

How to Perform a Mann-Whitney U Test in Excel to Compare Two Samples

Authored by
stats writer

March 9, 2026

RECOMMENDED CITATION

stats writer (2026). *How to Perform a Mann-Whitney U Test in Excel to Compare Two Samples*. PSYCHOLOGICAL SCALES. Retrieved from <https://scales.arabpsychology.com/?p=134806>

Understanding the Mann-Whitney U Test and Its Importance in Statistics

The **Mann-Whitney U test**, which is also frequently identified as the **Wilcoxon rank-sum test**, represents one of the most powerful **nonparametric statistics** tools available to researchers. Its primary function is to determine whether there is a significant difference between the distributions of two independent groups. Unlike parametric tests that rely on specific distributional parameters, this test is uniquely designed to handle data that does not necessarily follow a **normal distribution**, making it an essential asset for scientists and analysts working with real-world data that is often skewed or contains outliers.

In many experimental settings, researchers are faced with small sample sizes where the underlying population variance is unknown. When these sample sizes are particularly limited, typically with an "n" of less than 30, the assumptions required for a standard **independent samples t-test** are often violated. In such instances, the Mann-Whitney U test provides a reliable alternative by focusing on the ranks of the data points rather than their raw values. By transforming the quantitative data into ordinal ranks, the test mitigates the influence of extreme values and provides a more accurate reflection of the central tendency differences between the groups.

Utilizing **Excel** to perform this analysis is a practical choice for many professionals due to the software's accessibility and its robust set of built-in mathematical functions. While Excel does not have a single, dedicated button for the Mann-Whitney U test, the process can be easily executed through a series of logical steps involving data ranking and basic algebraic formulas. This tutorial will guide you through the comprehensive workflow, ensuring that you can derive meaningful insights from your comparative studies without requiring specialized statistical software.

Core Assumptions and the Decision to Use a Nonparametric Approach

Before proceeding with the technical execution in **Excel**, it is vital to understand the underlying assumptions of the Mann-Whitney U test. First and foremost, the test requires that the two samples being compared are independent of one another; this means that the observations in one group should have no influence on the observations in the second group. Additionally, the dependent variable should be measured on at least an ordinal scale, though continuous data is most commonly used. The test does not require the data to be **normally distributed**, which is its greatest advantage over the t-test.

The decision to utilize a nonparametric method often stems from the nature of the data collection. For instance, in fields like psychology or medicine, measurements may be based on Likert scales or small-scale clinical trials where the criteria for parametric testing cannot be met. If your data fails the **Shapiro-Wilk test** or other normality tests, the Mann-Whitney U test becomes the most appropriate **statistical significance** tool. It essentially tests the **null hypothesis** that it is equally

likely that a randomly selected value from one population will be less than or greater than a randomly selected value from a second population.

Furthermore, the Mann-Whitney U test is particularly robust against the presence of outliers. Because the test relies on the rank order of observations, a single extreme value will only be assigned the highest or lowest rank, rather than pulling the mean in a specific direction. This characteristic ensures that the resulting **p-value** is more representative of the overall dataset. By following the structured steps outlined in this guide, you will be able to verify your findings with a high degree of confidence and academic rigor.

The Experimental Scenario: Analyzing Fuel Treatment Efficiency

To illustrate the application of this test, let us consider a practical experiment conducted by automotive researchers. The goal of the study is to determine if a specific chemical fuel treatment leads to a quantifiable change in the average miles per gallon (mpg) of a standard passenger vehicle. In this experiment, the researchers have two distinct groups: a "Treated" group consisting of 12 cars that received the additive, and a "Control" group consisting of 12 cars that did not. This small sample size of 24 total vehicles necessitates a careful choice of statistical methodology.

The researchers suspect that the mpg data may not be **normally distributed** due to varying driving conditions and mechanical differences between individual vehicles. Given these concerns and the small sample size, they have opted to perform a Mann-Whitney U test to determine if there is a **statistically significant difference** in fuel efficiency between the two groups. This real-world example serves as a perfect template for understanding how to structure your own data and interpret the final metrics.

In this context, the **null hypothesis** states that there is no difference in the distribution of mpg between the treated and untreated cars. Conversely, the alternative hypothesis suggests that the fuel treatment significantly alters the fuel consumption profile. By calculating the **U statistic** and the subsequent **z test statistic**, we can conclude whether the observed differences are likely due to the treatment or simply a result of random chance.

Step 1: Organizing and Preparing Your Data in Excel

The first step in conducting any statistical analysis in **Excel** is to ensure that your data is organized in a clean, logical format. For the Mann-Whitney U test, you should create two distinct columns, each representing one of the independent groups. In our fuel treatment example, Column A would be labeled "Treated" and Column B would be labeled "Control." Each row within these columns will contain the individual mpg measurements for each respective car.

