

How to Calculate Spearman Rank Correlation in SPSS: A Step-by-Step Guide

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The Spearman Rank Correlation coefficient, often denoted as Spearman's rho (ρ), is a non-parametric statistical measure designed to assess the strength and direction of the monotonic relationship between two continuous or ordinal variables. Unlike the Pearson correlation coefficient, which requires that the data be normally distributed and the relationship be strictly linear, Spearman's rho operates on the ranks of the data rather than the raw scores themselves. This makes it a robust choice when dealing with non-normally distributed data or when the relationship between variables is not strictly linear but consistently increasing or decreasing.

The calculation process involves first converting the raw data for both variables into ranks. If there are ties in the data, the average rank (midrank) is assigned to all tied observations. Subsequently, the difference between the ranks (d_i) for each corresponding pair of observations is computed. The core formula then sums the squares of these rank differences, incorporating the sample size (N). The resultant value always falls within the range of -1 to $+1$. A correlation value close to 1 implies a strong, positive (monotonic) relationship, meaning as the rank of one variable increases, the rank of the other consistently increases. Conversely, a value near -1 indicates a strong negative relationship, and a value close to 0 suggests a very weak or non-existent monotonic relationship.

In analytical software like SPSS (Statistical Package for the Social Sciences), the entire calculation is automated. Beyond providing the correlation coefficient itself, the software generates a corresponding **p-value**. This crucial value, derived typically through hypothesis testing, allows the researcher to determine if the observed correlation is **statistically significant**--that is, whether the relationship is likely to exist in the broader population or if it merely occurred by chance in the sample studied. Understanding how to correctly input data and interpret the SPSS output is essential for accurate quantitative research.

Understanding Correlation and Spearman's Rho

In statistics, the term **correlation** serves as a fundamental measure characterizing the dependence between two or more variables, quantifying the strength and direction of their relationship. While there are many measures of association, choosing the correct one depends on the scale of measurement and the underlying distribution of the data.

One special type of correlation is the **Spearman Rank Correlation**, which is specifically designed to measure the monotonic association between two ranked variables. This is particularly useful when analyzing ordinal data, such as comparing the ranking of a student's Math exam score versus the ranking of their Science exam score in a class, or assessing the relationship between two Likert scale items. Its non-parametric nature allows it to be used reliably even when the data fails to meet the assumptions of parametric tests, such as normal distribution.

The most efficient and widely accepted method to calculate the Spearman Rank Correlation between two variables in SPSS is by navigating the menu system using the path: **Analyze > Correlate > Bivariate**. This initiates the primary dialog box necessary for configuring the analysis.

The following comprehensive example details the process, demonstrating how to handle variable selection and interpret the resulting output matrix in a practical application.

The Advantages of Rank-Based Analysis




The decision to use Spearman's Rho over Pearson's R is usually driven by methodological considerations related to data integrity and assumption fulfillment. Spearman's method is fundamentally less sensitive to the distribution shape of the data, as it converts raw scores into ranks. This ranking process effectively normalizes the variables, mitigating the influence of extreme scores or outliers that could otherwise distort the correlation coefficient derived from raw scores.

Furthermore, Spearman's Rho is the definitive choice when the relationship between the two variables is expected to be monotonic but non-linear. If a researcher observes that higher values in Variable A consistently correspond to higher values in Variable B, but the rate of increase changes (e.g., exponential growth), the rank correlation accurately captures this association without forcing a linear interpretation. This flexibility makes it indispensable in social sciences and medical research where relationships are often complex and non-linear.

By focusing on ranks, the Spearman correlation coefficient provides a more conservative and robust estimate of association when the stringent requirements for parametric tests cannot be met. It provides a reliable metric of association strength, ensuring that the statistical conclusions drawn are valid given the characteristics of the sampled data.

