

9/27/2006 7:57:16 PM

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For background to this demonstration, see Text Problems 7.81-7.84, page 291 (but use the corrected
differences I gave in class).

```
MTB > OneT 'diffs';  
SUBC> Test 0;  
SUBC> Alternative -1.
```

NOTE: "Alternative -1" means one-sided, lower. This makes sense in this application. For the
eye drop data, the null hypothesis is that the drug makes no improvement over placebo, and we want
to reject H_0 only in the case of evidence that the drug is indeed effective. In this case, for the differences
given by $D = A - P$, where A = active drug itching score and P = placebo itching score, we reject if the
sample mean is sufficiently less than 0. Below, the Minitab "one-sample T" procedure gives a 95% C.I.
for μ and the p-value for a one-sided test of $\mu=0$ vs $\mu < 0$. The one-sided 95% C.I. is
$(-\infty, -0.331)$, which excludes the null hypothesis value 0. The p-value is 0.011, which means that
H_0 is rejected at the $\alpha = .05$ significance level but not quite at the $\alpha = .01$ significance level.
The output also gives statistics from the data: sample mean = -1.00, s.d. = 1.155, SE of the mean = 0.365,
and the value of the test statistic is $(\text{sample mean} - 0)/\text{SE} = (-1.0 - 0)/0.365 = -2.74$.

One-Sample T: diffs

Test of $\mu = 0$ vs $\mu < 0$

Variable	N	Mean	StDev	SE Mean
diffs	10	-1.000	1.155	0.365

Variable	95.0% Upper Bound	T	P
diffs	-0.331	-2.74	0.011

Let's look at the data:

```
MTB > print diffs
```

Data Display

```
diffs  
-1 0 1 -2 -3 -1 -2 -1 0 -1
```

Looking at the preponderance of negative values (indicating effectiveness of the drug), one can
intuitively conclude that the data is strongly suggestive evidence in favor of the alternative. In fact, there
is a "sign test" that one can carry out with this data. Unlike the above t-test, it makes no assumptions
about the parent distribution of the differences. Its rationale goes as follows: if H_0 is true, we should
expect the difference to be positive or negative with equal probability 1/2. So we reject if the number of
negative signs is "unusually high" under this null hypothesis. Here is Minitab's rendition of the sign test.
(We shall discuss this test formally later in Chapter 9.)

```
MTB > STest 0.0 'diffs';  
SUBC> Alternative -1.
```

Sign Test for Median: diffs

Sign test of median = 0.00000 versus < 0.00000

	N	Below	Equal	Above	P	Median
diffs	10	7	2	1	0.0352	-1.000

For the sign test with this data, we get a p-value of 0.035. As with the above t-test, this corresponds to
rejection of H_0 at the .05 significance level but not at the .01 significance level.

If we want more conclusive evidence for or against H_0, we should get more information -- i.e., take a
larger sample size in this experiment.

MTB >