Proper data entry is crucial because any errors at this stage will propagate through the ranking and

calculation steps. Ensure that there are no empty cells within your data range and that all values are numerical. If you have unequal sample sizes, that is perfectly acceptable for this test; however, for this specific example, we will maintain two groups of 12 for consistency and ease of calculation. Once your data is entered, you will have a clear visual representation of your experimental results before moving into the ranking phase.

	A	B	C	D	E
1	Treated	Untreated			
2	24	20			
3	25	23			
4	21	21			
5	22	25			
6	23	18			
7	18	17			
8	17	18			
9	28	24			
10	24	20			
11	27	24			
12	21	23			
13	23	19			
14					
15					
16					
17					
18					

As shown in the image above, the data is clearly segregated. This structure allows us to use **Excel** functions that reference specific ranges. It is also helpful to leave space to the right of your data for the ranking columns and the final summary table where the **U statistic** and **p-value** will be displayed. Organization is the foundation of accurate data analysis, particularly when dealing with manual formula entries.

Step 2: Assigning Ranks for Both Experimental Groups

The core mechanism of the Mann-Whitney U test involves ranking every single data point from both groups combined. You treat all observations as a single dataset and assign a rank of 1 to the smallest value, 2 to the next smallest, and so on. If there are duplicate values (ties), you must assign the average of the ranks they would have otherwise occupied. Fortunately, **Excel** provides the **RANK.AVG** function to automate this complex task, saving significant time and reducing the risk of manual error.

To calculate the ranks for the first value in the "Treated" group, you will use a formula that compares the individual cell against the entire range of both groups. The syntax involves the specific cell you are ranking, the full reference range (using absolute references with dollar signs, e.g., $\$A\$2:\$B\13), and a "1" to indicate ascending order. This ensures that as you drag the formula down the column, the reference range remains fixed while the individual cell reference updates relatively.

	A	B	C	D	E	F	G	H	I	J	K	L
1	Treated	Untreated		Treated (ranks)	Untreated (ranks)							
2	24	20		18.5								
3	25	23										
4	21	21										
5	22	25										
6	23	18										
7	18	17										
8	17	18										
9	28	24										
10	24	20										
11	27	24										
12	21	23										
13	23	19										
14												
15												
16												
17												
18												

After entering the formula for the first cell, you can simply use the "fill handle" to drag the formula across all cells for both the "Treated" and "Control" rank columns. This results in a new set of data where every mpg value has a corresponding rank. These ranks are what the Mann-Whitney U test uses to determine if one group's values are systematically higher or lower than the other's. The visual output in your spreadsheet should now show four columns: two for the raw data and two for the assigned ranks.

	A	B	C	D	E	F
1	Treated	Untreated		Treated (ranks)	Untreated (ranks)	
2	24	20		18.5	7.5	
3	25	23		21.5	14.5	
4	21	21		10	10	
5	22	25		12	21.5	
6	23	18		14.5	4	
7	18	17		4	1.5	
8	17	18		1.5	4	
9	28	24		24	18.5	
10	24	20		18.5	7.5	
11	27	24		23	18.5	
12	21	23		10	14.5	
13	23	19		14.5	6	
14						
15						
16						
17						
18						

Step 3: Calculating Necessary Values for the Test Statistic

With the ranks assigned, the next phase involves calculating the **U test statistic**. This requires several intermediate values: the sum of the ranks for each group (R1 and R2) and the sample sizes for each group (n1 and n2). In **Excel**, you can use the **SUM** function to quickly total the ranks for the "Treated" group and the "Control" group respectively. You can use the **COUNT** function to verify the number of observations in each sample, which is critical if your datasets are large or uneven.

The U statistic itself is calculated for each group using a specific formula: $U = R - (n(n+1)/2)$. Here, R is the sum of ranks for that specific group, and n is the sample size of that group. The final Mann-Whitney U value is the smaller of the two calculated U values (U1 and U2). This **U statistic** represents the number of times a value in one group precedes a value in another group when all values are sorted. It is the fundamental numerical output that describes the relationship between your two samples.

	A	B	C	D	E	F	G	H
1	Treated	Untreated		Treated (ranks)	Untreated (ranks)			
2	24	20		18.5	7.5			
3	25	23		21.5	14.5			
4	21	21		10	10			
5	22	25		12	21.5			
6	23	18		14.5	4			
7	18	17		4	1.5			
8	17	18		1.5	4			
9	28	24		24	18.5			
10	24	20		18.5	7.5			
11	27	24		23	18.5			
12	21	23		10	14.5			
13	23	19		14.5	6			
14								
15				R1	172	=SUM(D2:D13)		
16				R2	128	=SUM(E2:E13)		
17								
18				N1	12	=COUNT(A2:A13)		
19				N2	12	=COUNT(B2:B13)		
20								
21				U1	50	=E18*E19+E18*(E18+1)/2-E15		
22				U2	94	=E18*E19+E19*(E19+1)/2-E16		
23								
24				U	50	=MIN(E21, E22)		
25								
26								
27								

The calculations shown in the image above demonstrate how to derive U1 and U2. These steps are essential because they bridge the gap between raw data ranks and the standardized test statistics used for significance testing. By documenting these intermediate values in your **Excel** sheet, you create a transparent and reproducible analysis that can be easily audited or updated if new data becomes available.

Step 4: Deriving the Z-Score and Final P-Value

For sample sizes larger than a few observations, the distribution of the **U statistic** tends toward a normal distribution. This allows us to calculate a **z test statistic**, which standardizes the U value. To calculate the Z-score, you first need to determine the mean and the **standard error** of the U distribution. The mean is calculated as $(n1 * n2) / 2$, and the standard error involves a more complex square root formula based on the product of the sample sizes and the total number of observations.

Once the Z-score is determined, **Excel** can calculate the **p-value** using the **NORM.S.DIST**

function. The p-value is the most critical piece of information in your analysis, as it tells you the probability of obtaining your results if the **null hypothesis** were true. A low p-value suggests that the observed difference is unlikely to have occurred by chance, leading you to reject the null hypothesis in favor of the alternative.

	A	B	C	D	E	F	G	H	I	J
1	Treated	Untreated		Treated (ranks)	Untreated (ranks)					
2	24	20		18.5	7.5					
3	25	23		21.5	14.5					
4	21	21		10	10					
5	22	25		12	21.5					
6	23	18		14.5	4					
7	18	17		4	1.5					
8	17	18		1.5	4					
9	28	24		24	18.5					
10	24	20		18.5	7.5					
11	27	24		23	18.5					
12	21	23		10	14.5					
13	23	19		14.5	6					
14										
15				R1	172	=SUM(D2:D13)				
16				R2	128	=SUM(E2:E13)				
17										
18				N1	12	=COUNT(A2:A13)				
19				N2	12	=COUNT(B2:B13)				
20										
21				U1	50	=E18*E19+E18*(E18+1)/2-E15				
22				U2	94	=E18*E19+E19*(E19+1)/2-E16				
23										
24				U	50	=MIN(E21, E22)				
25										
26				z	-1.270170592	=(E24-E18*E19/2)/SQRT(E18*E19*(E18+E19+1)/12)				
27				p	0.20402387	=NORM.DIST(E26, 0, 1, TRUE)*2				
28										

In our mpg experiment, the calculated **p-value** is approximately **0.204**. This value is used to make a definitive statistical judgment. Because the calculation of Z and p-values can be sensitive to rounding, using **Excel** functions ensures a high level of precision. At this stage, you have successfully transformed raw observations into a standardized metric that can be compared against established **significance levels**.

Interpreting the Results and Statistical Significance

Interpretation is the final and most important step of the statistical process. In scientific research, the standard threshold for **statistical significance** is typically set at an alpha level of 0.05. If your calculated **p-value** is less than or equal to 0.05, you reject the **null hypothesis** and conclude that there is a significant difference between the groups. If the p-value is greater than 0.05, you fail to reject the null hypothesis, meaning the evidence is insufficient to suggest a real difference exists.

In our fuel treatment case, the **p-value** of **0.20402387** is significantly higher than the 0.05 threshold. Therefore, we fail to reject the null hypothesis. This implies that the data collected does not provide enough evidence to conclude that the fuel treatment has a significant impact on the car's fuel efficiency. While there might be a numerical difference in the **mean** mpg between the two groups in the sample, this difference is not large enough to be considered statistically reliable or generalizable to the broader population of vehicles.

It is important to remember that "failing to reject the null hypothesis" is not the same as proving the null hypothesis is true. It simply means that, based on the current data and sample size, no significant effect was detected. Researchers might use this result to decide whether to conduct a larger study with more cars or to explore different types of fuel additives. This nuance in interpretation is what separates professional data analysts from casual observers.

Conclusion: The Power of Excel for Nonparametric Analysis

The ability to perform a **Mann-Whitney U test** in **Excel** demonstrates the versatility of spreadsheet software for high-level statistical analysis. By following this structured approach--organizing data, assigning ranks, calculating U statistics, and deriving p-values--you can perform complex **nonparametric statistics** without the need for expensive, specialized software. This workflow is not only efficient but also provides a deep understanding of how the test functions under the hood.

Whether you are evaluating the effectiveness of a medical intervention, a marketing campaign, or an industrial process, the Mann-Whitney U test remains a gold standard for comparing independent groups with non-normal data. Excel's ability to provide graphical representations alongside these numerical results further enhances your ability to communicate findings to stakeholders. By mastering these steps, you empower yourself to make data-driven decisions backed by rigorous mathematical proof.

As you continue your journey in data analysis, remember that the choice of test is just as important as the execution. Always check your data's **standard deviation** and distribution before deciding on a parametric or nonparametric path. With the tools and knowledge provided in this guide, you are now well-equipped to handle small-sample comparisons with confidence and precision, ensuring your research is both accurate and impactful.