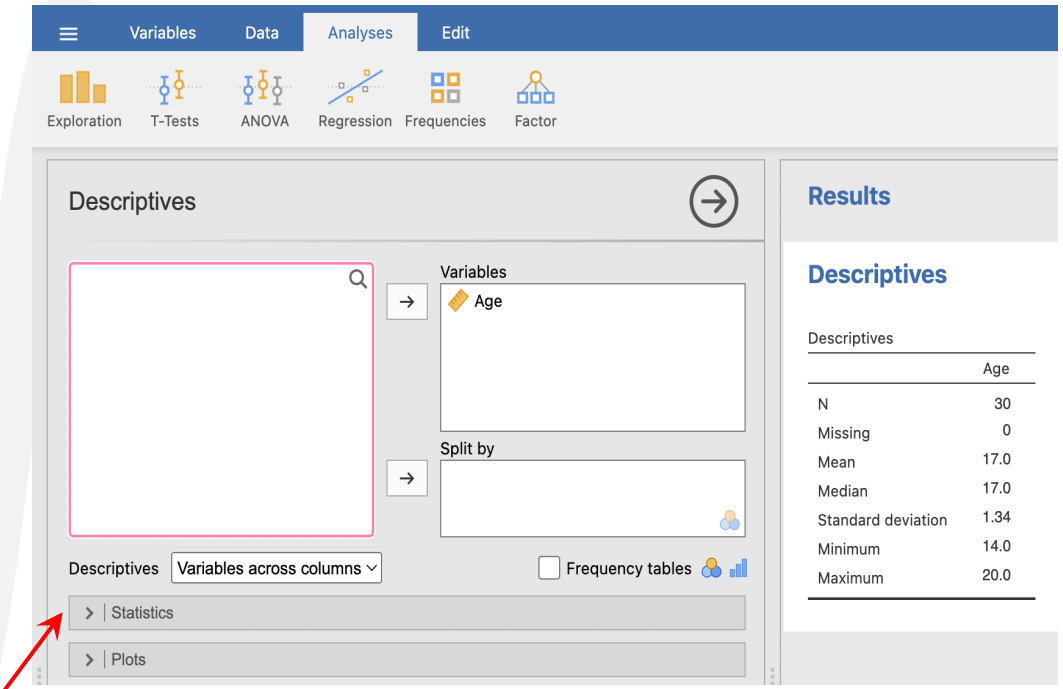
Tests of Normality

Click Descriptives



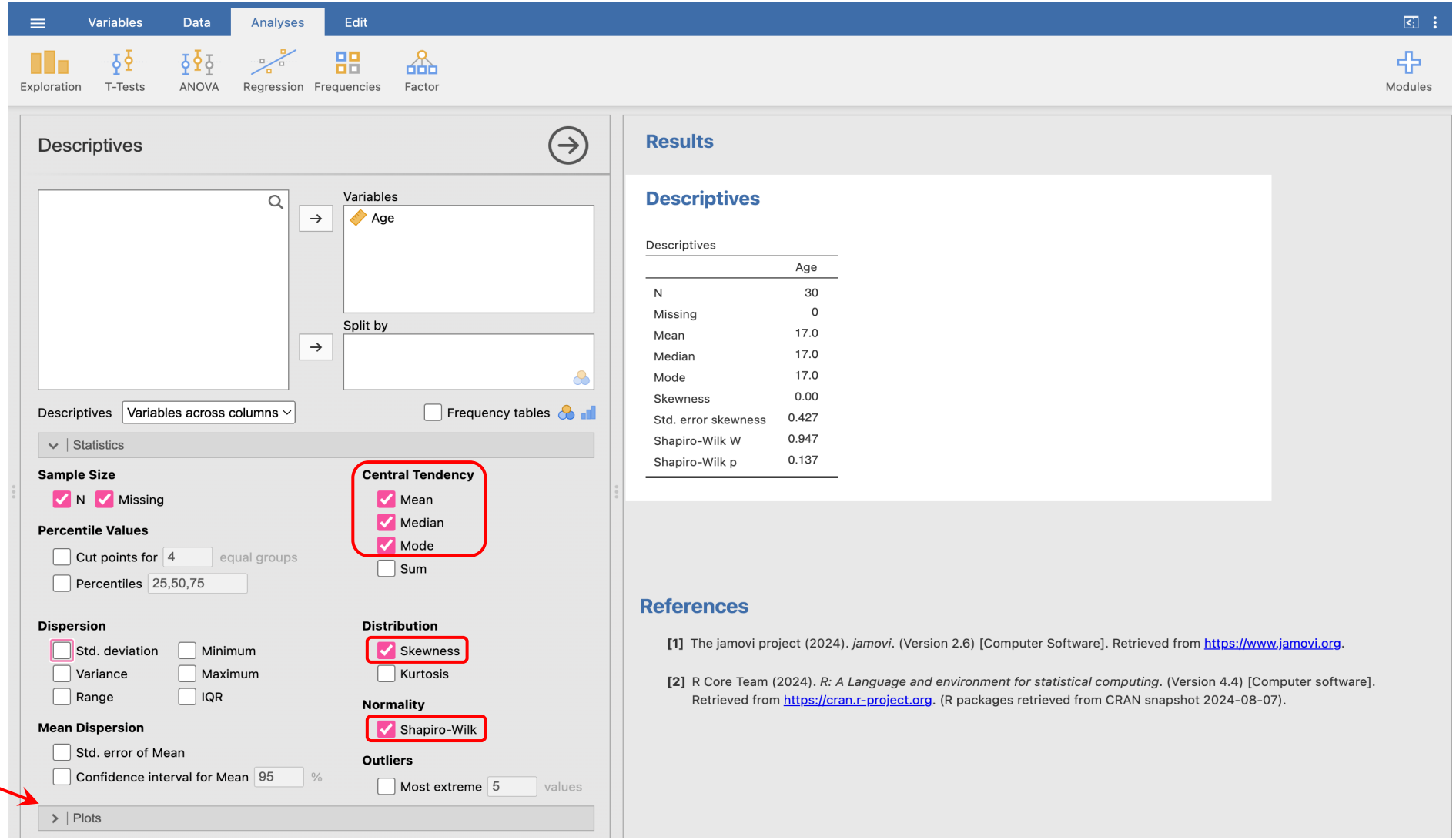
Tests of Normality





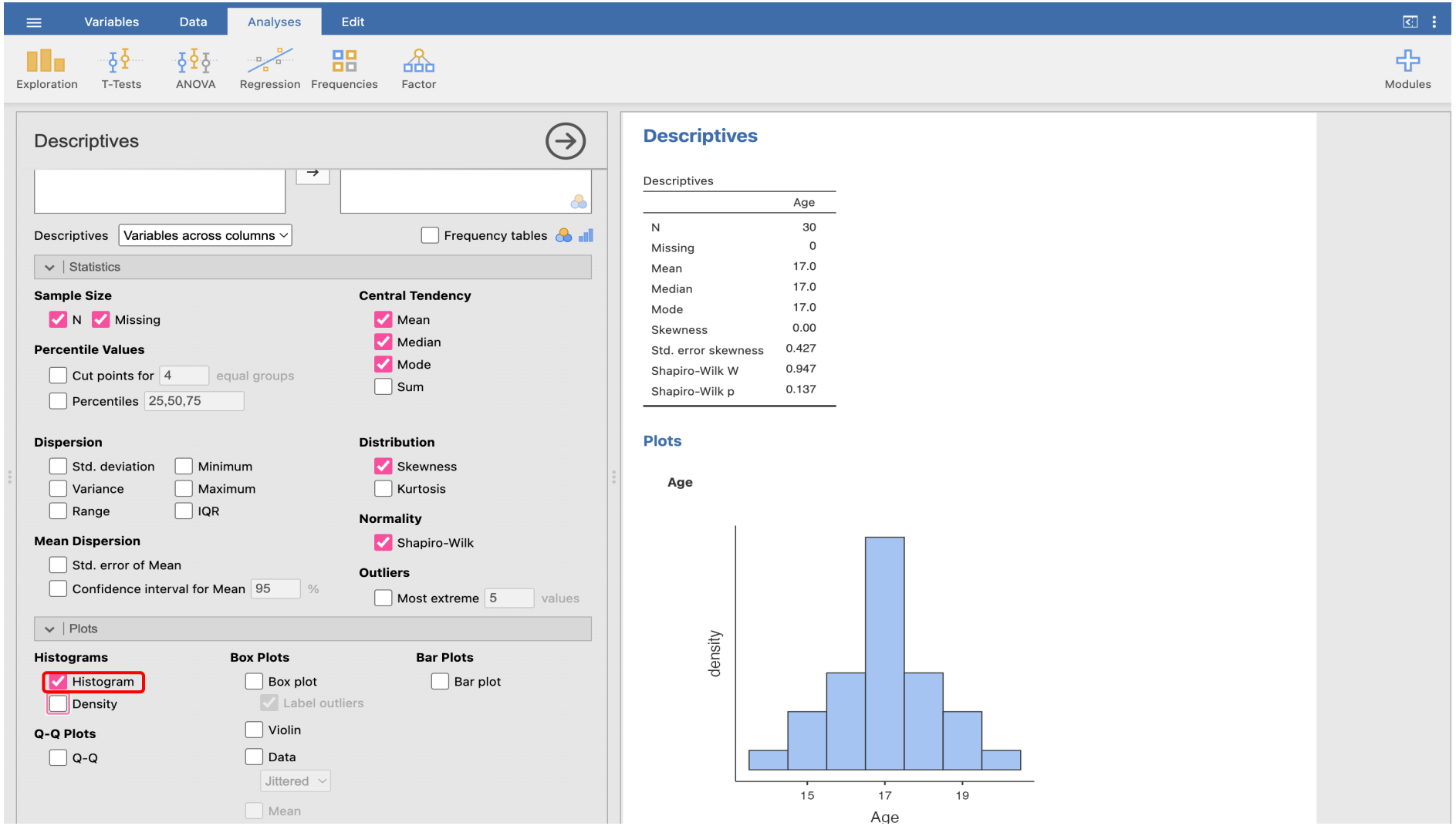
Click Statistics

Tests of Normality



Click Plots

Tests of Normality



Parametric and Non-Parametric Tests

If you want to calculate a hypothesis test, you must first check the prerequisites of the hypothesis test. A very common requirement is that the data used must be subject to some distribution, usually the normal distribution.

- If your data are normally distributed, parametric tests can usually be used.
- If they are not normally distributed, non-parametric tests are the appropriate tests to used.

Parametric: Pearson's-r, regression, t-tests, ANOVA, MANOVA, etc.

Non-Parametric: Spearman's Rho, Chi-Square, Kruskal-Wallis, Mann-Whitney, Wilcoxon signed-rank, etc.

Correlation Tests

Parametric tests usually have stricter requirements than nonparametric tests, and are able to make stronger inferences from the data. They can only be conducted with data that adheres to the common assumptions of statistical tests.

Correlation tests **check whether variables are related** without hypothesizing a cause-and-effect relationship. These can be used to test whether two variables you want to use in (for example) a multiple regression test are autocorrelated.

	Variables	Research question example
Pearson's *r*	• 2 continuous variables	How are latitude and temperature related?

Regression Tests

Regression tests look for **cause-and-effect relationships**. They can be used to estimate the effect of one or more continuous variables on another variable.

	Predictor variable	Outcome variable	Research question example
Simple linear regression	• Continuous • 1 predictor	• Continuous • 1 outcome	What is the effect of income on longevity?
Multiple linear regression	• Continuous • 2 or more predictors	• Continuous • 1 outcome	What is the effect of income and minutes of exercise per day on longevity?
Logistic regression	• Continuous	• Binary	What is the effect of drug dosage on the survival of a test subject?

Comparison Tests

Comparison tests look for **differences among group means**. They can be used to test the effect of a categorical variable on the mean value of some other characteristic, t-tests are used in comparing the means of precisely two groups (e.g., the average heights of men and women). ANOVA and MANOVA tests are used when comparing the means of more than two groups (e.g., the average heights of children, teenagers, and adults).