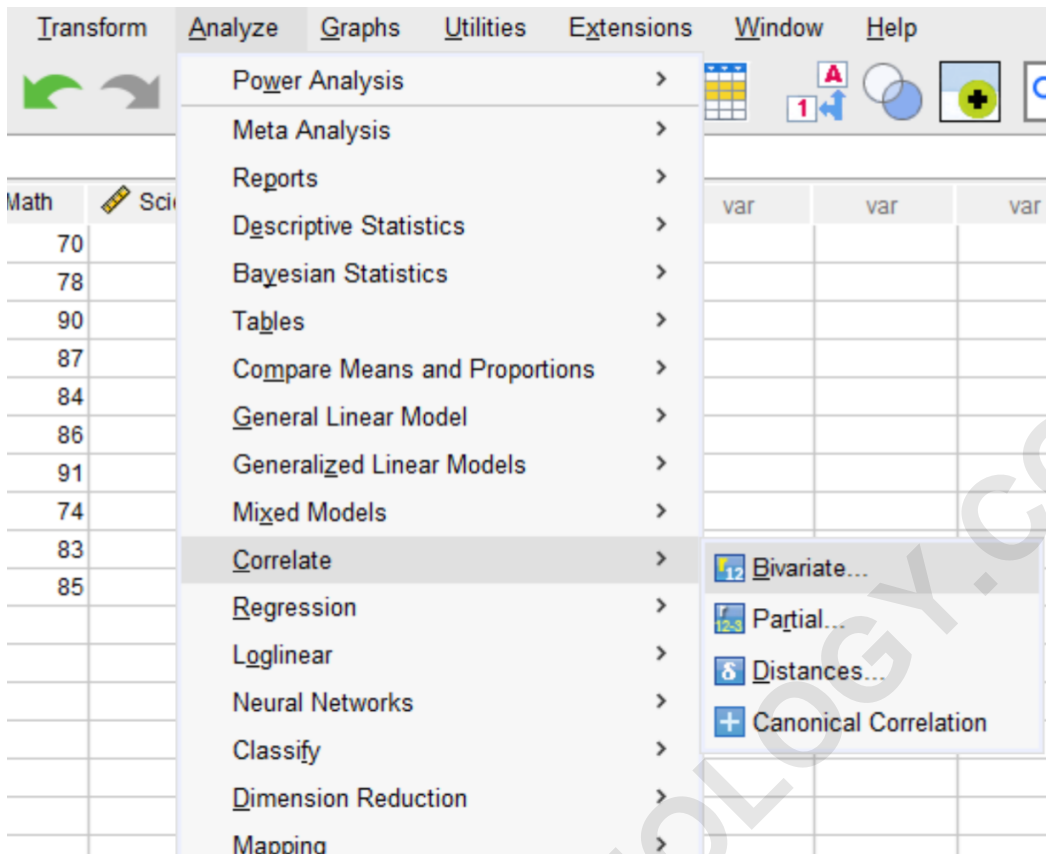
Example: How to Perform a Correlation Test in SPSS

Suppose we have the following dataset in SPSS that contains information about the math exam score and science exam score received by 10 students in a particular class. This small dataset will serve as our foundation for demonstrating the procedural steps necessary to calculate Spearman's Rho:

	 Student	 Math	 Science	var	var	
1	A	70	90			
2	B	78	94			
3	C	90	79			
4	D	87	86			
5	E	84	84			
6	F	86	83			
7	G	91	88			
8	H	74	92			
9	I	83	76			
10	J	85	75			
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We aim to calculate the correlation between these two variables and perform a corresponding statistical test to determine if the calculated correlation coefficient is statistically significant. Our null hypothesis (H_0) is that there is no monotonic relationship between Math and Science scores in the population ($\rho = 0$).

To begin the analysis, click the **Analyze** tab on the top menu bar, then hover over **Correlate**, and finally click **Bivariate**. This sequence opens the Bivariate Correlations dialog box, which is the gateway for defining our rank correlation analysis settings:



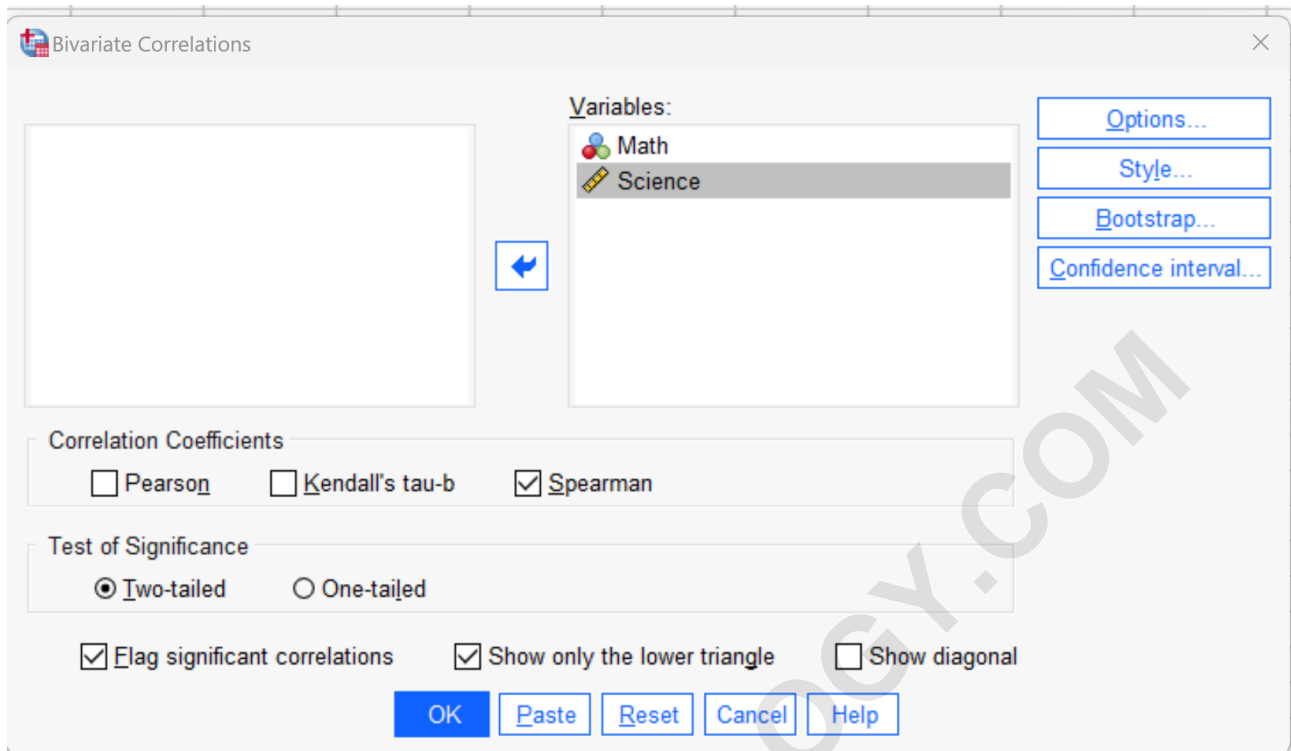
Configuring the Bivariate Correlation Dialogue

