

Dependent t-test

Use when...

Use this inferential statistical test when you wish to compare two population means, μ_1 and μ_2 , and the observations are dependent (or systematically paired). You do not know the population means nor either population standard deviation (or variance). By “dependent” we mean that the observations come in pairs; e.g., IQ scores might be obtained from the same sample of persons on two different occasions (as in a repeated measures design), or observations regarding marital satisfaction might be obtained from husband and wife pairs.

This test is also known by different names, such as correlated t-test, matched-pairs t-test, and paired samples t-test.

Assumptions

- Random sampling
- Sampled pairs of observations are independent
- Population distribution for difference scores is normal
- Variable for which means are computed is continuous
- H_0 is true

Hypotheses

Usual Form

$$H_0: \mu_1 = \mu_2$$

$$H_A: \mu_1 > \mu_2$$

$$\text{or } \mu_1 < \mu_2$$

Alternative Form

$$H_0: \mu_{\text{diff}} = 0$$

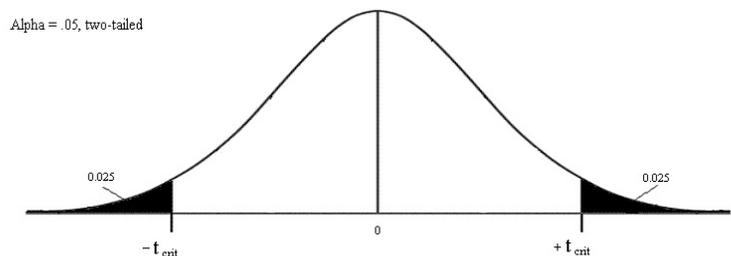
$$H_A: \mu_{\text{diff}} > 0$$

$$\text{or } \mu_{\text{diff}} < 0$$

Sampling Distribution and Critical Values

The t distribution is the sampling distribution from which t_{crit} is determined. The darkened area in the distribution to the right is the “rejection region.” When t_{obs} falls in the rejection region, the result is

“statistically significant”, which means that the null hypothesis is rejected. The t_{crit} value is taken from a table of such values or determined using an online calculator. The shape of the t distribution changes depending upon the number of people (observations) in the sampling process. As the sample size grows larger, the distribution approaches a normal curve. For smaller sample sizes, it is somewhat platykurtic. To obtain the correct t_{crit} value, the degrees of freedom value is used. For the dependent t-test, $df = n_{\text{pairs}} - 1$.



Formulas

Observed statistic: $t_{obs} = \frac{\bar{X}_{diff}}{s_{diff} / \sqrt{n_{pairs}}}$ $df = n_{pairs} - 1$

Standardized effect size: $d = \frac{\bar{X}_{diff}}{s_{diff}}$ Cohen's Conventions: .2 = small, .5 = med, .8 = large

Eta-squared can also be used: $\eta^2 = \frac{t_{obs}^2}{t_{obs}^2 + df}$ CCs: .01 = small, .06 = med, .14 = large

Confidence Interval (written as: $? \leq \mu_{diff} \leq ?$) $\bar{X}_{diff} \pm (|t_{crit}|) \left(\frac{s_{diff}}{\sqrt{n_{pairs}}} \right)$

If width of the interval is approximately equal to s_{diff} , then the interval is "middling" precision; if smaller, then "narrow" (precise); if larger, then "wide" (imprecise).

Alternatively, you can compare the width of the interval to the possible scale range and judge as narrow, middling, or wide.

APA Style Example

The differences between the brothers' and sisters' parenting style ratings were analyzed with a matched-pairs t test. The girls' ($M = 8.17$, $SD = 6.18$) average rating was slightly more authoritarian than the boys' ($M = 7.22$, $SD = 3.99$), but this difference was not statistically significant, $t(8) = -1.76$, $p = .12$, two-tailed. The mean difference was also small ($M_{diff} = -1.56$, $SD_{diff} = 2.65$, $d = .59$) based on Cohen's conventions for effect size, and the 99% confidence interval was fairly wide (-4.52 to 1.41) for the 0 to 20 point scale.