# 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 mu and the p-value for a one-sided test of mu=0 vs mu < 0. The one-sided 95% C.I. is # (-infinity, -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 (sample mean - 0)/SE = (-1.0 - 0)/0.365 = - 2.74.

One-Sample T: diffs

Test of mu = 0 vs mu < 0

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Mean</th>
<th>StDev</th>
<th>SE Mean</th>
</tr>
</thead>
<tbody>
<tr>
<td>diffs</td>
<td>10</td>
<td>-1.00</td>
<td>1.155</td>
<td>0.365</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Variable</th>
<th>95.0% Upper Bound</th>
<th>T</th>
<th>P</th>
</tr>
</thead>
<tbody>
<tr>
<td>diffs</td>
<td>-0.331</td>
<td>-2.74</td>
<td>0.011</td>
</tr>
</tbody>
</table>

# 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
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.