In the new Bivariate Correlations window that appears, the first step is to transfer the variables designated for analysis. Drag both the **Math** and **Science** variables from the list on the left side into the **Variables** box on the right. This tells SPSS which pair of variables should be included in the correlation matrix calculation.

Next, under the **Correlation Coefficients** section, it is crucial to specify the required coefficient. Check the box next to **Spearman**. Ensure that the default Pearson box is unchecked if you are only interested in the rank correlation. We are selecting Spearman's Rho because we are analyzing the relationship based on rank order, not assuming linearity or normality.

For cleaner output, especially when correlating only two variables, adjust the display settings. Check the box next to **Show only the lower triangle**. This hides the redundant upper half of the correlation matrix, which is a mirror image of the lower half. Additionally, uncheck the box next to **Show diagonal**, as the correlation of a variable with itself is always 1, providing no meaningful insight into the association between the two different subjects.

The final configuration panel should look like this before execution:



Once the configuration is finalized, click **OK**. SPSS will then process the request, converting the raw scores into ranks internally and applying the Spearman formula.

Interpreting the **SPSS** Output Results

The following output table, labeled "Correlations," will appear in the SPSS Output Viewer window, containing the calculated value, the test statistics, and the sample size. This table is the central piece of evidence for drawing conclusions about the relationship between the two variables:

➔ Nonparametric Correlations

		Correlations	
		Math	
Spearman's rho	Science	Correlation Coefficient	-.418
		Sig. (2-tailed)	.229
		N	10

From the output generated by the Bivariate Correlations procedure, we can systematically extract the necessary information for interpretation and reporting. The matrix provides the following statistics under the row intersection for Math and Science:

Spearman correlation coefficient (ρ): **-.481**

p-value (Sig. 2-tailed): **.229**

N (number of pairs): **10**

The **Spearman correlation coefficient** (ρ) of **-.481** indicates that there is a moderate negative association between the ranks of Math scores and Science scores. A negative coefficient means that as a student ranks higher in Math (e.g., rank 1, 2, 3), they tend to rank lower in Science, suggesting an inverse monotonic relationship between the two subjects in this small sample. The magnitude (-.481) suggests the relationship is present but not extremely strong.

Determining Statistical Significance

The crucial step in concluding the analysis is assessing the **statistical significance** by examining the associated **p-value**. For this analysis, the p-value (Sig. 2-tailed) is **.229**. Researchers typically compare this value against a predetermined alpha level (α), commonly set at 0.05. If the p-value is less than or equal to 0.05, the correlation is deemed statistically significant, allowing us to reject the null hypothesis of no relationship.

In this instance, the p-value of **.229** is significantly larger than the conventional $\alpha = 0.05$.

Because the p-value exceeds the threshold, we must conclude that the observed correlation of $\rho = -0.481$ is **not statistically significant**. This means that although a negative relationship was observed in the sample of 10 students, there is insufficient statistical evidence to assert that this monotonic relationship exists consistently in the wider population. The observed association may simply be due to sampling variability.

When reporting these findings, it is vital to state both the direction and strength of the correlation alongside the statistical inference. The final conclusion should clearly articulate the lack of statistical support for a monotonic relationship given the data: "A Spearman Rank Correlation test showed a moderate negative relationship between Math and Science exam score ranks ($\rho = -0.481$), but this correlation was not statistically significant ($N=10$, $p = 0.229$)."

Further Exploration of Non-Parametric Tools in SPSS

While Spearman's Rho is essential for assessing monotonic relationships, SPSS provides a suite of other non-parametric methods, often found under the **Analyze > Nonparametric Tests** menu, which are crucial for handling data that violate distributional assumptions. For instance, when analyzing paired data that is non-normally distributed, the Wilcoxon Signed-Rank Test is the rank-based alternative to the paired t-test.

If the data structure required comparing the ranks across multiple independent groups, the Kruskal-Wallis H Test would be used instead of a one-way ANOVA. Understanding the relationship between these rank-based tests and their parametric counterparts is key to selecting the most methodologically sound approach for any given research question. These tools collectively ensure that robust statistical inferences can be drawn even when dealing with complex or ordinal data.

The following tutorials explain how to perform other common operations in SPSS: