MIXED BETWEEN-WITHIN SUBJECTS ANOVA

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Presentation Outline

- Introduction
- Assumptions
- SPSS procedure
- Presenting results
Introduction

- **Mixed between-within subjects ANOVA** – combination of between-subjects ANOVA and repeated measures ANOVA

- **What do you need?**
  - One categorical between-subjects IV (violent and non-violent offenders)
  - One categorical within-subjects IV (Time 1, Time 2, Time 3)
  - One continuous DV (scores on Criminal Identity)

- **Research Question:**
  - Which group of offenders score higher on Criminal Social Identity Scale across the 3 time periods
  - Is there a change in Criminal Social Identity scores for offenders across of time spend in prison?
Introduction

- **What it does?**
  - It tests whether there are main effects for each of the IVs and whether the interaction between the 2 IVs is significant.
  - It will tell us whether there is a change in Criminal Identity scores over 3 time periods (main effect for time).
  - It will compare 2 groups of offenders in terms of Criminal Identity (main effect for group).
  - It will tell us whether the change in Criminal Identity scores over time is different for the two groups (interaction effect).
Assumptions

- **Independence of observations** – observations must not influenced by any other observation (e.g. behaviour of each member of the group influences all other group members)
- **Normal distribution**
- **Random Sample** (difficult in real-life research)
- **Homogeneity of Variance** – variability of scores for each of the groups is similar.
  - Levene’s test for equality of variances (Sig. greater than .05)
- **Homogeneity of intercorrelations** – for each of the levels of the between-subjects variable, the pattern of intercorrelations among the levels of the within-subjects variables should be the same.
  - Check Box’s M statistic (the probability level should be greater than .001)
SPSS procedure for mixed between-within subjects ANOVA

- From the menu at the top of screen click on Analyze, then select General Linear Model, then Repeated Measures.
SPSS procedure for mixed between-within subjects ANOVA

- In the **Within Subject Factor Name** box, type in a name of IV (e.g. Time)
- In the **Number of Levels** box – time periods (e.g. 3)
- Click **Add**
SPSS procedure for mixed between-within subjects ANOVA

- Click on **Define** button
- Select the 3 variables that represent repeated measures variable (Criminal Identity, Criminal Identity 2, Criminal Identity 3) and move them into the **Within Subjects Variables** box
SPSS procedure for mixed between-within subjects ANOVA

- Click on between subject variable (type of criminals) and move this IV to the **Between-Subjects Factors** box.
Click **Options**, and click **Descriptive Statistics**, **Estimates of effect size** and **Homogeneity tests** box in **Display** box

- Click on **Continue**
SPSS procedure for mixed between-within subjects ANOVA

- Click on **Plots**
- Click on within-group factor (time) and move it into **Horizontal Axis** box
- Click on between-group factor (TypCrim) and move it into **Separate Lines** box
- Click on **Add**
- **Continue** and **OK**
Maluchly’s Test of Sphericity

The sphericity assumption requires that the variance of population difference scores for any two conditions are the same as the variance of the population difference scores for any other two conditions (an assumption that is commonly violated; Sig. = .000)

Mauchly's Test of Sphericity

<table>
<thead>
<tr>
<th>Within Subjects Effect</th>
<th>Mauchly's W</th>
<th>Approx. Chi-Square</th>
<th>df</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>time</td>
<td>.429</td>
<td>72.816</td>
<td>2</td>
<td>.000</td>
</tr>
</tbody>
</table>

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.

a. May be used to adjust the degrees of freedom for the averaged tests of significance. Corrected tests are displayed in the Tests of Within-Subjects Effects table.

b. Design: Intercept + TypCrim
   Within Subjects Design: time

There are ways to compensate for this assumption violation – multivariate statistics
Interpretation of SPSS output

- **Descriptive Statistics**

- **Levene’s Test of Equality of Error Variances**
  - It tests the homogeneity of variance
  - Sig. should be > .05

- **Box’s Test of Equality of Covariance Matrices**
  - Sig. should be > .001
Interpretation of SPSS output

- **Interaction effect** – is there the same change in scores over time for two different groups?

