Non-Parametric Tests in SPSS (within-subjects)

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Outline

• Wilcoxon Signed-rank test
  – SPSS procedure
  – Interpretation of SPSS output
  – Reporting
• Fridman’s test
  – SPSS procedure
  – Interpretation of SPSS output
  – Reporting
Wilcoxon

• This is appropriate for within participants designs

• The Wilcoxon test is conceptually similar to the related samples t test
  – Condition 1 and condition 2
  – Time 1 and time 2
Wilcoxon

• **Design**: Non-parametric
  – 1 continuous DV (criminal identity)
  – 2 conditions or variable measured at 2 different time points (IV) - same participants in both conditions

• **Purpose**: To determine if there is a significant change in level of criminal social identity between time 1 (2000) and time 2 (2010)
SPSS Procedure

- Click Analyze
- Nonparametric Tests
- Legacy Dialogs
- 2 Related Samples
SPSS Procedure

- Transfer the variables Criminal Identity and Criminal Identity2, which represent the Criminal Identity in 2000 and 2010, respectively. There are two ways to do this. You can either: (1) highlight both variables and then press the SPSS Right Arrow button; or (2) drag-and-drop each variable into the boxes.

Make sure that the Wilcoxon checkbox is ticked.
SPSS Procedure

• Click on the **Options** button and then tick **Descriptive** and **Quartiles** within the Statistics area

• Click **Continue**

• Then click **OK** button, which will get SPSS to generate the output for the Wilcoxon test
### Descriptive Statistics

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Minimum</th>
<th>Maximum</th>
<th>25th</th>
<th>50th (Median)</th>
<th>75th</th>
</tr>
</thead>
<tbody>
<tr>
<td>Criminal Identity</td>
<td>21</td>
<td>22.2857</td>
<td>6.37293</td>
<td>8.00</td>
<td>33.00</td>
<td>18.5000</td>
<td>22.0000</td>
<td>26.5000</td>
</tr>
<tr>
<td>Criminal Identity2</td>
<td>21</td>
<td>30.1905</td>
<td>5.75864</td>
<td>12.00</td>
<td>38.00</td>
<td>28.0000</td>
<td>31.0000</td>
<td>35.0000</td>
</tr>
</tbody>
</table>
The Ranks table provides some interesting data on the comparison of prisoners' criminal identity scores at time 1 and time 2.

We can see from the table's legend that none of the prisoners in 2000 had a higher scores than in 2010. All of them had a higher Criminal Identity Score in 2010 and none of them saw no change in their score.
By examining the final Test Statistics table, we can discover whether these change in criminal identity led overall to a statistically significant difference.

We are looking for the Asymp. Sig. (2-tailed) value, which in this case is 0.000. This is the p value for the test.

We report the Wilcoxon signed-ranks test using the Z statistic.
Effect Size

• Must be calculated manually, using the following formula:

\[
\frac{Z}{\sqrt{N}} = r
\]

-4.085

\[
\frac{r}{\sqrt{42}} = -.63
\]

The N here is the total number of observations that were made (typically, participants x 2 when you have two levels) – this example r = -.63 (large effect size)
As the data was skewed (not normally distributed) the most appropriate statistical test was Wilcoxon Signed-rank test. There was a significant increase from time 1 (median = 18) to time 2 (median = 28) in the levels of criminal identity, $Z = -4.09$, $p < .001$, and the increase was large ($r = -.63$).
Friedman’s test

• The Friedman’s test is the nonparametric test equivalent to the repeated measures ANOVA, and an extension of the Wilcoxon test
  – it allows the comparison of more than two dependent groups (two or more conditions)
Friedman’s test

• **Design:** Non-parametric
  – 1 continuous DV (criminal identity)
  – 3 conditions or variable measured at 3 different time points (IV) - same participants in all conditions

• **Purpose:** To determine if there is a significant change in level of criminal social identity between time 1 (2000) and time 2 (2010) and time 3 (2013)
SPSS Procedure

- Click Analyze
- Nonparametric Tests
- Legacy Dialogs
- K Related Samples
SPSS Procedure

- Move all levels of DV (this example “Criminal Identity”, “Criminal Identity1”, “Criminal Identity2”) to the **Test Variable**: box by using the SPSS Right Arrow button.

Make sure that the Friedman checkbox is ticked.
SPSS Procedure

• Click on the **Options** button and then tick **Descriptive** and **Quartiles** within the Statistics area

• Click **Continue**

• Then click **OK** button, which will get SPSS to generate the output for the test
• Descriptive statistics

<table>
<thead>
<tr>
<th></th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Minimum</th>
<th>Maximum</th>
<th>Percentiles</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>25th</td>
</tr>
<tr>
<td>Criminal Identity</td>
<td>21</td>
<td>17.2381</td>
<td>4.41480</td>
<td>8.00</td>
<td>25.00</td>
<td>13.0000</td>
</tr>
<tr>
<td>Criminal Identity2</td>
<td>21</td>
<td>26.9048</td>
<td>5.34701</td>
<td>15.00</td>
<td>35.00</td>
<td>22.5000</td>
</tr>
<tr>
<td>Criminal Identity3</td>
<td>21</td>
<td>36.9524</td>
<td>4.16505</td>
<td>25.00</td>
<td>40.00</td>
<td>34.5000</td>
</tr>
</tbody>
</table>
There was a significant change in levels of criminal social identity over time, $\chi^2(2, N = 21) = 42.00, p < .001$.

### Ranks

<table>
<thead>
<tr>
<th></th>
<th>Mean Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>Criminal Identity</td>
<td>1.00</td>
</tr>
<tr>
<td>Criminal Identity2</td>
<td>2.00</td>
</tr>
<tr>
<td>Criminal Identity3</td>
<td>3.00</td>
</tr>
</tbody>
</table>

### Test Statistics\(^a\)

<p>| | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>N</td>
<td>21</td>
</tr>
<tr>
<td>Chi-Square</td>
<td>42.00</td>
</tr>
<tr>
<td>df</td>
<td>2</td>
</tr>
<tr>
<td>Asymp. Sig.</td>
<td>.000</td>
</tr>
</tbody>
</table>

\(^a\) Friedman Test

$\chi^2$ value should be reported with degree of freedom

You should generally report the asymptotic $p$ value
Following-up a Significant K-W Result

- If overall Friedman test is significant, conduct a series of Wilcoxon tests to identify where the specific differences lie, but with corrections to control for inflation of type I error.

- No option for this in SPSS, so manually conduct a Bonferroni correction ($\alpha = .05 / \text{number of comparisons}$) and use the corrected $\alpha$-value to interpret the results
  - This example $0.05/3 = 0.016$
  - Reminder: Bonferroni corrections are overly conservative, so they might not be significant.
Tip!

- If you have many levels of the IV ("repetitions," "times," etc.) consider comparing only some of them, chosen according to
  - theory or your research question
  - Or time 1 vs. time 2, time 2 vs. time 3, time 3 vs. time 4, etc.
Reporting Kruskal-Wallis

• In our example, we can report that there was a statistically significant increase in criminal social identity from year 2000 (median = 18) to 2010 (median = 28) and 2013 (median = 39) ($\chi^2(2, N = 21) = 42.00, p < .001$).

• Also report the post-hoc tests with effect size (see lecture on Wilcoxon test)