1. 7.14 in the Moore text
   a) \( df = n - 1 = 10 - 1 = 9 \)
   b) This is a one-sided test, so if \( t = -2.25 \), p-value is between .025 and .05

2. 7.16 in the Moore text
   a) There are two outliers (9.4 and 22.8), but they do not affect the approximately normal shape of the distribution since they are not extreme values. The difference between the mean and the median is very small, showing no significant skew to the distribution.

   \[
   \text{Mean} = 15.59 \\
   \text{Median} = 15.75 \\
   S = 2.55
   \]

   See histogram presented in class

   b) \( \text{Mean} = 15.59, \ s = 2.55, \ n = 44, \ df = 43, \ \text{confidence} = 95\%, \ t^* = 2.021 \) (at \( df = 40 \), a more conservative interval)

   \[
   c.i. = \bar{X} \pm t^* \left( \frac{s}{\sqrt{n}} \right) = 15.59 \pm 2.021 \left( \frac{2.55}{\sqrt{44}} \right) = 15.59 \pm .78 = 14.81 \text{ to } 16.37
   \]

   We are 95\% confident that the mean length of great white sharks is between 14.81 and 16.37 feet. Based on this interval, there is significant evidence to reject the claim that sharks average 20 feet in length. The interval does not cover the hypothesized 20 feet in length.

   c) We need a more precise definition of the population of great white sharks. Are they male or female, adults or babies, etc.?
3. In 2000, mid-western adults spent an average of 3.2 hours per day watching television. You wonder if this average changes depending on the season. You conduct a telephone survey with a random sample of 50 mid-western adults during January 2001 and find that they spend an average of 3.45 hours per day watching television (s = 1.9). Perform a hypothesis test to determine if this is significantly different from the yearly average. Set $\alpha = .01$.

**Given:** $\alpha = .01; \mu = 3.2; \bar{X} = 3.45; s = 1.9; n = 30; df = 29$

Use the t distribution. $\sigma$ is not known and sample is small

**Step 1: State hypotheses.**

$H_0: \mu = 3.2$

$H_a: \mu \neq 3.2$

**Step 2: Calculate test statistic.**

$$t = \frac{\bar{X} - \mu_0}{\frac{s}{\sqrt{n}}} = \frac{3.45 - 3.2}{\frac{1.9}{\sqrt{30}}} = \frac{.25}{.347} = .72$$

**Step 3: Make a decision.**

If $t = .72$ and $df = 29$, then the p-value is between .40 and .50 [2 x (.20 and .25)]

- OR -

$t_{29,.01}^* = \pm 2.756$

**Decision:** Fail to reject the null hypothesis (because $.72 < \pm 2.756$ and/or .40 to .50 > .01). The mean daily TV viewing time of mid-western adults in January 2001 is not significantly different from their mean daily TV viewing time for all of 2000.
4. A tobacco company claims that the nicotine content of their brand of cigarettes is 1.5 milligrams. You are suspicious and plan to investigate the advertised claim. You think the nicotine content is actually higher. You measure the nicotine content of 65 randomly selected cigarettes of that brand. You find the mean is 1.75 mg and the standard deviation is .50 mg. Construct a 95% confidence interval. Can you refute the manufacturer's claim? What is the chance you could be wrong?

Given: \( \mu = 1.5 \text{ mg}; n = 65; \bar{X} = 1.75 \text{ mg}; s = .50 \text{ mg}; \text{ confidence} = 95\% \)

Use the \( t \) distribution because \( \sigma \) is unknown. \( df = n - 1 = 64; t_{64, 95\%} = 2.00 \)

NOTE: When between \( df \) values, choose the smaller \( df \), which results in a higher \( t^* \) value and thus a more conservative interval (or hypothesis test, if applicable).

