

## Alternative to the Paired Difference Test

The conditions for the paired difference test are:

- $20n \leq N$
- The sample differences have no outliers (Boxplot)
- The sample differences come from a population that is normally distributed (QQ Plot)

If the conditions are not all satisfied we can turn to the nonparametric test known as the **Wilcoxon Matched-Pairs Signed-Ranks Test**.

The differences between the two paired samples are computed and then are ranked from smallest to largest in terms of absolute value. The ranks for positive differences and negative differences are totaled.

If the positive and negative total ranks are close that indicates that there is no difference but if they are far apart that could indicate that the population mean difference is not equal to 0.

### Differences for This Test

**Step 1:** This test involves the median population difference.

$$H_0: M_d = 0$$

The sign for  $H_1$  depends on how you subtract and the wording of the claim.

**Step 3:** Nonparametric Alternative to Paired Difference

**Step 4:** Stat > Nonparametrics > Wilcoxon Signed Ranks

Click the button for "Paired".

Select the columns for sample 1 and sample 2.

Leave the value in the null hypothesis as 0.

Select the correct sign for the alternative hypothesis and click Compute.

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*On the back of this page are 4 paired difference hypothesis tests. If the conditions for the paired difference test are met, then perform the standard paired difference test. Otherwise switch to its alternative test – the Wilcoxon Signed Ranks test. Write each hypothesis test using our standard 5-step procedure.*

1) In a study of a new wonder diet, a sample of 10 patients was taken. Here are there weights before and after.

Before	219	178	169	212	180	192	158	180	211	193
After	196	171	170	207	177	190	159	180	203	183

Test at the 0.01 level of significance the claim that this diet is effective, in other words, that the diet will reduce the weight of a person.

2) The Visalia Police Department has installed cameras designed to catch drivers running red lights. The number of red light tickets was recorded for one week prior to their installation and one week after.

	Sun	Mon	Tue	Wed	Thu	Fri	Sat
Before	7	21	27	18	20	24	16
After	8	18	24	19	16	19	16

Test the claim that the cameras have lowered the number of people running red lights at the 0.05 level of significance.

3) Here are the scores of twelve randomly selected students on the SAT exam (combined Math and English) on their first and second attempt at the exam. At the 0.05 level of significance, test the claim that scores improve from the first attempt to the second attempt.

Student	1	2	3	4	5	6	7	8	9	10	11	12
1st Score	680	1140	910	1370	1110	1000	710	830	1090	1050	1170	1060
2nd Score	650	1140	910	1420	1110	1090	740	870	1270	1130	1160	1110

4) Here are the serum cholesterol levels (mg/dL) of 7 participants in a clinical trial, taken before the trial began and again 1 month after switching to a vegan diet.

Person	1	2	3	4	5	6	7
Before	255	243	264	249	275	280	259
After	241	245	251	248	268	269	246

Test the claim that a vegan diet makes no difference in the cholesterol levels of people at the 0.05 level of significance.