University of HUDDERSFIELD

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

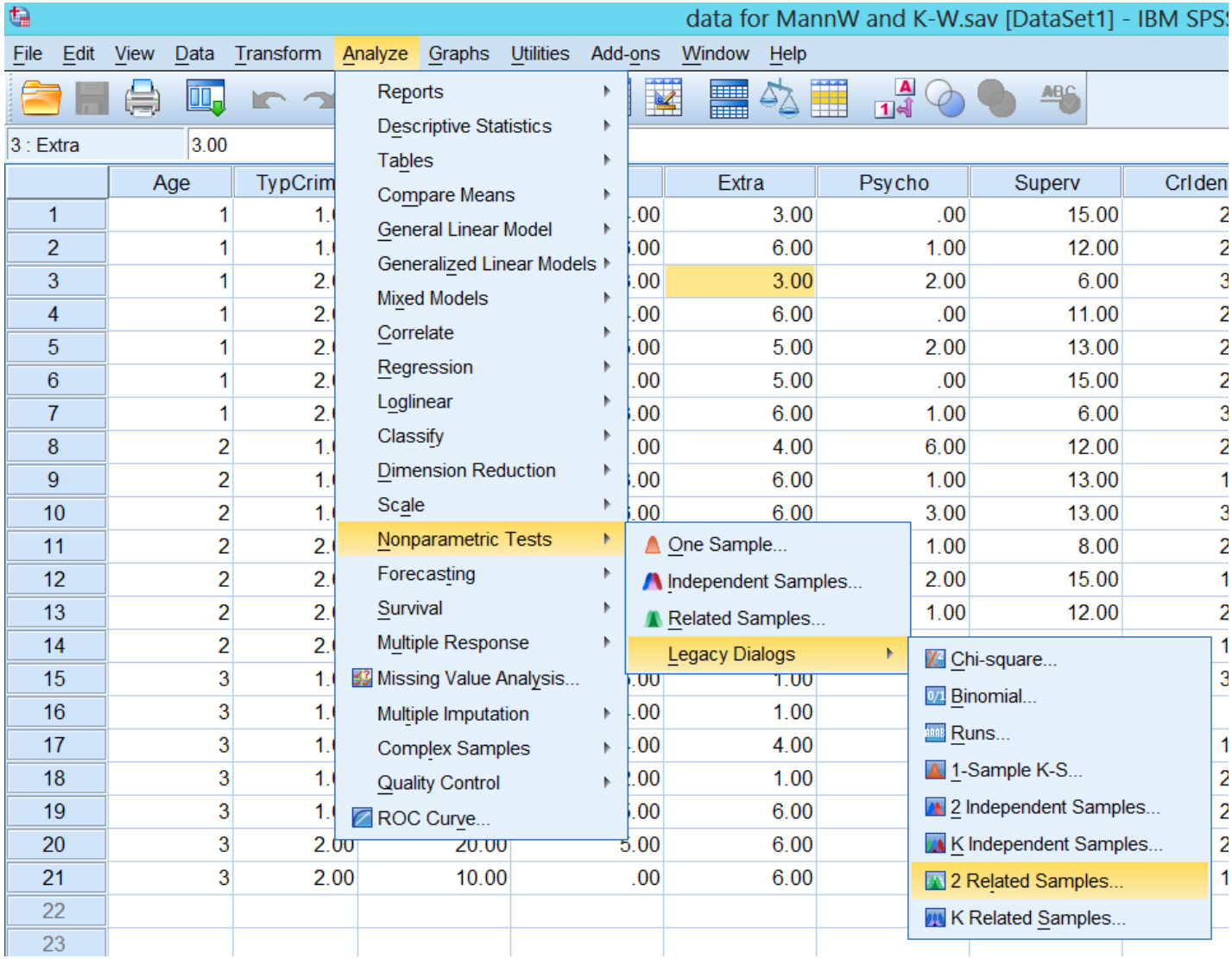
- This is appropriate for within participants designs
- The Wilcoxon test is conceptually similar to the related samples t test
  - Condition 1 and condition 2
  - Time 1 and time 2

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

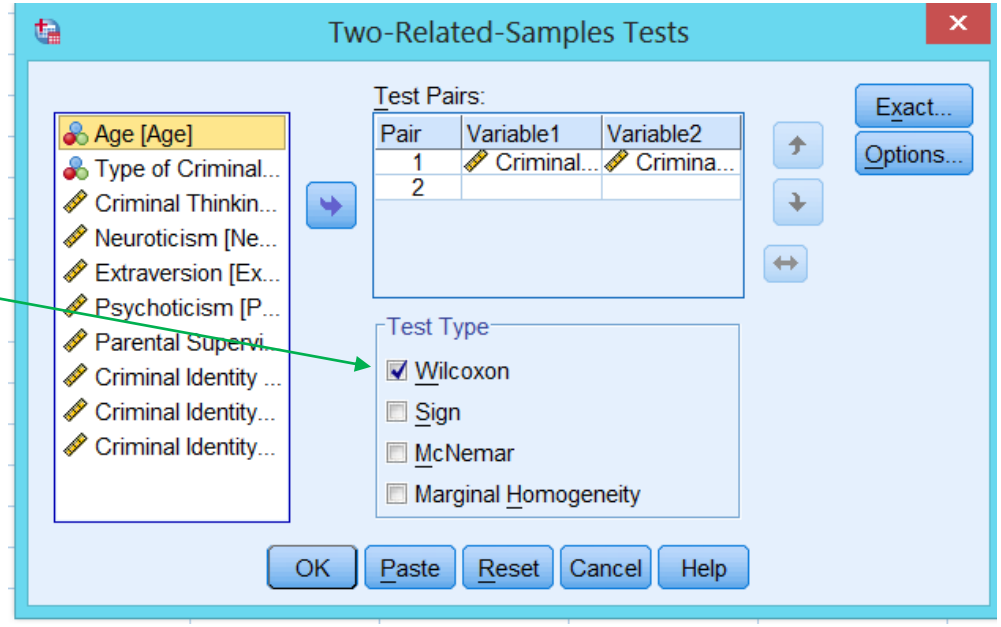
- Click **Analyze**
- **Nonparametric Tests**
- **Legacy Dialogs**
- **2 Related Samples**



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

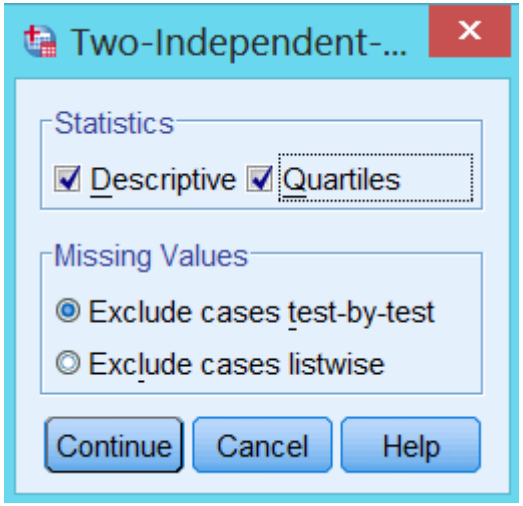


SPSS Procedure

- 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



SPSS Output

- Descriptive statistics

Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum	Percentiles		
						25th	50th (Median)	75th
Criminal Identity	21	22.2857	6.37293	8.00	33.00	18.5000	22.0000	26.5000
Criminal Identity2	21	30.1905	5.75864	12.00	38.00	28.0000	31.0000	35.0000

SPSS Output

Ranks

		N	Mean Rank	Sum of Ranks
Criminal Identity2 - Criminal Identity	Negative Ranks	0[a]	.00	.00
	Positive Ranks	21[b]	11.00	231.00
	Ties	0[c]		
	Total	21		

a. Criminal Identity2 < Criminal Identity

b. Criminal Identity2 > Criminal Identity

c. Criminal Identity2 = Criminal Identity

- The Ranks table provides some interesting data on the comparison of prisoners' criminal identity sores 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

SPSS Output

Test Statistics[a]

	Criminal Identity2 - Criminal Identity
Z	-4.085[b]
Asymp. Sig. (2-tailed)	.000

a. Wilcoxon Signed Ranks Test

b. Based on negative ranks.

