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Course > Inference: Relationships C→Q > Matched Pairs > Matched Pairs: Idea Behind the Paired t-test

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Matched Pairs: Idea Behind the Paired t-test

Learning Objective: In a given context, carry out the inferential method for comparing groups and draw the appropriate conclusions.

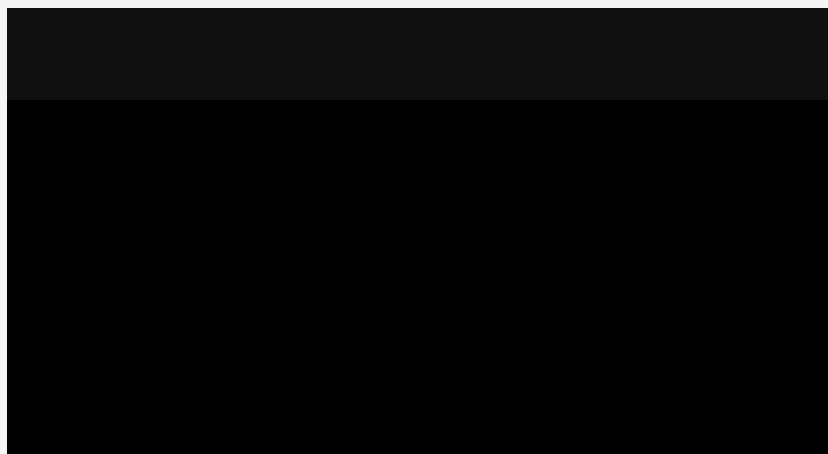
So far, we have discussed and illustrated cases in which the matched pairs design comes up, and we are now ready to discuss how to carry out the test in this case. We will first present the idea behind the paired t-test, and then go through the four steps in the testing process.

The Paired t-test

Idea

The idea behind the paired t-test is to reduce this two-sample situation, where we are comparing two means, to a single sample situation where we are doing inference on a single mean, and then use a simple t-test that we introduced in the previous module. We will first illustrate this idea using our example, and then more generally.

Matched Pairs



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In our example we have 20 drivers and for each one of them we have two

measurements: the measurement in sample one, which is the total reaction time

before drinking the two beers; and the measurement in sample two, the total

Video

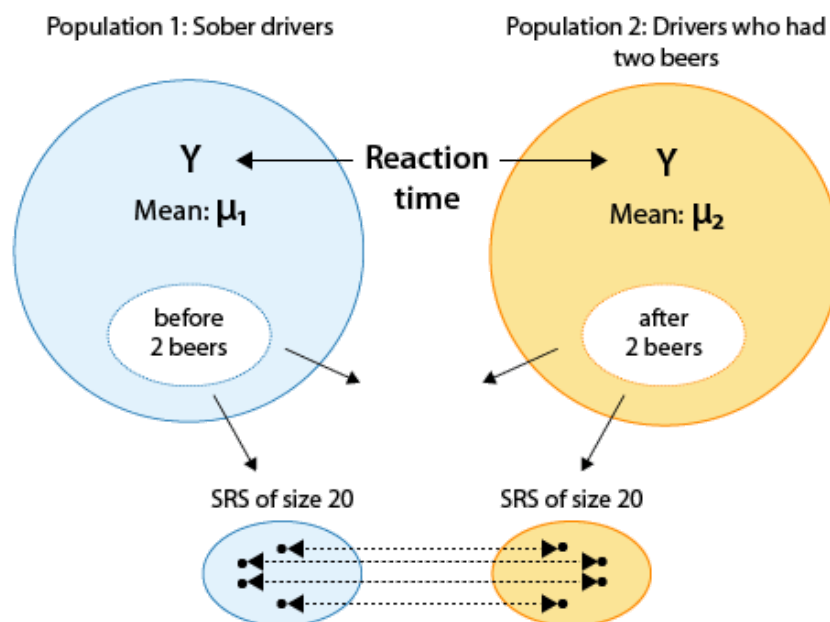
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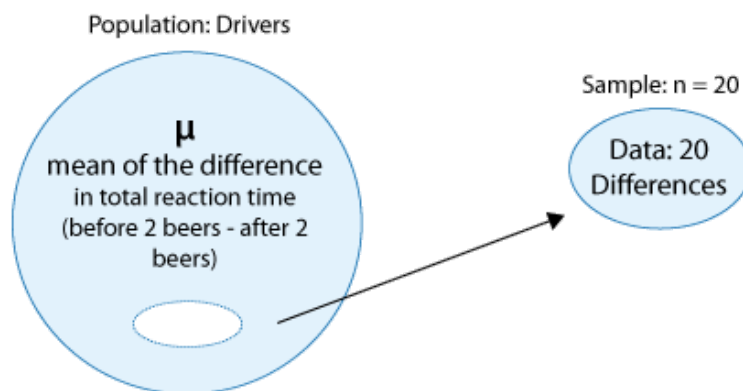
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In other words, by reducing the two samples to one sample of differences, we are essentially reducing the problem from a problem where we're comparing two means (i.e., doing inference on $\mu_1 - \mu_2$):



to a problem where we are making an inference about a single mean — the mean of the differences:



In general, in every matched pairs problem, our data consist of 2 samples which are organized in n pairs:

Pairs	1	2	3	4	...	n
Sample 1	*	*	*	*	...	*
Sample 2	*	*	*	*	...	*

We reduce the two samples to only one by calculating for each pair the difference between the two observations (in the figure we used $d_1, d_2, d_3, \dots, d_n$ to denote the differences).

Pairs	1	2	3	4	...	n
Sample 1	*	*	*	*	...	*
Sample 2	*	*	*	*	...	*
Differences sample 1 - sample 2	d_1	d_2	d_3	d_4	...	d_n

The paired t-test is based on this one sample of n differences,

Pairs	1	2	3	4	...	n
Sample 1	*	*	*	*	...	*
Sample 2	*	*	*	*	...	*
Differences sample1-sample2	d_1	d_2	d_3	d_4	...	d_n

and it uses those differences as data for a simple t-test on a single mean — the mean of the differences.

This is the general idea behind the paired t-test; it is nothing more than a regular one-sample t-test for the mean of the differences. We will now go through the 4-step process of the paired t-test.

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