

Within-subjects t-test

The within-subjects t-test, used for comparisons with a continuous dependent variable, is also known as the *paired samples t-test* (the SPSS term), the *dependent samples t-test*, *correlated samples t-test*, or the *repeated measures t-test*. The reason the test has all of these names is because it is used in several different situations: the same person is in the study twice (longitudinal or repeated measures design), pairs of individuals are linked together or “yoked” (e.g., twins, or married couples), or because they are naturally linked or the experimenter linked them as when they are ‘matched’ on some score (e.g., matched on age).

Example. We could have conducted the charter school study in a different way—by comparing teachers’ satisfaction ratings before and after a school was converted to a privately operated school. This design could be classified as a single-group pretest-posttest design (Remember from our design discussion that there are some methodological problems with this design that can be addressed with some changes, but let us just assume this is the design for now).

I have used the same numbers as in the first between-subjects example given in class to illustrate a point, but this is completely different example where we have two scores for each of 5 teachers. Notice that in this design we only are using half the number of cases. Each teacher has two scores.

Teacher	Public (Pretest)	Charter (Posttest)	D	$D - \bar{D}$	$(D - \bar{D})^2$
1	2	7	-5	2	4
2	4	8	-4	1	1
3	6	10	-4	1	1
4	8	8	0	3	9
5	10	12	-2	1	1
			$\bar{D} = -3$		$\sum(D - \bar{D})^2 = 16$

Formulas:

$$s_D^2 = \frac{\sum(D - \bar{D})^2}{N - 1} = \frac{16}{4} = 4$$

$$s_{\bar{D}} = \sqrt{\frac{s_D^2}{N}} = \sqrt{\frac{4}{5}} = .89$$

$$t = \frac{\bar{D}}{s_{\bar{D}}} = \frac{-3}{.89} = -3.35$$

df = N-1 = 5-1 = 4. t_{crit} at $\alpha = .05$ with df = 4 is 2.776. The difference is significant, because the (absolute value of the) calculated value, 3.35, exceeds the critical value of 2.776.

Statistical comment. Notice that the same data in the very first between-subjects example (presented in class) yielded a non-significant difference (with twice as many cases!!). The reason the within-subjects test has more powerful is that variation due to individual differences is eliminated in the within-subjects design. Each subject serves as his/her own comparison or control.

SPSS Menus Steps

1. Analyze → Compare Means → Paired Samples t-test
2. Move over the two variables (e.g., pretest score variable, posttest score variable)
3. Click “Ok.”

The Output will look something like this (note that this was generated in SPSS 11.5):

SPSS Output

T-Test

Paired Samples Statistics

		Mean	N	Std. Deviation	Std. Error Mean
Pair 1	charter satisfaction with charter	6.0000	5	3.16228	1.41421
	public satisfaction with public	9.0000	5	2.00000	.89443

Paired Samples Test

		Paired Differences					t	df	Sig. (2-tailed)
		Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference				
					Lower	Upper			
Pair 1	charter satisfaction with charter - public satisfaction with public	-3.00000	2.00000	.89443	-5.48333	-.51667	-3.354	4	.028

Example write-up. Using a repeated measures t-test, public school teachers’ satisfaction ratings prior to privatization of their school were compared to their satisfaction ratings after privatization of their school. Satisfaction ratings were significantly higher before privatization ($M = 9$) than after privatization ($M = 6$) as indicated by a significant t-test, $t(4) = 3.35$, $p < .05$. This finding indicates that there was a decline in satisfaction ratings over time that was not likely to be due to chance.