- **Wilks’ Lambda** – if the Sig. > .05 = the interaction is not statistically significant

<table>
<thead>
<tr>
<th>Effect</th>
<th>Value</th>
<th>F</th>
<th>Hypothesis df</th>
<th>Error df</th>
<th>Sig.</th>
<th>Partial Eta Squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>time</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pillai’s Trace</td>
<td>.875</td>
<td>300.225(^a)</td>
<td>2.000</td>
<td>86.000</td>
<td>.000</td>
<td>.875</td>
</tr>
<tr>
<td>Wilks’ Lambda</td>
<td>.125</td>
<td>300.225(^a)</td>
<td>2.000</td>
<td>86.000</td>
<td>.000</td>
<td>.875</td>
</tr>
<tr>
<td>Hotelling's Trace</td>
<td>6.982</td>
<td>300.225(^a)</td>
<td>2.000</td>
<td>86.000</td>
<td>.000</td>
<td>.875</td>
</tr>
<tr>
<td>Roy's Largest Root</td>
<td>6.982</td>
<td>300.225(^a)</td>
<td>2.000</td>
<td>86.000</td>
<td>.000</td>
<td>.875</td>
</tr>
<tr>
<td>time * TypCrim</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pillai’s Trace</td>
<td>.007</td>
<td>.297(^a)</td>
<td>2.000</td>
<td>86.000</td>
<td>.744</td>
<td>.007</td>
</tr>
<tr>
<td>Wilks’ Lambda</td>
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a. Exact statistic
b. Design: Intercept + TypCrim
Within Subjects Design: time
Interpretation of SPSS output

- **Main Effect** – the value you are interested in is *Wilks’ Lambda* for time
  - In this example Wilks’ Lambda = .125 with Sig. value = .000 (there was a change in Criminal Identity across 3 different time periods)

- **Effect size** - the value you are interested in is *Partial Eta Squared* (.875 indicates very large effect size)

- **According to Cohen (1988)**
  - .01 = small effect
  - .06 = medium effect
  - .14 = large effect

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**Multivariate Tests**

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<th>Error df</th>
<th>Sig.</th>
<th>Partial Eta Squared</th>
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<td>.007</td>
</tr>
</tbody>
</table>

*a. Exact statistic  
b. Design: Intercept + TypCrim  
Within Subjects Design: time*
**Between-subjects effect**

- If the Sig. value is less than .05 – significant difference between groups (see Sig. column)
- In this example: Sig. = .107 (there was no significant difference in the Criminal Identity scores for the 2 groups)
  - Partial Eta Squared = .030

### Tests of Between-Subjects Effects

<table>
<thead>
<tr>
<th>Source</th>
<th>Type III Sum of Squares</th>
<th>df</th>
<th>Mean Square</th>
<th>F</th>
<th>Sig.</th>
<th>Partial Eta Squared</th>
</tr>
</thead>
<tbody>
<tr>
<td>Intercept</td>
<td>182863.258</td>
<td>1</td>
<td>182863.258</td>
<td>682.294</td>
<td>.000</td>
<td>.887</td>
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<td>TypCrim</td>
<td>710.299</td>
<td>1</td>
<td>710.299</td>
<td>2.650</td>
<td>.107</td>
<td>.030</td>
</tr>
<tr>
<td>Error</td>
<td>23317.071</td>
<td>87</td>
<td>268.012</td>
<td></td>
<td></td>
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</tr>
</tbody>
</table>
A mixed between-within subjects analysis of variance was conducted to compare scores on the criminal social identity between violent and non-violent offenders across three time periods (Time 1, Time 2, and Time 3). There was no significant interaction between type of criminals and time, Wilks’ Lambda = .99, F (2, 86) = .297, p > .05. There was a significant main effect for time, Wilks’ Lambda = .13, F (2, 86) = 300.23, p < .001, partial eta squared = .88, with both groups of offenders showing an increase in Criminal Identity scores across the three time points (see Table 1). The main effect comparing the two groups of offenders was not significant, F (1, 87) = 2.65, p < .001, partial eta squared = .03, suggesting no difference in criminal identity scores between violent and non-violent offenders.
Table 1. Descriptive Statistics for Criminal Social Identity for the Two Groups of Offenders Across Three Time Periods

<table>
<thead>
<tr>
<th>Time period</th>
<th>Non-violent Offenders</th>
<th>Violent Offenders</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>M</td>
<td>SD</td>
</tr>
<tr>
<td>Time 1</td>
<td>17.22</td>
<td>9.64</td>
</tr>
<tr>
<td>Time 2</td>
<td>24.78</td>
<td>11.18</td>
</tr>
<tr>
<td>Time 3</td>
<td>31.62</td>
<td>12.51</td>
</tr>
</tbody>
</table>
Presenting results - Plots

Estimated Marginal Means of MEASURE_1

Type of Criminals
- NonV
- Violent

Estimated Marginal Means

Time

1
2
3