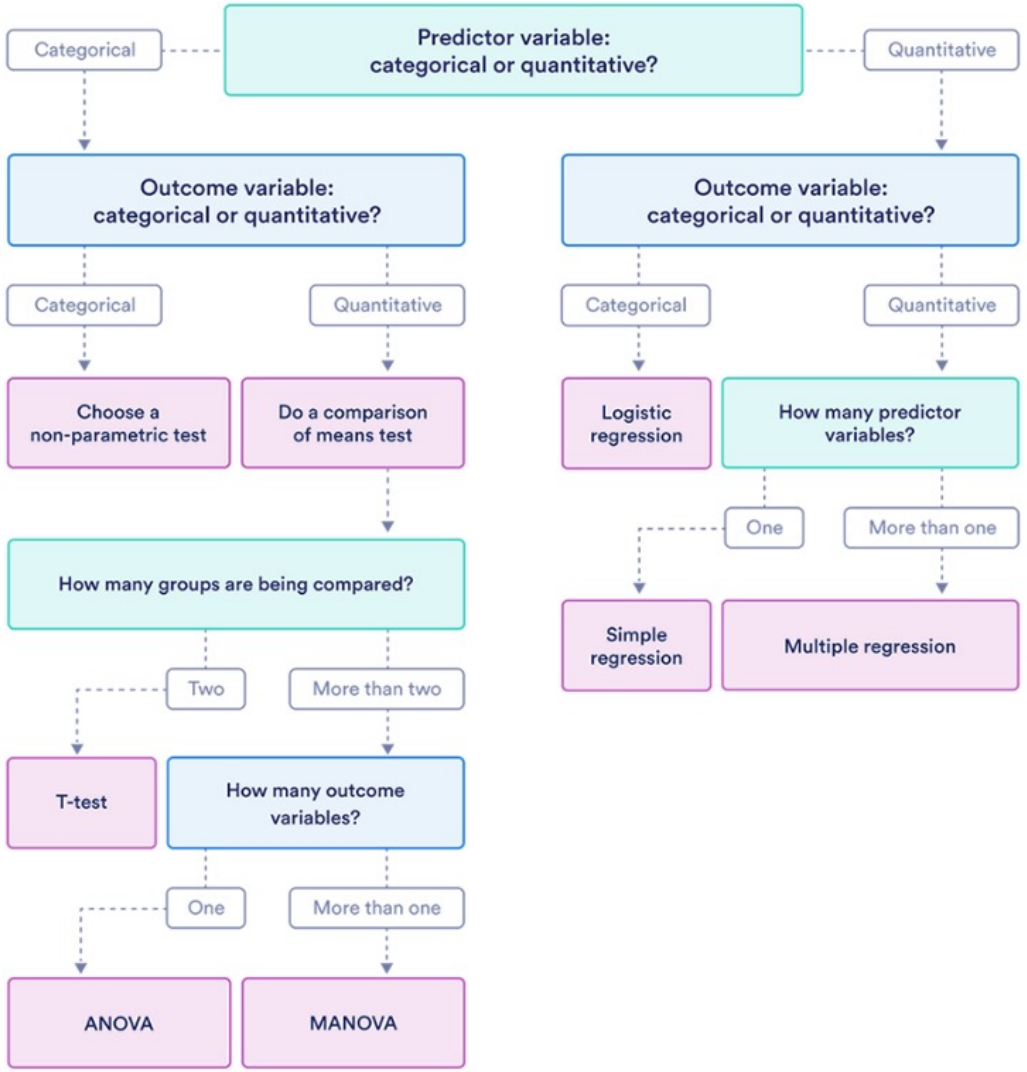
	Predictor variable	Outcome variable	Research question example
Paired t-test	• Categorical • 1 predictor	• Quantitative • groups come from the same population	What is the effect of two different test prep programs on the average exam scores for students from the same class?
Independent t-test	• Categorical • 1 predictor	• Quantitative • groups come from different populations	What is the difference in average exam scores for students from two different schools?
ANOVA	• Categorical • 1 or more predictor	• Quantitative • 1 outcome	What is the difference in average pain levels among post-surgical patients given three different painkillers?
MANOVA	• Categorical • 1 or more predictor	• Quantitative • 2 or more outcome	What is the effect of flower species on petal length, petal width, and stem length?

Non-Parametric

	Predictor variable	Outcome variable	Use in place of...
Spearman's *r*	• Quantitative	• Quantitative	Pearson's *r*
Chi square test of independence	• Categorical	• Categorical	Pearson's *r*
Sign test	• Categorical	• Quantitative	One-sample *t*-test
Kruskal–Wallis *H*	• Categorical • 3 or more groups	• Quantitative	ANOVA
ANOSIM	• Categorical • 3 or more groups	• Quantitative • 2 or more outcome variables	MANOVA
Wilcoxon Rank-Sum test	• Categorical • 2 groups	• Quantitative • groups come from different populations	Independent t-test
Wilcoxon Signed-rank test	• Categorical • 2 groups	• Quantitative • groups come from the same population	Paired t-test

Non-parametric tests don't make as many assumptions about the data, and are useful when one or more of the common statistical assumptions are violated. However, the inferences they make aren't as strong as with parametric tests.

