

How to calculate Spearman Rank Correlation in Google Sheets

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The field of statistics provides numerous tools for quantifying relationships between datasets. Among the most crucial metrics is the concept of correlation, which assesses both the strength and the direction of the association between two distinct variables. While the widely known Pearson product-moment correlation coefficient is designed for normally distributed, continuous data, many real-world datasets involve ordinal or non-parametric data where simple averages are inappropriate. For these scenarios, the Spearman Rank Correlation (often denoted as ρ) offers a robust alternative. This powerful non-parametric statistic measures the correlation between the ranked values of the variables, making it indispensable when dealing with data that may not meet the strict assumptions of parametric tests.

Calculating this coefficient manually involves several complex steps, including ranking the data, finding the differences between ranks, squaring those differences, and applying the specialized Spearman Rank Correlation formula. Fortunately, modern spreadsheet applications like Google Sheets streamline this process significantly. By employing a combination of ranking functions and the built-in correlation function, users can quickly and accurately determine the correlation coefficient. This guide provides a step-by-step tutorial on how to leverage the functionalities of Google Sheets to calculate the Spearman coefficient efficiently, ensuring the result is reliable for subsequent statistical analysis.

The resulting correlation coefficient, whether calculated via Spearman's method or others, always falls within the range of -1 to 1. This numerical output provides a standardized interpretation of the relationship between the two variables under examination. A value of 1 signifies a perfect positive relationship, meaning as one variable increases, the other increases proportionally. Conversely, a value of -1 denotes a perfect negative relationship, where an increase in one variable corresponds perfectly to a decrease in the other. A coefficient close to 0 indicates a weak or non-existent linear relationship between the variables. Understanding these boundary values is crucial for interpreting the final calculation and drawing meaningful conclusions from the statistical analysis.

Understanding the Correlation Coefficient Range

In statistics, the numerical value derived from a correlation calculation serves as a powerful indicator of the relationship between two variables. This metric, often called the correlation coefficient, standardizes the complexity of variable relationships into a simple, interpretable number between -1 and 1. This standardized range allows researchers across different disciplines to universally understand the nature of the observed dependency. It is the foundation upon which decisions about variable interaction and model building are based, making its correct interpretation vital for accurate data analysis.

The directional aspect of the coefficient is just as important as its magnitude. A positive correlation (values greater than 0) implies that the variables move in the same direction--as one variable's

values tend to rise, the other variable's values tend to rise as well. In contrast, a negative correlation (values less than 0) implies an inverse relationship; as one variable increases, the other generally decreases. The magnitude of the number--how close it is to 1 or -1--determines the strength of this relationship, irrespective of its direction.

These interpretations are universally applied regardless of whether one uses the Pearson coefficient for linear relationships or the Spearman Rank Correlation for monotonic (rank-based) relationships. The key distinction of the Spearman method is that it measures the relationship between the ranks of the data points, not the data points themselves. This characteristic makes it highly resistant to outliers and effective for non-normally distributed data or data measured on an ordinal scale.

-1: Represents a **perfect negative relationship** between two variables, meaning the variables are inversely related with perfect consistency.

0: Indicates **no monotonic relationship** between two variables. Changes in one variable are not predictably associated with changes in the other.

1: Signifies a **perfect positive relationship** between two variables, meaning they increase or decrease together with absolute consistency.

Distinguishing Spearman Rank Correlation

The Spearman Rank Correlation is a specialized non-parametric measure, specifically designed to assess the monotonic relationship between two variables. Unlike the Pearson correlation, which strictly measures the linear association between continuous variables, Spearman's coefficient determines how well the relationship between two variables can be described using a monotonic function. A monotonic relationship is one where the variables tend to move in the same general direction (either both increasing or both decreasing), but not necessarily at a constant rate. This subtlety makes it suitable for data where the underlying distribution is unknown or heavily skewed.

This method works by first converting the raw data values into their corresponding rank order. For instance, if we compare a student's rank in a mathematics exam versus their rank in a science exam within the same class, we are interested in whether higher math ranks generally correspond to higher science ranks. The Spearman coefficient then calculates the Pearson correlation on these newly created ranks. This transformation is the critical step that distinguishes it from other correlation methods and allows it to handle ordinal data effectively. It focuses entirely on the sequence or relative position of the data points, minimizing the impact of extreme outliers.

Choosing Spearman over Pearson is generally recommended when dealing with ordinal data (e.g., survey responses on a Likert scale like "strongly disagree" to "strongly agree"), or when the relationship is known to be non-linear but consistently directional. It provides a robust measure of association even when the fundamental assumptions of normality or homoscedasticity required by

parametric tests are violated. Therefore, for researchers analyzing data from psychological assessments, sociological surveys, or any field involving ranked preference or non-interval scales, the Spearman method is the preferred tool for robust analysis.

Example: Calculating Spearman Rank Correlation in Google Sheets

To illustrate the practical application of this statistical technique, we will walk through a detailed example using [Google Sheets](#). Our scenario involves analyzing the performance of 10 students in two different subjects: Math and Science. The objective is to determine the Spearman rank correlation between their scores, which will tell us if a student who scores highly (or ranks highly) in Math generally scores highly (or ranks highly) in Science. This example requires four distinct phases: data entry, calculating the ranks, determining the correlation coefficient, and finally, assessing its significance.

This methodology utilizes built-in functions within [Google Sheets](#) to bypass the tedious manual calculation steps involved in ranking and difference calculation. By correctly implementing the `RANK.AVG` and `CORREL` functions, we can leverage the computational power of the spreadsheet software to yield immediate and accurate results. This approach ensures that the calculation is performed consistently, even with a large sample size, upholding the integrity of the statistical process.

For our example, the sample size (n) is 10. The raw scores are entered into adjacent columns, serving as the foundation for the subsequent rank transformation. The resulting correlation coefficient will then provide empirical evidence regarding the interdependence of academic performance across these two distinct disciplines for this specific group of students. Following the steps precisely ensures that any potential ties in scores are handled correctly by the `RANK.AVG` function, maintaining the accuracy required for Spearman's rho.

Step 1: Entering the Raw Data into Google Sheets

The foundational step in any statistical analysis within a spreadsheet environment is the correct organization and entry of the raw data. In this example, we begin by setting up three columns: one for the Student ID, one for the Math Exam Score (Variable X), and one for the Science Exam Score (Variable Y). Accuracy in data entry is paramount, as errors at this stage will propagate through all subsequent calculations. We populate the cells with the scores for our 10 hypothetical students, ensuring each score corresponds correctly to the respective student and subject.

It is beneficial to label the columns clearly (e.g., 'Student', 'Math Score', 'Science Score') to maintain clarity throughout the process. For our tutorial, let's assume the Math scores are entered into column B and the Science scores into column C, starting from row 2. This structured approach not only improves readability but also facilitates the easy definition of ranges when we introduce

formulas in the next steps. The raw data itself, even if continuous, will soon be converted into ordinal ranks to satisfy the requirements of the Spearman method.

The visual representation of the initial data setup is critical for verification before proceeding. The structure should clearly delineate the paired observations--each row represents a single student's paired scores. This paired structure is essential because correlation analysis requires corresponding data points for the two variables being compared.

	A	B	C	D
1	Student	Math	Science	
2	A	70	90	
3	B	78	94	
4	C	90	79	
5	D	87	86	
6	E	84	84	
7	F	86	83	
8	G	91	88	
9	H	74	92	
10	I	83	76	
11	J	85	75	
12				
13				
14				
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18				
19				
20				
21				

Step 2: Calculating Ranks Using the `RANK.AVG` Function

The core principle of Spearman Rank Correlation requires transforming the raw scores into their relative ranks. Google Sheets offers the powerful `RANK.AVG` function, which is ideal for this purpose, especially as it correctly handles ties in scores by assigning the average rank to the tied values. This function prevents inflation or deflation of the correlation due to common scores. We will create two new columns, 'Math Rank' (Column D) and 'Science Rank' (Column E), to house these transformed values.

To calculate the rank for the first Math score (B2), we input the formula into cell D2. The syntax for `RANK.AVG` requires three arguments: the value to rank (B2), the range of values to rank against

(the entire Math score column $\$B\$2:\$B\11), and the order (0 for descending order, meaning the highest score gets rank 1). Crucially, the range must be absolute (using dollar signs, e.g., $\$B\$2:\$B\11) so that the range does not shift when the formula is copied down to the other rows. We repeat this process for the Science scores in cell E2.

The specific formulas entered into the first row are as follows. Note the use of absolute references to fix the data array:

Cell D2 (Math Rank):

```
=RANK.AVG(B2, $B$2:$B$11, 0)
```

Cell E2 (Science Rank):

```
=RANK.AVG(C2, $C$2:$C$11, 0)
```

	A	B	C	D	E
1	Student	Math	Science	Math Rank	Science Rank
2	A	70	90	10	3
3	B	78	94		
4	C	90	79		
5	D	87	86		
6	E	84	84		
7	F	86	83		
8	G	91	88		
9	H	74	92		
10	I	83	76		
11	J	85	75		
12					
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19					

After inputting the formulas in D2 and E2, the next step is to efficiently apply these formulas to the remaining students. We achieve this by highlighting the target cells (D2 and E2) and then extending the selection down to row 11, covering all 10 students. The use of the keyboard shortcut Ctrl+D (or Cmd+D on Mac) serves as an efficient way to 'fill down' the formulas. Because we used absolute references for the ranges, only the relative reference (B2 or C2) will update for each row, ensuring the correct ranking against the entire dataset for each student. This completes the rank

transformation necessary for the Spearman analysis.

fx | =RANK.AVG(B2, \$B\$2:\$B\$11, 0)

	A	B	C	D	E
1	Student	Math	Science	Math Rank	Science Rank
2	A	70	90	10	3
3	B	78	94		
4	C	90	79		
5	D	87	86		
6	E	84	84		
7	F	86	83		
8	G	91	88		
9	H	74	92		
10	I	83	76		
11	J	85	75		
12					
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Upon executing the 'fill down' command, the spreadsheet instantly populates Columns D and E with the calculated ranks for all 10 students. These rank columns now serve as our primary data variables for calculating the correlation coefficient. We have successfully transformed the raw, interval scores into ordinal, rank-based data, satisfying the first major requirement of the Spearman method.

	A	B	C	D	E
1	Student	Math	Science	Math Rank	Science Rank
2	A	70	90	10	3
3	B	78	94	8	1
4	C	90	79	2	8
5	D	87	86	3	5
6	E	84	84	6	6
7	F	86	83	4	7
8	G	91	88	1	4
9	H	74	92	9	2
10	I	83	76	7	9
11	J	85	75	5	10
12					
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22					

Step 3: Calculating the Spearman Rank Correlation Coefficient

With the ranks successfully calculated in Columns D and E, we proceed to the final step: determining the Spearman rank correlation coefficient (ρ). This is accomplished by calculating the standard Pearson correlation coefficient, but applied specifically to the rank columns rather than the raw score columns. Google Sheets simplifies this through the use of the `CORREL()` function. The `CORREL()` function accepts two arguments: the range of the first array (the Math Ranks) and the range of the second array (the Science Ranks).

We will choose an empty cell, perhaps F1, to display the final result. The formula will be `=CORREL(D2:D11, E2:E11)`. This command instructs Google Sheets to measure the linear relationship between the two sets of ranks, which, by definition, yields the Spearman Rank Correlation coefficient. The simplicity of this step highlights the efficiency of using spreadsheet software for complex statistical measures once the data transformation (ranking) has been correctly executed.

Upon execution of the `CORREL` formula, the resulting correlation coefficient is displayed. For our

example dataset of 10 students, the value calculated is **-0.41818**. This result indicates a moderate, negative monotonic relationship between the ranks of the Math scores and the ranks of the Science scores. In practical terms, this suggests that students who rank higher in Math tend, to some extent, to rank lower in Science, though the relationship is not extremely strong.

fx =CORREL(D2:D11, E2:E11)					
	A	B	C	D	E
1	Student	Math	Science	Math Rank	Science Rank
2	A	70	90	10	3
3	B	78	94	8	1
4	C	90	79	2	8
5	D	87	86	3	5
6	E	84	84	6	6
7	F	86	83	4	7
8	G	91	88	1	4
9	H	74	92	9	2
10	I	83	76	7	9
11	J	85	75	5	10
12					
13	Spearman Correlation:	-0.4181818182			
14		=? =CORREL(D2:D11, E2:E11)			
15					
16					
17					
18					
19					
20					
21					

Step 4 (Optional): Determining Statistical Significance

Finding the Spearman Rank Correlation coefficient (**-0.41818**) is only half the battle; the next crucial step in rigorous statistics is determining whether this observed correlation is statistically significant. A finding is considered statistically significant if the probability of observing such a correlation by random chance is sufficiently low. To assess this, we must compare the absolute value of our calculated coefficient against a predetermined critical value, which is found using a specialized table tailored for the Spearman test.

The critical value depends on two primary factors: the sample size (n) and the chosen significance level (α), commonly set at 0.05 (representing a 5% chance of error). For our study, the sample size is $n = 10$. Consulting the Spearman rank correlation table of critical values allows us to identify the threshold for statistical significance based on these parameters. If the absolute value of our calculated correlation (ignoring the negative sign, so 0.41818) is greater than the critical value from

the table, we can reject the null hypothesis and conclude that the correlation is statistically significant.

Referring to the provided table of critical values for $n=10$ and a significance level (α) of 0.05, we find the critical value to be **0.564**. This value represents the minimum correlation magnitude required to confidently assert a non-random relationship. Since the absolute value of our calculated Spearman coefficient (**0.41818**) is smaller than the critical value (0.564), we conclude that the observed correlation, while suggesting a negative trend, is **not statistically significant** at the 0.05 level. This means that, based on this small sample size, we cannot definitively rule out the possibility that the apparent correlation is merely due to random chance.

n	α				
	0.10	0.05	0.025	0.01	0.005
5	0.800	0.900	1.000	1.000	-
6	0.657	0.829	0.886	0.943	1.000
7	0.571	0.714	0.786	0.893	0.929
8	0.524	0.643	0.738	0.833	0.881
9	0.483	0.600	0.700	0.783	0.833
10	0.455	0.564	0.648	0.745	0.794
11	0.427	0.536	0.618	0.709	0.755
12	0.406	0.503	0.587	0.678	0.727
13	0.385	0.484	0.560	0.648	0.703
14	0.367	0.464	0.538	0.626	0.679
15	0.354	0.446	0.521	0.604	0.654
16	0.341	0.429	0.503	0.582	0.635
17	0.328	0.414	0.488	0.566	0.618
18	0.317	0.401	0.472	0.550	0.600
19	0.309	0.391	0.460	0.535	0.584
20	0.299	0.380	0.447	0.522	0.570
21	0.292	0.370	0.436	0.509	0.556
22	0.284	0.361	0.425	0.497	0.544
23	0.278	0.353	0.416	0.486	0.532
24	0.271	0.344	0.407	0.476	0.521
25	0.265	0.337	0.398	0.466	0.511
26	0.259	0.331	0.390	0.457	0.501
27	0.255	0.324	0.383	0.449	0.492
28	0.250	0.318	0.375	0.441	0.483
29	0.245	0.321	0.368	0.433	0.475
30	0.240	0.306	0.362	0.425	0.467

Conclusion and Interpretation of Results

Through this systematic application of Google Sheets functions, we successfully calculated the Spearman rank correlation coefficient for our sample student data. We utilized the `RANK.AVG`

function to correctly handle score ties and the `CORREL` function to find the association between the resulting ranks. The calculated coefficient of -0.41818 suggests a moderate tendency for high rankings in one subject to correspond to lower rankings in the other. This type of analysis is invaluable in educational statistics, allowing educators to identify potential areas of student specialization or curriculum imbalance.

However, the subsequent step of assessing statistical significance provided a critical nuance. By comparing our coefficient against the critical value derived from a standard table, we determined that the observed correlation was not strong enough to be deemed non-random for a sample size of $n=10$. This outcome does not mean that there is no relationship, but rather that the evidence derived from this specific, small sample is insufficient to reject the null hypothesis with 95% confidence.

In summary, the process of calculating the Spearman Rank Correlation in Google Sheets is efficient and reliable, requiring only two major functional components: ranking and correlation calculation. Researchers and analysts should always remember that the statistical significance check is a non-negotiable part of the analysis, providing the necessary context for interpreting the magnitude of the calculated correlation coefficient. For practical application, if a significant correlation is required, this study suggests that a larger sample size would be necessary to increase the power of the test and confirm the observed negative trend.

Further Resources:

[How to Calculate Spearman Rank Correlation in Excel](#)