

# 12. Nonparametric Statistics

## Objectives

- ◆ Calculate Mann-Whitney Test
- ◆ Calculate Wilcoxon's Matched-Pairs Signed-Ranks Test
- ◆ Calculate Kruskal-Wallis One-Way ANOVA
- ◆ Calculate Friedman's Rank Test for k Correlated Samples

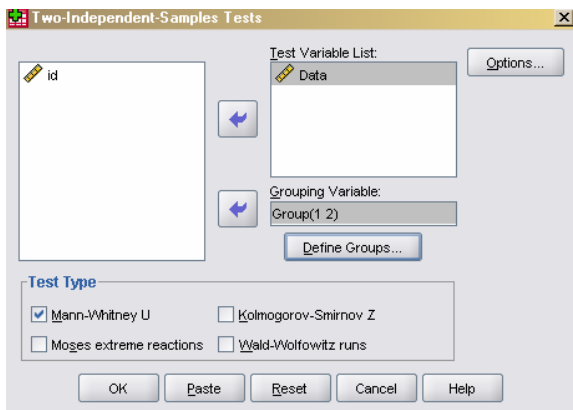
Nonparametric statistics or distribution-free tests are those that do not rely on parameter estimates or precise assumptions about the distributions of variables. In this chapter we will learn how to use SPSS Nonparametric statistics to compare 2 independent groups, 2 paired samples, k independent groups, and k related samples.

## Mann-Whitney Test

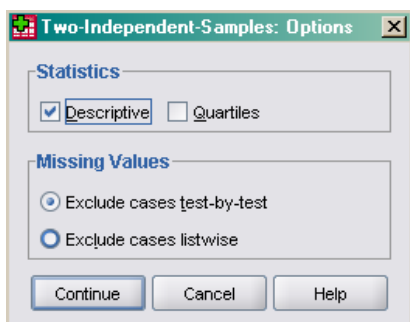
Let's begin by comparing 2 independent groups using the Mann-Whitney Test. We'll use the example presented in Table 20.1 in the textbook. We want to compare the number of stressful life events reported by cardiac patients and orthopedic patients.

✓ **Open** *stressful events.sav*.

✓ Select **Analyze/Nonparametric Tests/Two Independent Samples**.



✓ Select data as the **Test Variable** and group as the **Grouping Variable**. Click on **Define Groups** and specify 1 for **Group 1** and 2 for **Group 2**, then click **Continue**. Under Test-Type, select **Mann-Whitney U**. Then click on **Options**.



✓ Under **Statistics**, select **Descriptives**. Then click **Continue**. In the main dialog box, click **Ok**. The output follows.

### Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum
Data	11	8.6364	11.12001	.00	32.00
Group	11	1.4545	.52223	1.00	2.00

### Mann-Whitney Test

#### Ranks

Group	N	Mean Rank	Sum of Ranks
Data Cardiac Patient	6	7.50	45.00
Non-cardiac Patient	5	4.20	21.00
Total	11		

#### Test Statistics<sup>b</sup>

	Data
Mann-Whitney U	6.000
Wilcoxon W	21.000
Z	-1.647
Asymp. Sig. (2-tailed)	.100
Exact Sig. [2*(1-tailed Sig.)]	.126 <sup>a</sup>

a. Not corrected for ties.

b. Grouping Variable: Group

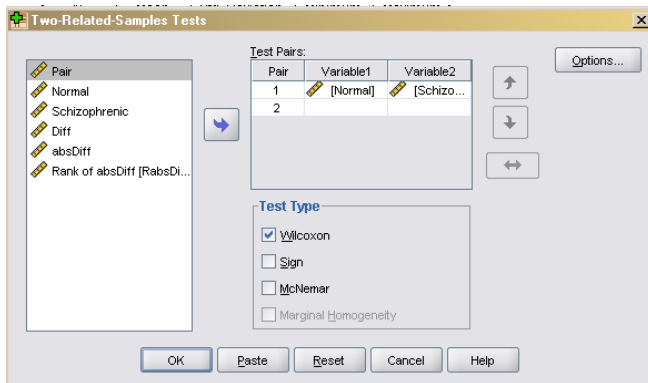
Compare this output to the results in Section 20.1 of the textbook. Specifically, focus on the row labeled Wilcoxon W in the **Test Statistics** table. As you can see they are the same. There is not a statistically significant difference in stressful life events for the 2 groups. But if this is the Mann-Whitney test, why did I tell you to look at Wilcoxon's W? The reason is that I cheated in the text. To avoid talking about two Wilcoxon tests, I called this one the Mann-Whitney (which is basically true) but showed you how to calculate the Wilcoxon statistic. It honestly doesn't make any difference.

