

Chapter 25: Paired Samples and Blocks

We cannot use a two-sample t-test for paired data because paired data come from samples that are not independently chosen. If we know the data are paired, we can examine the paired differences. Because it is the differences we care about, we treat them as if they were the data and ignore the original two sets of data.

Now that we have only one set of data to consider, we can return to the simple one-sample t-test. Mechanically, a paired t-test is just a one-sample t-test for the mean of the pairwise differences. The sample size is the number of pairs.

P (define parameter) μ_d : mean difference between _____ and _____

H (write hypotheses)
 $H_0: \mu_d = \Delta_0$ (this value is usually 0)
 $H_A: \mu_d < \Delta_0$
 $:\mu_d > \Delta_0$
 $:\mu_d \neq \Delta_0$

A (check assumptions)

1. Random sample (using paired data)
2. Sample is large enough
 Small: ($n < 15$) \approx normal (no outliers, unimodal, symmetric)
 Medium: ($15 < n < 40$) unimodal, symmetric
 Large: ($n > 40$) not necessary to check shape because of CLT
3. ...but not too large
 $N \geq 10n$ pairs of _____ and _____

N (name procedure) If all of the necessary assumptions and conditions have been met, we may proceed with the paired t-test

T (calculate test statistic) $t_{n-1} = \frac{\bar{d} - \Delta_0}{\frac{s_d}{\sqrt{n}}}$ ($\bar{d} = \bar{x}_1 - \bar{x}_2$)

O (obtain p-value)

M (make decision) _____ H_0 since the p-value is _____ α

S (state conclusion) If H_0 were true, we would expect to see a sample result at least as extreme as the one we observed in about _____ out of every _____ samples of this size by chance. This _____ strong enough evidence to conclude H_A .

We may also construct a confidence interval to estimate the true mean difference.

P (define parameter)
(same)

μ_d :

A (check assumptions)
(same)

1. Random sample (using _____ data)

2. Sample is large enough
Small: ($n < 15$)

Medium: ($15 < n < 40$)

Large: ($n > 40$)

3. ...but not too large

N (name procedure)

If all of the necessary assumptions and conditions have been met, we may proceed with the paired t-interval

I (find interval)

$estimate \pm critical\ value \times SE(estimate)$

$$\bar{d} \pm t_{n-1}^* \frac{s_d}{\sqrt{n}}$$

C (state conclusion)

We are _____% confident that the true mean difference between _____ and _____ is between about _____ and _____, because _____% of all samples of this size will produce an observed difference within about _____ of the true mean difference.