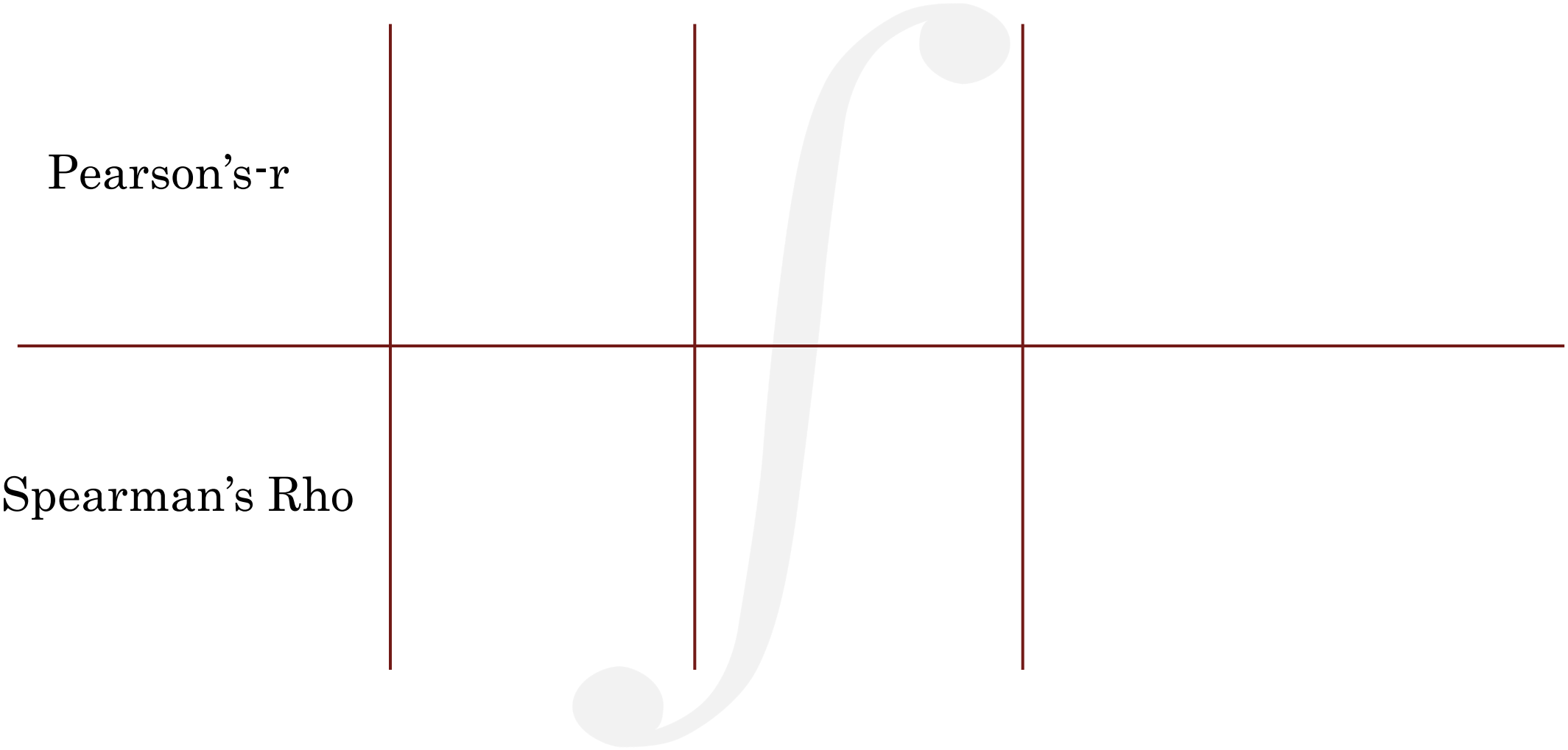
Useful Flowchart



Correlation Tests

Pearson's-r

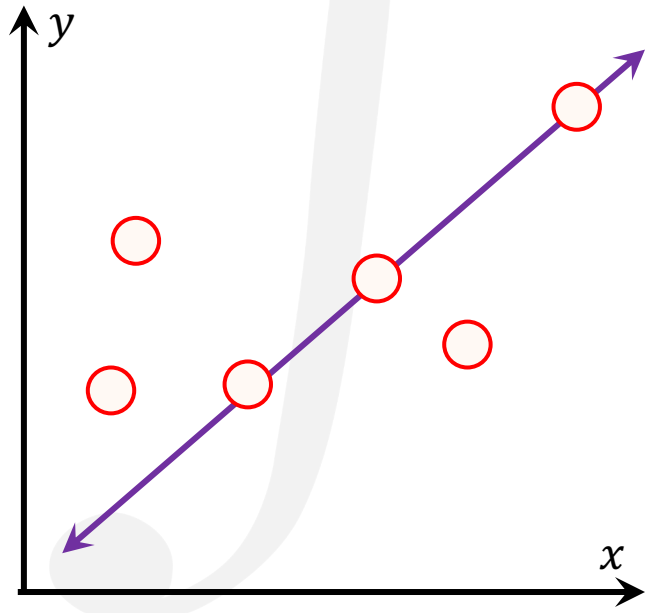
Spearman's Rho



Correlation

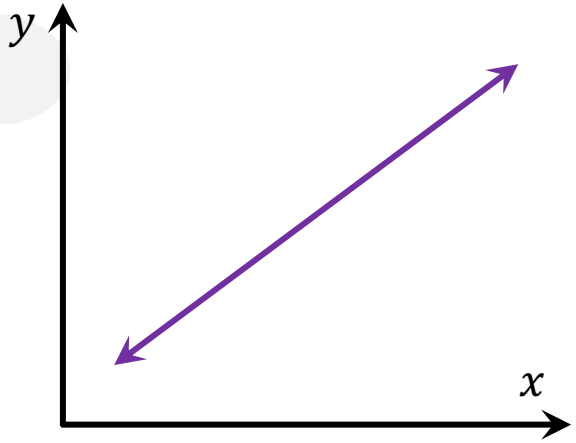
Definition.

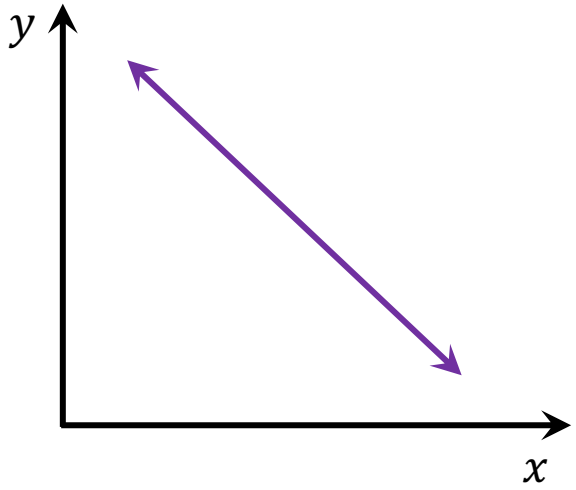
Correlation is a statistical technique that is used to describe and measure the relationship of two or more variables.



Direction of Correlation

Positive Relationship – It indicates that there is a direct relationship between the variables. Increase in one variable is also an increase on another variable.





