The Mann-Whitney $U$ test evaluates whether the medians on a test variable differ significantly between two groups. To conduct the Mann-Whitney $U$ test, each case must have scores on two variables, the grouping variable (independent or categorical variable) and the test variable (dependent or quantitative variable). The grouping variable divides cases into two groups or categories, and the test variable assesses individuals on a variable with at least an ordinal scale.

**UNDERSTANDING THE MANN-WHITNEY $U$ TEST**

To help understand how the Mann-Whitney $U$ test evaluates differences in medians, we will look at an example provided by Green and Salkind (2008). First, we must describe what data are being analyzed in this test. We will be using the Visual Spatial Memory Task (VSMT) data for young and elderly women (Lesson 42 from Green & Salkind).

For a Mann-Whitney $U$ test, the scores on the test variable (VSMT) are converted to ranks (Ranked_VSMT), ignoring group membership (Age: Young or Elderly Women). The Mann-Whitney $U$ test then evaluates whether the mean ranks for the two groups differ significantly from each other. For this example, we will be evaluating whether the mean rank for the younger group of 23.17 differs significantly from the mean rank for the elderly group of 15.54.
Because analyses for the Mann-Whitney U test are conducted on ranked scores, the distributions of the test variable for the two populations do not have to normally distributed. However, the distribution should be continuous and have identical forms (for the two groups).

**ASSUMPTIONS UNDERLYING A MANN-WHITNEY U TEST**

*Assumption 1:* The continuous distributions for the test variable are exactly the same (except their medians) for the two populations.

*Assumption 2:* The cases represent random samples from the two populations, and the scores on the test variable are independent of each other.

*Assumption 3:* The z-approximation test for the Mann-Whitney U test requires a large sample size.

An exact test is printed by SPSS if the number of cases is less than or equal to 41. Accordingly, the z-approximation test does not have to be used unless the sample size is greater than 41. A sample size of at least 42 should be sufficiently large to yield relatively accurate p values with the z-approximation test. The z-approximation test includes a correction for ties but does not include a continuity correction.

**EFFECT SIZE STATISTICS FOR THE MANN-WHITNEY U TEST**

SPSS does not report an effect size index for the Mann-Whitney U test, but simple indices can be computed to communicate the size of the effect. For example, Green and Salkind suggest that differences in mean ranks or medians between the two groups can serve as an effect size index.

**THE DATA SET**

The data set that we will look at for this example is from Lesson 42 from Green and Salkind’s (2008) *Using SPSS for Windows and Macintosh: Analyzing and Understanding Data (5th ed.).* The data set represents data from an example on aging and performance on a visual spatial memory task (VSMT). The grouping variable (AGE) has two levels: Younger Women and Older Women. The test variable (VSMT) is the visual spatial memory task, which yields scores that range in value potentially from 0 to 100, with higher scores indicating better memory.

**THE RESEARCH QUESTIONS**

The research questions used in this example can be asked to reflect differences in medians between groups or a relationship between two variables.

1. **Differences** between the medians: Does the median performance on the visual spatial memory task differ for younger and older women?
2. **Relationship** between two variables: Is performance on the visual spatial memory task related to age for women?
CONDUCTING THE MANN-WHITNEY U TEST IN SPSS

To conduct the Mann-Whitney U test in SPSS, use the following steps:

- Open the dataset in SPSS to be used for the Mann-Whitney U Test analysis
- Click **Analyze**, click (mouse over) **Nonparametric Tests**, and then click **2 Independent-Samples**
  - You should now be in the **Two-Independent Samples Tests** dialog box
    - Click on your (Test Variable), and click ▶ to move it to the Test Variable List: box
    - Click on your (Grouping Variable), and click ▶ to move it to the Grouping Variable: box
    - Click **Define Groups**
      - Type 1 in the Group 1 box to indicate that Group 1 is the first level of your grouping variable.
      - Type 2 in the Group 2 box indicating that Group 2 is the second level of your grouping variable.
    - Click **Continue**
    - Click **Options**
      - Under Statistics
        - Select [✓] Descriptive
    - Click **Continue**
      - Be sure Mann-Whitney U is checked in the Test Type area.
      - Click **OK**
- You are now ready to analyze the output data…

SPSS OUTPUT

NPar Tests

<table>
<thead>
<tr>
<th>Descriptive Statistics</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Minimum</th>
<th>Maximum</th>
</tr>
</thead>
<tbody>
<tr>
<td>VSMT</td>
<td>40</td>
<td>69.58</td>
<td>18.178</td>
<td>34</td>
<td>98</td>
</tr>
<tr>
<td>Age</td>
<td>40</td>
<td>1.35</td>
<td>.483</td>
<td>1</td>
<td>2</td>
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</tbody>
</table>
Mann-Whitney Test

<table>
<thead>
<tr>
<th>Age</th>
<th>N</th>
<th>Mean Rank</th>
<th>Sum of Ranks</th>
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</thead>
<tbody>
<tr>
<td>VSMT younger</td>
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<td>23.17</td>
<td>602.50</td>
</tr>
<tr>
<td>elderly</td>
<td>14</td>
<td>15.54</td>
<td>217.50</td>
</tr>
<tr>
<td>Total</td>
<td>40</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Test Statistics

<table>
<thead>
<tr>
<th></th>
<th>VSMT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mann-Whitney U</td>
<td>112.500</td>
</tr>
<tr>
<td>Wilcoxon W</td>
<td>217.500</td>
</tr>
<tr>
<td>Z</td>
<td>-1.974</td>
</tr>
<tr>
<td>Asymp. Sig. (2-tailed)</td>
<td>.048</td>
</tr>
<tr>
<td>Exact Sig. [2*(1-tailed Sig.)]</td>
<td>.048</td>
</tr>
</tbody>
</table>

a. Not corrected for ties.

**APA Results**

Based on the results produced from the above example, the APA results would be:

A Mann-Whitney $U$ test was conducted to evaluate the hypothesis that elderly women would score lower, on the average, than younger women on a visual spatial memory task. The results of the test were in the expected direction and significant, $z = -1.97, p < .05$. Elderly women had an average rank of 15.54, while younger women had an average rank of 23.17.

**Reference**