### Wilcoxon's Matched Pairs Signed-Ranks Test

Now, let's compare paired or related data. We will use the example illustrated in Section 20.2 of the textbook. We will compare the volume of the left hippocampus in twin pairs, one of whom is schizophrenic and one of whom is normal.

✓ **Open** *Hippocampus Volume.sav*.

✓ Select **Analyze/Nonparametric Tests/2 Related Samples**.



✓ Select Normal and Schizophrenic for the **Test Pairs List**. Select **Wilcoxon** for **Test Type**. Then, click **Ok**. The output follows.

### Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum
Normal	15	1.7593	.24150	1.25	2.08
Schizophrenic	15	1.5600	.30126	1.02	2.02

### Wilcoxon Signed Ranks Test

#### Ranks

		N	Mean Rank	Sum of Ranks
Schizophrenic - Normal	Negative Ranks	14 <sup>a</sup>	7.93	111.00
	Positive Ranks	1 <sup>b</sup>	9.00	9.00
	Ties	0 <sup>c</sup>		
	Total	15		

a. Schizophrenic < Normal

b. Schizophrenic > Normal

c. Schizophrenic = Normal

#### Test Statistics<sup>b</sup>

	Schizophrenic - Normal
Z	-2.897 <sup>a</sup>
Asymp. Sig. (2-tailed)	.004

a. Based on positive ranks.

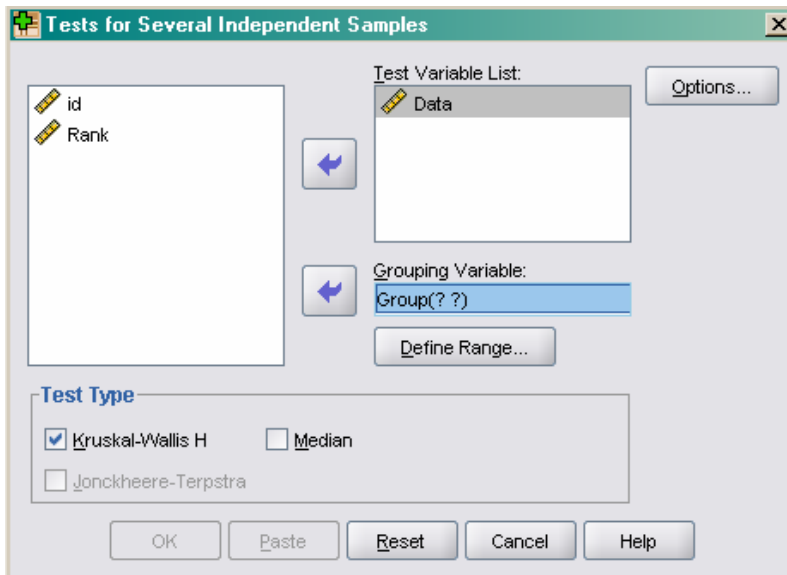
b. Wilcoxon Signed Ranks Test

The Sum of Ranks column includes the T values. Compare them to the values in the text. Note that the test statistic in SPSS is  $z$ . Regardless, the results are the same. There is a significant difference in hippocampal volume between normals and schizophrenics..

## Kruskal-Wallis One-Way ANOVA

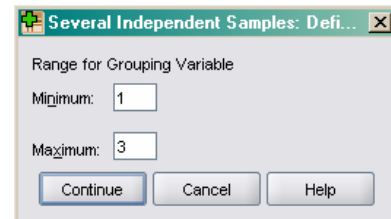
Now let's compare more than 2 independent groups. We'll use the example illustrated in Table 20.4 of the text, comparing the number of problems solved correctly in one hour by people who received a depressant, stimulant, or placebo drug.