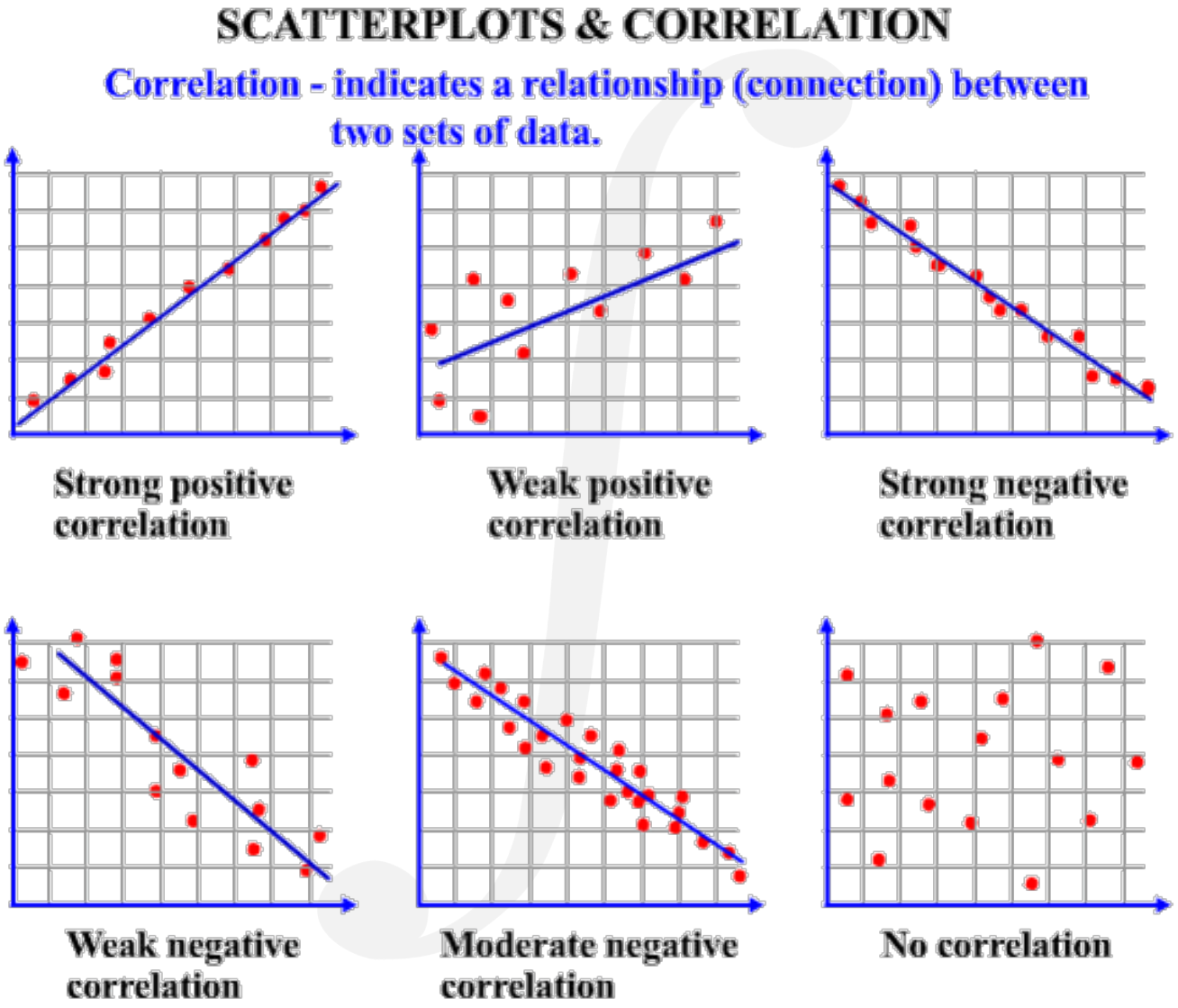
Negative Relationship - It emphasizes an inverse relationship between the variables. An increase of one variable has a correspondent decrease on another variable (vice versa).

Strength of Relationship

Value of r	Interpretation
−1.00	Perfect negative correlation
−0.50 to − 0.99	Strong negative correlation
−0.30 to − 0.49	Moderate negative correlation
−0.10 to − 0.29	Weak negative correlation
−0.01 to − 0.09	Very weak negative correlation
0.00	No correlation
0.01 to 0.09	Very weak positive correlation
0.10 to 0.29	Weak positive correlation
0.30 to 0.49	Moderate positive correlation
0.50 to 0.99	Strong positive correlation
+1.00	Perfect positive correlation

- If the correlation coefficient is close to +1 or −1, then the relationship is strong.
- If the correlation coefficient is close 0, then the relationship is weak.

Correlation



Pearson-r vs. Spearman's Rho

Regression analysis is a set of statistical processes for estimating the relationships between a dependent variable and one or more error-free independent variables

Pearson- r – it is used in correlating continuous variables. It is also parametric.

$$r = \frac{\sum(x_i - \bar{x})(y_i - \bar{y})}{\sqrt{\sum(x_i - \bar{x})^2 \sum(y_i - \bar{y})^2}} \qquad t_{statistic} = \frac{r\sqrt{N-2}}{\sqrt{1-r^2}}$$

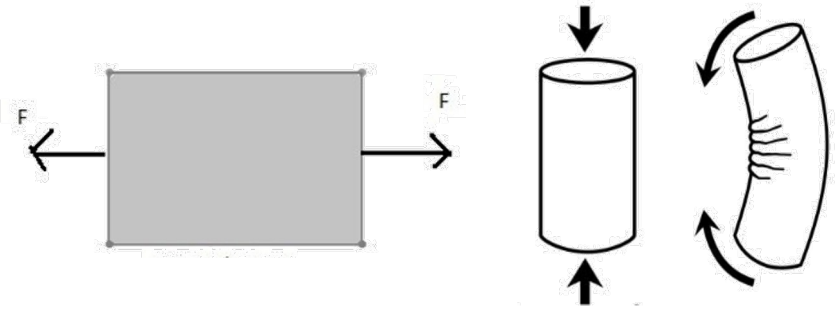
Spearman's Rho – it is used when one or both variables are or ordinal scaling. Considered as non-parametric.

$$\rho = 1 - \frac{6\sum d_i^2}{n(n^2-1)} \qquad t_{statistic} = \frac{\rho\sqrt{N-2}}{\sqrt{1-\rho^2}}$$

Pearson-r

Example. In a certain type of metal test specimen, the normal stress on a specimen is known to be functionally related to the shear resistance. The following is a set of coded experimental data on the two variables:

Normal Stress, x	Shear Resistance, y
26.8	26.5
25.4	27.3
28.9	24.2
23.6	27.1
27.7	23.6
23.9	25.9
24.7	26.3
28.1	22.5
26.9	21.7
27.4	21.4
22.6	25.8
25.6	24.9



Normal Stress

Shear Resistance

By Pearson-r formula,

$r = -0.656$

Interpretation:
Strong Negative Correlation

Is there a significant relationship between the normal stress and shear resistance?

