Lab Assignment 3:  
Examining the Difference Between Two Means  
Due April 6

For this assignment, you have two choices. First, you could choose to perform three \(t\) tests for dependent samples (i.e. the matched-pairs \(t\) test). If so, go to Section I below. Second, you could choose to perform three \(t\) tests for independent samples (i.e. the two-sample \(t\) test). If so, go to Section II below.

Please work closely with the instructor to make certain what you plan to do makes sense.

Section I: Matched-pair case. I would like you to perform three different matched-pairs \(t\) tests, using the difference between two time periods. You therefore need to select three different quantitative variables that you want to evaluate for change from Time 1 to Time 2. In this dataset, there are a number of quantitative measures from both the base year and the first follow-up year that you can use (e.g. standardized test scores, attitudes, etc.). You can investigate whether students have, on average, changed on these measures. However, because many of the interval measures are standardized separately at Time 1 and Time 2, this becomes a little more complicated. Standardizing separately at each of the two times pretty much guarantees the overall means from the two time periods will be nearly equal. I would suggest that if you want to look at differences over time, you choose to do so for only a subsample of the dataset – for example, for African Americans only, or for females only.

a. For each of the three analyses, make a box plot for the differences between the “Time 1” and “Time 2” data. Comment on whether the distributions seem normal.

b. Provide basic descriptive statistics for each of the three analyses. You should report the mean and standard deviation (SD) of Time 1, mean and SD of Time 2, and mean and SD of the difference scores. For each analysis, you should generate the descriptive statistics for people who have “complete” data only, meaning those who have both Time 1 and Time 2 data.

c. Perform three matched-pair \(t\) tests, two-tailed, at alpha = 0.05. If your \(t\) tests are non-significant, that’s fine.

d. Calculate the standardized effect size statistic for each of the three matched-pair \(t\) tests. (For the matched-pair case, you should calculate the standardized difference between two means).

e. Report the 95% confidence interval for each analysis.

f. Make a table for the three analyses that includes the means, standard deviations, sample sizes, degrees of freedom, effect size statistics, \(t\) statistic, \(P\)-value. You can use the model I have attached for “Table 1”.

The Write-Up for Section I

Write a brief (2 pages max) summary of your results for this lab assignment. You may structure it in the way that makes most sense to you, but be sure to include:

- Explanations or descriptions for steps a through e.
- A summary of your $t$ test results (size of $t$ statistic, $P$-value), including confidence intervals.
- A summary of what you learned about the difference in means you investigated.

Include graphs and tables to support what you describe in your text.

Section II. Independent samples case. Pick two independent groups that you would like to compare for this analysis—such as gender (Male/Female). Then pick three quantitative variables where you would want to compare the two groups.

a. For each of the three analyses, make a box plot, with one “box” corresponding to “Group 1” data, and one “box” corresponding to “Group 2” data. Comment on whether the distributions seem normal and whether the within-group variability is similar (compare interquartile ranges).

b. Provide basic descriptive statistics for each of the three analyses. You should have the mean and SD of Group 1, mean and SD of Group 2.

c. Perform three independent samples $t$ tests, one for each of the three quantitative variables you selected. Perform the tests two-tailed, at alpha = 0.05. If your $t$ tests are non-significant, that’s fine.

d. Calculate the standardized effect size statistic for each of the three two-sample $t$ tests. (the standardized difference between two means). Note that if SPSS does not provide the pooled standard deviation in the output, you can calculate it from the standard error:

$$ s_p = SE_{x_1-x_2} \sqrt{\frac{1}{n_1} + \frac{1}{n_2}} $$

E. Report the 95% confidence interval for each analysis.

f. Make a table for the three analyses that includes the means, standard deviations, sample sizes, degrees of freedom, effect size statistics, $t$ value, $P$-value. You can use the model I have attached for “Table 2”.
The Write-Up for Section II

Write a brief (2 pages max) summary of your results for this lab. You may structure it in the way that makes most sense to you, but be sure to include:

- Explanations or descriptions of steps a through f.
- A summary of your t test results (size of t statistic, P-value), including confidence intervals.
- A summary of what you learned about the difference in means you investigated.

Include graphs and tables to support what you describe in your text.
Table 1

Matched-Pair Analyses for Math, Self-Esteem, and Anxiety Scores

<table>
<thead>
<tr>
<th>N of pairs</th>
<th>Time 1 M</th>
<th>Time 1 SD</th>
<th>Time 2 M</th>
<th>Time 2 SD</th>
<th>Difference M</th>
<th>Difference SD</th>
<th>Effect Size</th>
<th>95% CI LL</th>
<th>95% CI UL</th>
<th>t statistic</th>
<th>df</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
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<td>x</td>
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<td>x</td>
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<td>x</td>
<td>x</td>
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<tr>
<td>Anxiety</td>
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<td>x</td>
<td>x</td>
<td>x</td>
<td>x</td>
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<td>x</td>
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Table 2

Differences between Boys and Girls on Math, Self-Esteem, and Anxiety

<table>
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<th>Boys M</th>
<th>SD</th>
<th>N</th>
<th>Girls M</th>
<th>SD</th>
<th>N</th>
<th>Effect Size</th>
<th>95% CI LL</th>
<th>95% CI UL</th>
<th>t value</th>
<th>df</th>
<th>P-value</th>
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