1. One goal of the ATFV treatment for vocal fold scar is to increase mean phonation time (MPT). The following data show preop and postop MPT values for 5 patients.

<table>
<thead>
<tr>
<th>Preop</th>
<th>10</th>
<th>7</th>
<th>10.2</th>
<th>5</th>
<th>13.8</th>
</tr>
</thead>
<tbody>
<tr>
<td>Postop</td>
<td>17</td>
<td>5</td>
<td>18</td>
<td>14</td>
<td>15</td>
</tr>
</tbody>
</table>

Test whether the MPT for patients after surgery is greater than the MPT for patients before surgery using a 5% significance level, and find the \( p \)-value.

2. Another goal of the ATFV treatment for vocal fold scar is to increase phonatory range (PR). The following data show preop and postop PR values for 4 patients.

<table>
<thead>
<tr>
<th>Preop</th>
<th>31</th>
<th>18</th>
<th>16</th>
<th>9</th>
</tr>
</thead>
<tbody>
<tr>
<td>Postop</td>
<td>38</td>
<td>15</td>
<td>17</td>
<td>26</td>
</tr>
</tbody>
</table>

Test whether the PR for patients after surgery is greater than the PR for patients before surgery using a 5% significance level, and find the \( p \)-value.

3. The following figure shows data from a clinical trial of a blood pressure medication.

(a) What was the average blood pressure in the treatment group before receiving the medication? After?

(b) What was the average change in blood pressure in the treatment group?

(c) How many patients were in the treatment group?

(d) Test whether the average drop in blood pressure in the treatment group was statistically significant at the 5% significance level.

(e) Test whether the average drop in blood pressure in the control group was statistically significant at the 5% significance level.

(f) Test whether the average drop in blood pressure caused by the medication is greater than the average drop in blood pressure caused by the placebo at the 5% significance level.
1. Let $D = \text{Postop} - \text{Preop}$.
   
   - The testing problem is
     \[ H_0 : \mu_D = 0 \text{ vs. } H_A : \mu_D > 0 \]
   
   - $T = 2.16$ which is beyond 2.132.
   
   - Therefore, we reject $H_0$ at the 5% significance level.
   
   - That is, the increase in MPT is statistically significant, providing some evidence that the ATFV treatment increases MPT.
   
   - However, since there is no control group in this study, it isn’t certain that this increase was caused by the ATFV treatment. It could be the result of, for example, natural healing.
   
   - A second concern is raised by the small sample size. It is not clear that the results of this study will generalize to the population of all patients with vocal fold scar, since these patients were not randomly selected from the larger population.
   
   - The $p$-value is 0.0484.

2. Let $D = \text{Postop} - \text{Preop}$.

   - The testing problem is
     \[ H_0 : \mu_D = 0 \text{ vs. } H_A : \mu_D > 0 \]
   
   - $T = 1.265$ which is not beyond 2.353.
   
   - Therefore, we do not reject $H_0$ at the 5% significance level.
   
   - That is, the increase in PR is not statistically significant, so we don’t have strong evidence that the ATFV treatment increases PR.
   
   - The $p$-value is 0.148.

3. (a) Before it was 171.2. After it was 165.6.
   
   (b) $-5.6$
   
   (c) 80
   
   (d) For the treatment group, let $D = \text{Postop} - \text{Preop}$, and test

   \[ H_0 : \mu_D = 0 \text{ vs. } H_A : \mu_D < 0 \]

   $Z = -18.55$, which is less than $-1.645$, so the mean decrease in the treatment group is statistically significant.

   (e) For the control group, $Z = 0.849$, which is not less than $-1.645$, so the mean decrease in the control group is not statistically significant (it’s not even a decrease – it’s an increase).
(f) The testing problem is

\[ H_0 : \mu_{D_{\text{Treat}}} = \mu_{D_{\text{Contr}}} \text{ vs. } H_A : \mu_{D_{\text{Treat}}} < \mu_{D_{\text{Contr}}} \]

That is, we need to compare the difference column for the treatment group to the difference column for the control group, using an independent samples test.

\[
Z = \frac{\bar{D}_T - \bar{D}_C}{\sqrt{s^2_{D_T}/n_T + s^2_{D_C}/n_C}} = \frac{-5.6 - 0.3}{\sqrt{2.7^2/80 + 2.5^2/50}} = -12.69.
\]

Since \( Z < -1.645 \), we reject \( H_0 \) and are confident that \( H_A \) is true. Now, \( H_A \) says that \( \mu_{D_{\text{Treat}}} < \mu_{D_{\text{Contr}}} \), which actually means that the average drop in blood pressure caused by the treatment is greater than the average drop caused by the placebo.