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23.9	25.9
24.7	26.3
28.1	22.5
26.9	21.7
27.4	21.4
22.6	25.8
25.6	24.9

Is there a significant relationship between the normal stress and shear resistance?

Pearson-r

t Table

cum. prob	$t_{.50}$	$t_{.75}$	$t_{.80}$	$t_{.85}$	$t_{.90}$	$t_{.95}$	$t_{.975}$	$t_{.99}$	$t_{.995}$	$t_{.999}$	$t_{.9995}$
one-tail	0.50	0.25	0.20	0.15	0.10	0.05	0.025	0.01	0.005	0.001	0.0005
two-tails	1.00	0.50	0.40	0.30	0.20	0.10	0.05	0.02	0.01	0.002	0.001
df											
1	0.000	1.000	1.376	1.963	3.078	6.314	12.71	31.82	63.66	318.31	636.62
2	0.000	0.816	1.061	1.386	1.886	2.920	4.303	6.965	9.925	22.327	31.599
3	0.000	0.765	0.978	1.250	1.638	2.353	3.182	4.541	5.841	10.215	12.924
4	0.000	0.741	0.941	1.190	1.533	2.132	2.776	3.747	4.604	7.173	8.610
5	0.000	0.727	0.920	1.156	1.476	2.015	2.571	3.365	4.032	5.893	6.869
6	0.000	0.718	0.906	1.134	1.440	1.943	2.447	3.143	3.707	5.208	5.959
7	0.000	0.711	0.896	1.119	1.415	1.895	2.365	2.998	3.499	4.785	5.408
8	0.000	0.706	0.889	1.108	1.397	1.860	2.306	2.896	3.355	4.501	5.041
9	0.000	0.703	0.883	1.100	1.383	1.833	2.262	2.821	3.250	4.297	4.781
10	0.000	0.700	0.879	1.093	1.372	1.812	2.228	2.764	3.169	4.144	4.587
11	0.000	0.697	0.876	1.088	1.363	1.796	2.201	2.718	3.106	4.025	4.437
12	0.000	0.695	0.873	1.083	1.356	1.782	2.179	2.681	3.055	3.930	4.318
13	0.000	0.694	0.870	1.079	1.350	1.771	2.160	2.650	3.012	3.852	4.221
14	0.000	0.692	0.868	1.076	1.345	1.761	2.145	2.624	2.977	3.787	4.140
15	0.000	0.691	0.866	1.074	1.341	1.753	2.131	2.602	2.947	3.733	4.073
16	0.000	0.690	0.865	1.071	1.337	1.746	2.120	2.583	2.921	3.686	4.015
17	0.000	0.689	0.863	1.069	1.333	1.740	2.110	2.567	2.898	3.646	3.965
18	0.000	0.688	0.862	1.067	1.330	1.734	2.101	2.552	2.878	3.610	3.922
19	0.000	0.688	0.861	1.066	1.328	1.729	2.093	2.539	2.861	3.579	3.883
20	0.000	0.687	0.860	1.064	1.325	1.725	2.086	2.528	2.845	3.552	3.850
21	0.000	0.686	0.859	1.063	1.323	1.721	2.080	2.518	2.831	3.527	3.819
22	0.000	0.686	0.858	1.061	1.321	1.717	2.074	2.508	2.819	3.505	3.792
23	0.000	0.685	0.858	1.060	1.319	1.714	2.069	2.500	2.807	3.485	3.768
24	0.000	0.685	0.857	1.059	1.318	1.711	2.064	2.492	2.797	3.467	3.745
25	0.000	0.684	0.856	1.058	1.316	1.708	2.060	2.485	2.787	3.450	3.725
26	0.000	0.684	0.856	1.058	1.315	1.706	2.056	2.479	2.779	3.435	3.707
27	0.000	0.684	0.855	1.057	1.314	1.703	2.052	2.473	2.771	3.421	3.690
28	0.000	0.683	0.855	1.056	1.313	1.701	2.048	2.467	2.763	3.408	3.674
29	0.000	0.683	0.854	1.055	1.311	1.699	2.045	2.462	2.756	3.396	3.659
30	0.000	0.683	0.854	1.055	1.310	1.697	2.042	2.457	2.750	3.385	3.646
40	0.000	0.681	0.851	1.050	1.303	1.684	2.021	2.423	2.704	3.307	3.551
60	0.000	0.679	0.848	1.045	1.296	1.671	2.000	2.390	2.660	3.232	3.460
80	0.000	0.678	0.846	1.043	1.292	1.664	1.990	2.374	2.639	3.195	3.416
100	0.000	0.677	0.845	1.042	1.290	1.660	1.984	2.364	2.626	3.174	3.390
1000	0.000	0.675	0.842	1.037	1.282	1.646	1.962	2.330	2.581	3.098	3.300
z	0.000	0.674	0.842	1.036	1.282	1.645	1.960	2.326	2.576	3.090	3.291
	0%	50%	60%	70%	80%	90%	95%	98%	99%	99.8%	99.9%
	Confidence Level										

Example 2. A study was made by a retail merchant to determine the relation between weekly advertising expenditures and sales.

Advertising Costs ($)	Sales ($)
40	385
20	400
25	395
20	365
30	475
50	440
40	490
20	420
50	560
40	525
25	480
50	510

Is there a significant relationship between advertising costs and sales?