- 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:

$$r = \frac{Z}{\sqrt{N}}$$

$$r = \frac{-4.085}{\sqrt{42}}$$

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)

Reporting Wilcoxon

- 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

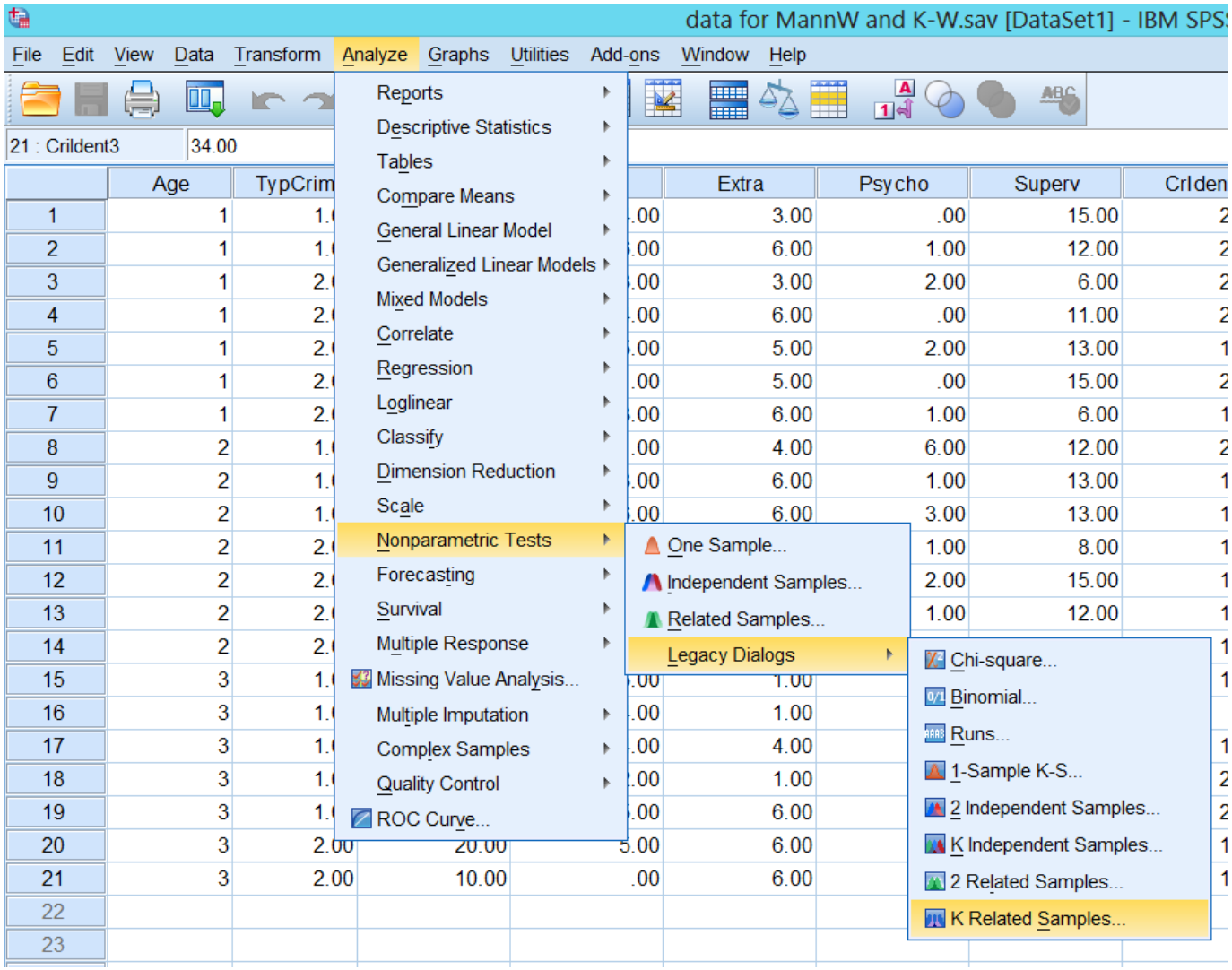
- The Friedman's test is the nonparametric test equivalent to the repeated measures ANOVA, and an extension of the Wilcoxon test
  - it allows the comparison of more than two dependent groups (two or more conditions)