\( H_0: \mu = 1.5 \text{ mg} \)
\( H_a: \mu > 1.5 \text{ mg} \)

\[
95\% \text{ c.i.} = \bar{X} \pm t^* \left( \frac{s}{\sqrt{n}} \right) = 1.75 \pm 2.00 \left( \frac{.50}{\sqrt{65}} \right) = 1.75 \pm .12 = 1.63 \text{ and } 1.87
\]

We are 95% confident that the mean amount of nicotine in this brand of cigarettes is between 1.63 and 1.87 milligrams per cigarette. We can thus refute the manufacturer’s claim that the mean amount is 1.5 mg. Our interval shows that it is significantly higher than 1.5 mg, anywhere between 1.63 and 1.87 mg. There is a small chance that we’re wrong. In 5 out of 100 samples of this size, we might find nicotine levels that are not significantly different from the advertised claim.
5. Twelve runners are asked to run a 10-kilometer race on each of two consecutive weeks. In one of the races, the runners wear one brand of shoe and in the other a second brand. Which brand they wear in which race is determined at random. All runners are timed and are asked to run their best in each race. The results (in minutes) are below. The mean difference is -.0683 minutes (s = .2316 mn.). Does Brand 1 produce slower times than Brand 2? Set \( \alpha = .05 \).

<table>
<thead>
<tr>
<th>Runner</th>
<th>Brand 1</th>
<th>Brand 2</th>
<th>Difference*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>31.23</td>
<td>31.67</td>
<td>-.44</td>
</tr>
<tr>
<td>2</td>
<td>29.33</td>
<td>28.98</td>
<td>.35</td>
</tr>
<tr>
<td>3</td>
<td>30.50</td>
<td>30.63</td>
<td>-.13</td>
</tr>
<tr>
<td>4</td>
<td>32.20</td>
<td>32.67</td>
<td>-.47</td>
</tr>
<tr>
<td>5</td>
<td>33.08</td>
<td>32.95</td>
<td>.13</td>
</tr>
<tr>
<td>6</td>
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<td>31.53</td>
<td>-.01</td>
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<tr>
<td>7</td>
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<td>30.83</td>
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<tr>
<td>8</td>
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<td>31.10</td>
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</tr>
<tr>
<td>9</td>
<td>33.00</td>
<td>33.12</td>
<td>-.12</td>
</tr>
<tr>
<td>10</td>
<td>29.67</td>
<td>29.50</td>
<td>.17</td>
</tr>
<tr>
<td>11</td>
<td>30.55</td>
<td>30.57</td>
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</tr>
<tr>
<td>12</td>
<td>32.12</td>
<td>32.20</td>
<td>-.08</td>
</tr>
</tbody>
</table>

*Difference = Brand 1 time - Brand 2 time

Given: \( \mu_{\text{difference}} = 0 \) minutes; \( \bar{X}_{\text{difference}} = -.0683 \text{mn.}; s = .2316 \text{mn.}; n = 12; \alpha = .05 \)

**Step 1: State hypotheses.**

- \( H_0: \mu_{\text{difference}} = 0 \) minutes
- \( H_a: \mu_{\text{difference}} < 0 \) minutes (we’re saying brand 1 time will be less than brand 2 time)

**Step 2: Calculate test statistic.**

Use the t distribution because \( \sigma \) is unknown and \( n \) is small. \( df = n - 1 = 11 \)

\[
t = \frac{\bar{X} - \mu_0}{s / \sqrt{n}} = \frac{-0.0683 - 0}{0.2316 / \sqrt{12}} = -1.02
\]

**Step 3: Make a decision.**

- \( p\)-value = between .15 and .20 (for \( df = 11 \), \( t = -1.02 \) falls between \( t = .876 \) and \( t = 1.088 \)) \( t^{*}_{11,0.05} = -1.796 \) (negative \( t^* \) because \( H_a \) states the difference is less than zero)

Decision: Fail to reject the null hypothesis (because \(|-1.02 < -1.796| \) and/or .15 to .20 > .05). Brand 1 shoe and Brand 2 shoe running times are not significantly different from one another. Brand 2 does not outperform Brand 1.