Pearson-r

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18	0.000	0.688	0.862	1.067	1.330	1.734	2.101	2.552	2.878	3.610	3.922
19	0.000	0.688	0.861	1.066	1.328	1.729	2.093	2.539	2.861	3.579	3.883
20	0.000	0.687	0.860	1.064	1.325	1.725	2.086	2.528	2.845	3.552	3.850
21	0.000	0.686	0.859	1.063	1.323	1.721	2.080	2.518	2.831	3.527	3.819
22	0.000	0.686	0.858	1.061	1.321	1.717	2.074	2.508	2.819	3.505	3.792
23	0.000	0.685	0.858	1.060	1.319	1.714	2.069	2.500	2.807	3.485	3.768
24	0.000	0.685	0.857	1.059	1.318	1.711	2.064	2.492	2.797	3.467	3.745
25	0.000	0.684	0.856	1.058	1.316	1.708	2.060	2.485	2.787	3.450	3.725
26	0.000	0.684	0.856	1.058	1.315	1.706	2.056	2.479	2.779	3.435	3.707
27	0.000	0.684	0.855	1.057	1.314	1.703	2.052	2.473	2.771	3.421	3.690
28	0.000	0.683	0.855	1.056	1.313	1.701	2.048	2.467	2.763	3.408	3.674
29	0.000	0.683	0.854	1.055	1.311	1.699	2.045	2.462	2.756	3.396	3.659
30	0.000	0.683	0.854	1.055	1.310	1.697	2.042	2.457	2.750	3.385	3.646
40	0.000	0.681	0.851	1.050	1.303	1.684	2.021	2.423	2.704	3.307	3.551
60	0.000	0.679	0.848	1.045	1.296	1.671	2.000	2.390	2.660	3.232	3.460
80	0.000	0.678	0.846	1.043	1.292	1.664	1.990	2.374	2.639	3.195	3.416
100	0.000	0.677	0.845	1.042	1.290	1.660	1.984	2.364	2.626	3.174	3.390
1000	0.000	0.675	0.842	1.037	1.282	1.646	1.962	2.330	2.581	3.098	3.300
z	0.000	0.674	0.842	1.036	1.282	1.645	1.960	2.326	2.576	3.090	3.291
	0%	50%	60%	70%	80%	90%	95%	98%	99%	99.8%	99.9%
	Confidence Level										

Spearman's Rho

Example. The table below released by the Federal Trade Commission, show the milligrams of tar and nicotine found in 10 brands of cigarettes. Calculate the rank correlation coefficient to measure the degree of relationship between tar and nicotine content in cigarettes.

Cigarette Brand	Tar Content	Nicotine Content
Viceroy	14	0.9
Marlboro	17	1.1
Chesterfield	28	1.6
Kool	17	1.3
Kent	16	1.0
Raleigh	13	0.8
Old Gold	24	1.5
Philip Morris	25	1.4
Oasis	18	1.2
Players	31	2.0

By Spearman's Rho formula,

$\rho = 0.967$

Interpretation:

Strong Positive Correlation

Is there a significant relationship between tar content and nicotine content

Spearman's Rho

Example 3. The table below released by the Federal Trade Commission, show the milligrams of tar and nicotine found in 10 brands of cigarettes. Calculate the rank correlation coefficient to measure the degree of relationship between tar and nicotine content in cigarettes.

Cigarette Brand	Tar Content	Nicotine Content
Viceroy	14	0.9
Marlboro	17	1.1
Chesterfield	28	1.6
Kool	17	1.3
Kent	16	1.0
Raleigh	13	0.8
Old Gold	24	1.5
Philip Morris	25	1.4
Oasis	18	1.2
Players	31	2.0

Is there a significant relationship between tar content and nicotine content

Spearman's Rho

t Table

cum. prob	$t_{.50}$	$t_{.75}$	$t_{.80}$	$t_{.85}$	$t_{.90}$	$t_{.95}$	$t_{.975}$	$t_{.99}$	$t_{.995}$	$t_{.999}$	$t_{.9995}$
one-tail	0.50	0.25	0.20	0.15	0.10	0.05	0.025	0.01	0.005	0.001	0.0005
two-tails	1.00	0.50	0.40	0.30	0.20	0.10	0.05	0.02	0.01	0.002	0.001
df											
1	0.000	1.000	1.376	1.963	3.078	6.314	12.71	31.82	63.66	318.31	636.62
2	0.000	0.816	1.061	1.386	1.886	2.920	4.303	6.965	9.925	22.327	31.599
3	0.000	0.765	0.978	1.250	1.638	2.353	3.182	4.541	5.841	10.215	12.924
4	0.000	0.741	0.941	1.190	1.533	2.132	2.776	3.747	4.604	7.173	8.610
5	0.000	0.727	0.920	1.156	1.476	2.015	2.571	3.365	4.032	5.893	6.869
6	0.000	0.718	0.906	1.134	1.440	1.943	2.447	3.143	3.707	5.208	5.959
7	0.000	0.711	0.896	1.119	1.415	1.895	2.365	2.998	3.499	4.785	5.408
8	0.000	0.706	0.889	1.108	1.397	1.860	2.306	2.896	3.355	4.501	5.041
9	0.000	0.703	0.883	1.100	1.383	1.833	2.262	2.821	3.250	4.297	4.781
10	0.000	0.700	0.879	1.093	1.372	1.812	2.228	2.764	3.169	4.144	4.587
11	0.000	0.697	0.876	1.088	1.363	1.796	2.201	2.718	3.106	4.025	4.437
12	0.000	0.695	0.873	1.083	1.356	1.782	2.179	2.681	3.055	3.930	4.318
13	0.000	0.694	0.870	1.079	1.350	1.771	2.160	2.650	3.012	3.852	4.221
14	0.000	0.692	0.868	1.076	1.345	1.761	2.145	2.624	2.977	3.787	4.140
15	0.000	0.691	0.866	1.074	1.341	1.753	2.131	2.602	2.947	3.733	4.073
16	0.000	0.690	0.865	1.071	1.337	1.746	2.120	2.583	2.921	3.686	4.015
17	0.000	0.689	0.863	1.069	1.333	1.740	2.110	2.567	2.898	3.646	3.965
18	0.000	0.688	0.862	1.067	1.330	1.734	2.101	2.552	2.878	3.610	3.922
19	0.000	0.688	0.861	1.066	1.328	1.729	2.093	2.539	2.861	3.579	3.883
20	0.000	0.687	0.860	1.064	1.325	1.725	2.086	2.528	2.845	3.552	3.850
21	0.000	0.686	0.859	1.063	1.323	1.721	2.080	2.518	2.831	3.527	3.819
22	0.000	0.686	0.858	1.061	1.321	1.717	2.074	2.508	2.819	3.505	3.792
23	0.000	0.685	0.858	1.060	1.319	1.714	2.069	2.500	2.807	3.485	3.768
24	0.000	0.685	0.857	1.059	1.318	1.711	2.064	2.492	2.797	3.467	3.745
25	0.000	0.684	0.856	1.058	1.316	1.708	2.060	2.485	2.787	3.450	3.725
26	0.000	0.684	0.856	1.058	1.315	1.706	2.056	2.479	2.779	3.435	3.707
27	0.000	0.684	0.855	1.057	1.314	1.703	2.052	2.473	2.771	3.421	3.690
28	0.000	0.683	0.855	1.056	1.313	1.701	2.048	2.467	2.763	3.408	3.674
29	0.000	0.683	0.854	1.055	1.311	1.699	2.045	2.462	2.756	3.396	3.659
30	0.000	0.683	0.854	1.055	1.310	1.697	2.042	2.457	2.750	3.385	3.646
40	0.000	0.681	0.851	1.050	1.303	1.684	2.021	2.423	2.704	3.307	3.551
60	0.000	0.679	0.848	1.045	1.296	1.671	2.000	2.390	2.660	3.232	3.460
80	0.000	0.678	0.846	1.043	1.292	1.664	1.990	2.374	2.639	3.195	3.416
100	0.000	0.677	0.845	1.042	1.290	1.660	1.984	2.364	2.626	3.174	3.390
1000	0.000	0.675	0.842	1.037	1.282	1.646	1.962	2.330	2.581	3.098	3.300
z	0.000	0.674	0.842	1.036	1.282	1.645	1.960	2.326	2.576	3.090	3.291
	0%	50%	60%	70%	80%	90%	95%	98%	99%	99.8%	99.9%
	Confidence Level										