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

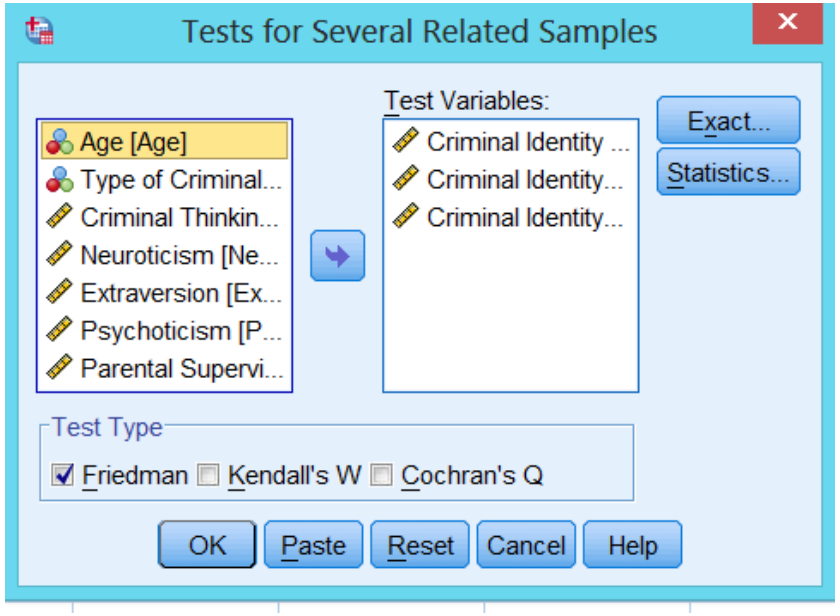
- Click **Analyze**
- **Nonparametric Tests**
- **Legacy Dialogs**
- **K Related Samples**



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

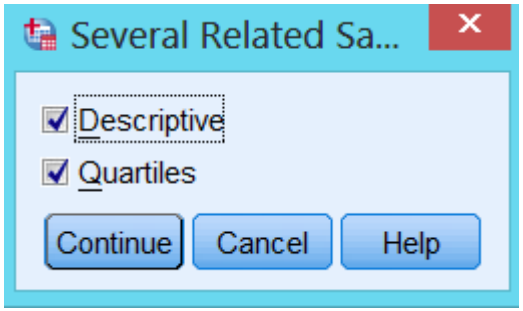


SPSS Procedure

- 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



SPSS Output

- Descriptive statistics

Descriptive Statistics

	N	Mean	Std. Deviation	Minimum	Maximum	Percentiles		
						25th	50th (Median)	75th
Criminal Identity	21	17.2381	4.41480	8.00	25.00	13.0000	18.0000	21.0000
Criminal Identity2	21	26.9048	5.34701	15.00	35.00	22.5000	28.0000	31.0000
Criminal Identity3	21	36.9524	4.16505	25.00	40.00	34.5000	39.0000	40.0000

SPSS Output

- There was a significant change in levels of criminal social identity over time, $\chi2(2, N = 21) = 42.00$, $p < .001$.

Ranks

	Mean Rank
Criminal Identity	1.00
Criminal Identity2	2.00
Criminal Identity3	3.00

Test Statistics[a]

N	21
Chi-Square	42.000
df	2
Asymp. Sig.	.000

a. Friedman Test

χ^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** (α = .05 / number of comparisons) and use the corrected α-value to interpret the results
  - This example .05/3 = .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)