T-tests

Daniel Boduszek

d.boduzech@interia.eu  danielboduzech.com
Presentation Outline

- Introduction to T-tests
  - Types of t-tests
  - Assumptions

- Independent samples t-test
  - SPSS procedure
  - Interpretation of SPSS output
  - Presenting results from HMR

- Paired samples t-test
  - SPSS procedure
  - Interpretation of SPSS output
  - Presenting results from HMR
T-tests compare the values on some continuous variable for two groups or on two occasions

Two types:

- independent samples t-test – compares the mean scores of two different groups of people or conditions
- paired samples t-test – compares the mean scores for the same group of people on two different occasions
Assumptions

- **Independence of observations** – observations must not be 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.
  - You want non significant result (Sig. greater than .05)
Independent Samples T-test

Research Question:
Is there a significant difference in the mean criminal behaviour scores for violent and non-violent offenders?
Independent Samples T-test (SPSS)

- From the menu click on **Analyze**

- then select **Compare means**

- then **Independent Samples T test**
Independent Samples T-test (SPSS)

- Move continuous DV (recidivism) into the Test variable box
- And categorical IV (type of criminal) into Grouping variable box
Independent Samples T-test (SPSS)

- Click on **Define groups** and type in the numbers used in data set to code each group
  - **Group 1** = 1
  - **Group 2** = 2
- Click on **Continue**
- and **OK**
Interpretation of SPSS output

- Checking the information about groups:
  - Means
  - Standard Deviations
  - Number of participants in each group

<table>
<thead>
<tr>
<th>Type of Criminals</th>
<th>N</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level of Recidivism</td>
<td>45</td>
<td>2.7556</td>
<td>1.73409</td>
<td>.25850</td>
</tr>
<tr>
<td>1.00 NonV</td>
<td>44</td>
<td>4.0000</td>
<td>3.32013</td>
<td>.50053</td>
</tr>
</tbody>
</table>
Interpretation of SPSS output

- **Checking assumptions**
  - **Levene’s test for equality of variance** (whether the variation of scores for two groups is the same)
  - If **Sig. value for Levene’s test > .05** – use the first line in the table (**Equal variance assumed**)
  - If **Sig. value for Levene’s test < or = .05** – use the second line in the table (**Equal variance not assumed**)

<table>
<thead>
<tr>
<th>Level of Recidivism</th>
<th>Levene’s Test for Equality of Variances</th>
<th>t-test for Equality of Means</th>
<th>95% Confidence Interval of the Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F</td>
<td>Sig.</td>
<td>t</td>
</tr>
<tr>
<td>Equal variances assumed</td>
<td>5.335</td>
<td>.023</td>
<td>-2.223</td>
</tr>
<tr>
<td>Equal variances not assumed</td>
<td>-2.209</td>
<td>64.513</td>
<td>.031</td>
</tr>
</tbody>
</table>
Interpretation of SPSS output

- **Differences between groups**
  - Check column **Sig. (2-tailed)**
  - If **Sig. value > .05** – no significant difference between groups
  - If **Sig. value < or = .05** – significant difference between groups

<table>
<thead>
<tr>
<th>Level of Recidivism</th>
<th>Levene's Test for Equality of Variances</th>
<th>t-test for Equality of Means</th>
<th>95% Confidence Interval of the Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>F</td>
<td>Sig.</td>
<td>t</td>
</tr>
<tr>
<td>Equal variances assumed</td>
<td>5.335</td>
<td>.023</td>
<td>-2.223</td>
</tr>
<tr>
<td>Equal variances not assumed</td>
<td>-2.209</td>
<td>64.513</td>
<td>.031</td>
</tr>
</tbody>
</table>
Calculating the effect size

- The formula is:

\[
\text{Etta squared} = \frac{t^2}{t^2 + (N1 + N2 - 2)}
\]

\[-2.21^2 = .05\]

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

An independent samples t-test was conducted to compare the criminal behaviour (recidivism) scores of violent and non-violent offenders. There was a significant difference in score between the two groups of offenders, $t(87) = -2.21$, $p < .05$, two-tailed, with violent offenders ($M = 4.00$, $SD = 3.32$) scoring higher than non-violent offenders ($M = 2.76$, $SD = 3.32$). The magnitude of the differences in the means (mean difference = -1.24, 95% CI: -2.37 to -.12) was small (eta squared = .05)
Paired samples t-test

- **A Paired samples t-test** – one group of participants measured on two different occasions or under two different conditions (e.g., pre-test & post-test; Time 1 & Time 2)

- **Research question** – Is there a significant change in prisoners’ criminal social identity scores after 2 year sentence in high security prison? Does the process of prisonization have an impact on prisoners’ criminal identity test scores?

- **You need:**
  - 1 categorical IV (Time 1, Time 2)
  - 1 continuous DV (criminal social identity test scores)
Paired samples t-test (SPSS)

- From the menu click on **Analyze**
- then select **Compare Means**
- then **Paired Samples T test**
Paired samples t-test (SPSS)

- Click on the 2 variables that you are interested in comparing for each subject (criminal identity, criminal identity 2) and move them into **Paired Variables** box.

- Click **OK**.
Interpretation of SPSS output

- **Descriptive Statistics**

<table>
<thead>
<tr>
<th>Pair 1</th>
<th>Mean</th>
<th>N</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>Criminal Identity</td>
<td>18.7303</td>
<td>89</td>
<td>8.93762</td>
<td>.94739</td>
</tr>
<tr>
<td>Criminal Identity2</td>
<td>26.3146</td>
<td>89</td>
<td>9.84031</td>
<td>1.04307</td>
</tr>
</tbody>
</table>

- **Correlations**

<table>
<thead>
<tr>
<th>Pair 1</th>
<th>N</th>
<th>Correlation</th>
<th>Sig.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Criminal Identity &amp; Criminal Identity2</td>
<td>89</td>
<td>.941</td>
<td>.000</td>
</tr>
</tbody>
</table>
Interpretation of SPSS output

Differences between Time 1 & Time 2

- Check column Sig. (2-tailed)
- If Sig. value > .05 – no significant difference
- If Sig. value < or = .05 – significant difference

<table>
<thead>
<tr>
<th>Paired Samples Test</th>
<th>Mean</th>
<th>Std. Deviation</th>
<th>Std. Error Mean</th>
<th>95% Confidence Interval of the Difference</th>
<th>t</th>
<th>df</th>
<th>Sig. (2-tailed)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pair 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Criminal Identity - Criminal Identity2</strong></td>
<td>-7.58427</td>
<td>3.35006</td>
<td>.35511</td>
<td>-8.28997</td>
<td>-6.87857</td>
<td>-21.358</td>
<td>88</td>
</tr>
</tbody>
</table>
Calculating the effect size

- The formula is:
  \[
  \eta^2 = \frac{t^2}{t^2 + (N - 1)}
  \]
  
  According to Cohen (1988)
  - \( .01 \) = small effect
  - \( .06 \) = medium effect
  - \( .14 \) = large effect

- Example calculation:
  
  \[
  \eta^2 = \frac{21.36^2}{21.36^2 + (88 - 1)} = 0.84
  \]
A paired samples t-test was conducted to evaluate the impact of the prisonization process on prisoners’ scores on the criminal social identity. There was a significant increase in criminal social identity scores from Time 1 (M = 18.73, SD = 8.94) to Time 2 (M = 26.31, SD = 9.84), t(88) = -21.36, p < .001 (two-tailed). The mean increase in criminal social identity scores was -7.58 with a 95% confidence interval ranging from -8.29 to -6.88. The eta squared statistic (.84) indicated a large effect size.