- ✓ **Open** *problem solving.sav*.
- ✓ Select **Analyze/Nonparametric Test/ K Independent Samples**.



- ✓ Select **problem** as the **Test Variable** and **group** as the **Grouping Variable**. Then, click on **Define Range**.

- ✓ Indicate 1 for the **Minimum** and 3 for the **Maximum** since there are 3 groups, identified as 1,2, and 3. Click **Continue**.



- ✓ Kruskal-Wallis is already selected in the main dialog box, so just click **Ok**. The output follows.

## Kruskal-Wallis Test

Ranks

	GROUP	N	Mean Rank
PROBLEM	1	7	5.00
	2	8	14.38
	3	4	10.00
	Total	19	

**Test Statistics<sup>a,b</sup>**

	PROBLEM
Chi-Square	10.407
df	2
Asymp. Sig.	.005

a. Kruskal Wallis Test

b. Grouping Variable: GROUP

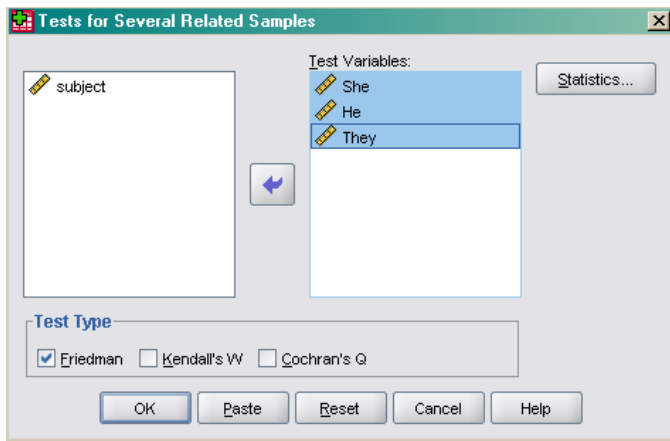
As you can see these results agree with those in the text, with minor differences in the decimal places. This is due to rounding. Both sets of results support the conclusion that problems solved correctly varied significantly by group.

### Friedman's Rank Test for K Related Samples

Now, let's move on to an example with  $k$  related samples. We'll use the data presented in Table 20.5 of the textbook as an example. We want to see if reading time is effected when reading pronouns that do not fit common gender stereotypes.

✓ **Open** *pronouns.sav*.

✓ Select **Analyze/Nonparametric Tests/K Related Samples**.



✓ Select **She, He, and They** as the **Test Variables**. **Friedman** is the default for **Test Type**, so we can click **Ok**. The output follows.

**Ranks**

	Mean Rank
HESHE	2.00
SHEHE	2.64
NEUTTHEY	1.36

**Test Statistics<sup>a</sup>**

N	11
Chi-Square	8.909
df	2
Asymp. Sig.	.012

a. Friedman Test

As you can see, the Chi Square value is in agreement with the one in the text. We can conclude that reading times are related to pronoun conditions.

In this chapter, you learned to use SPSS to calculate each of the Nonparametric Statistics included in the textbook. Complete the following exercises to help you become familiar with each.

### Exercises

1. Using *birthweight.sav*, use the Mann-Whitney Test to compare the birthweight of babies born to mothers who began prenatal care in the third trimester to those who began prenatal classes in the first trimester. Compare your results to the results presented in Table 20.2 of the textbook. (Note: SPSS chooses to work with the sum of the scores in the *larger* group (71), and thus  $n_1$  and  $n_2$  are reversed. This will give you the same  $z$  score, with the sign reversed. Notice that  $z$  in the output agrees with  $z$  in the text.)
2. Using *anorexia family therapy.sav* (the same example used for the paired t-test in Chapter 7 of this manual), compare the subjects' weight pre and post intervention using Wilcoxon's Matched Pairs Signed Ranks Test. What can you conclude?
3. Using *maternal role adaptation.sav* (the same example used for one-way ANOVA in Chapter 8 of this manual), compare maternal role adaptation for the 3 groups of mothers using the Kruskal-Wallis ANOVA. What can you conclude?
4. Using *Eysenck recall repeated.sav* (the same example used for Repeated Measures ANOVA in Chapter 10 of this manual), examine the effect of processing condition on recall using Friedman's Test. What can you conclude?