Spearman's Rho

Example. A consumer panel tests nine brands of microwave ovens for overall quality. The ranks assigned by the panel and the suggested retail prices are as follows:

Manufacturer	Panel Rating	Suggested Price
A	6	\$480
B	9	395
C	2	575
D	8	550
E	5	510
F	1	545
G	7	400
H	4	465
I	3	420

Is there a significant relationship between panel rating and suggested price?

Spearman's Rho

Example 4. A consumer panel tests nine brands of microwave ovens for overall quality. The ranks assigned by the panel and the suggested retail prices are as follows:

Manufacturer	Panel Rating	Suggested Price
A	6	\$480
B	9	395
C	2	575
D	8	550
E	5	510
F	1	545
G	7	400
H	4	465
I	3	420

Is there a significant relationship between panel rating and suggested price?

Spearman's Rho

t Table

cum. prob	$t_{.50}$	$t_{.75}$	$t_{.80}$	$t_{.85}$	$t_{.90}$	$t_{.95}$	$t_{.975}$	$t_{.99}$	$t_{.995}$	$t_{.999}$	$t_{.9995}$
one-tail	0.50	0.25	0.20	0.15	0.10	0.05	0.025	0.01	0.005	0.001	0.0005
two-tails	1.00	0.50	0.40	0.30	0.20	0.10	0.05	0.02	0.01	0.002	0.001
df											
1	0.000	1.000	1.376	1.963	3.078	6.314	12.71	31.82	63.66	318.31	636.62
2	0.000	0.816	1.061	1.386	1.886	2.920	4.303	6.965	9.925	22.327	31.599
3	0.000	0.765	0.978	1.250	1.638	2.353	3.182	4.541	5.841	10.215	12.924
4	0.000	0.741	0.941	1.190	1.533	2.132	2.776	3.747	4.604	7.173	8.610
5	0.000	0.727	0.920	1.156	1.476	2.015	2.571	3.365	4.032	5.893	6.869
6	0.000	0.718	0.906	1.134	1.440	1.943	2.447	3.143	3.707	5.208	5.959
7	0.000	0.711	0.896	1.119	1.415	1.895	2.365	2.998	3.499	4.785	5.408
8	0.000	0.706	0.889	1.108	1.397	1.860	2.306	2.896	3.355	4.501	5.041
9	0.000	0.703	0.883	1.100	1.383	1.833	2.262	2.821	3.250	4.297	4.781
10	0.000	0.700	0.879	1.093	1.372	1.812	2.228	2.764	3.169	4.144	4.587
11	0.000	0.697	0.876	1.088	1.363	1.796	2.201	2.718	3.106	4.025	4.437
12	0.000	0.695	0.873	1.083	1.356	1.782	2.179	2.681	3.055	3.930	4.318
13	0.000	0.694	0.870	1.079	1.350	1.771	2.160	2.650	3.012	3.852	4.221
14	0.000	0.692	0.868	1.076	1.345	1.761	2.145	2.624	2.977	3.787	4.140
15	0.000	0.691	0.866	1.074	1.341	1.753	2.131	2.602	2.947	3.733	4.073
16	0.000	0.690	0.865	1.071	1.337	1.746	2.120	2.583	2.921	3.686	4.015
17	0.000	0.689	0.863	1.069	1.333	1.740	2.110	2.567	2.898	3.646	3.965
18	0.000	0.688	0.862	1.067	1.330	1.734	2.101	2.552	2.878	3.610	3.922
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29	0.000	0.683	0.854	1.055	1.311	1.699	2.045	2.462	2.756	3.396	3.659
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60	0.000	0.679	0.848	1.045	1.296	1.671	2.000	2.390	2.660	3.232	3.460
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100	0.000	0.677	0.845	1.042	1.290	1.660	1.984	2.364	2.626	3.174	3.390
1000	0.000	0.675	0.842	1.037	1.282	1.646	1.962	2.330	2.581	3.098	3.300
z	0.000	0.674	0.842	1.036	1.282	1.645	1.960	2.326	2.576	3.090	3.291
	0%	50%	60%	70%	80%	90%	95%	98%	99%	99.8%	99.9%
	Confidence Level										