SECTION 8.3

Step 1: Determine the null and alternative hypotheses. The hypotheses can be structured in one of three ways:

<table>
<thead>
<tr>
<th>Left - Tailed Test</th>
<th>Two - Tailed Test</th>
<th>Right - Tailed Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>$H_0 : p = p_0$</td>
<td>$H_o : p = p_0$</td>
<td>$H_o : p = p_0$</td>
</tr>
<tr>
<td>$H_1 : p &lt; p_0$</td>
<td>$H_1 : p \neq p_0$</td>
<td>$H_1 : p &gt; p_0$</td>
</tr>
</tbody>
</table>

Step 2: Select the level of significance $\alpha$ based on the seriousness of making a Type 1 error.

Step 3: Compute the test statistic

$n = \text{sample size} \quad p = \text{population proportion} \quad q = 1-p \quad p = \text{sample proportion}$

$$z = \frac{\hat{p} - p}{\sqrt{\frac{pq}{n}}}$$

Step 4: If the P-value < $\alpha$, reject the null hypothesis.
If the P-value $\geq \alpha$, fail to reject the null hypothesis.
If the test statistics is in the critical region, reject the null hypothesis.
If the test statistics is not in the critical region, fail to reject the null hypothesis.
If p value is not within the confidence interval, reject the null hypothesis.
If p value is within the confidence interval, fail to reject the null hypothesis.

Step 5: State the conclusion

If we reject the null hypothesis then there is sufficient evidence to conclude (state the alternate hypothesis).
If we fail to reject the null hypothesis then there is insufficient evidence to conclude (state the alternate hypothesis) which indicates the sample evidence is consistent with the claim of the null hypothesis.
Example 1: Given the data determine the final decision, reject the null hypotheses or fail to reject the null hypothesis. Use all three methods.

Null hypotheses: \( p = 0.6 \)

Alternative hypotheses: \( p < 0.6 \)

\( n = 250 \quad x = 124 \quad \alpha = 0.01 \)

Step 1:

Step 2:

Step 3:

\[ P\text{-Value} \]

Critical Value

Confidence Interval

Step 4:

Statement
Example 2: An article distributed by the Associated Press included these results from a nationwide survey:
Of 880 randomly selected drives, 56% admitted that they run red lights. The claim is that the majority of all Americans run red lights.

Step 4:
Statement
Example 3: In 1997, 46% of Americans said they did not trust the media “when it comes to reporting the news fully, accurately and fairly”. In a 2007 poll of 1010 adults nationwide, 525 stated they did not trust the media. At the $\alpha = 0.05$ level of significance, is there evidence to support the claim that the percentage of Americans that do not trust the media to report fully and accurately has increased since 1997?

Step 1:

Step 2:

Step 3:

Step 4:

Statement
Example 4: In 2000, 58% of females aged 15 years of age and older lived alone, accordingly to the US Census Bureau. A sociologist test whether this percentage is different today by conducting a random sample of 500 females aged 15 years of age and older and finds that 285 are living alone. Is there sufficient evidence at the $\alpha = 0.1$ level of significance to conclude the proportion has changed since 2000?

Step 1:

Step 2:

Step 3:

Step 4:

Statement
SECTION 8.4

Step 1: Determine the null and alternative hypotheses.
The hypotheses can be structured in one of three ways

<table>
<thead>
<tr>
<th>Left - Tailed Test</th>
<th>Two – Tailed Test</th>
<th>Right - Tailed Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>$H_0 : \mu = \mu_0$</td>
<td>$H_0 : \mu = \mu_0$</td>
<td>$H_0 : \mu = \mu_0$</td>
</tr>
<tr>
<td>$H_1 : \mu &lt; \mu_0$</td>
<td>$H_1 : \mu \neq \mu_0$</td>
<td>$H_1 : \mu &gt; \mu_0$</td>
</tr>
</tbody>
</table>

Step 2: Select the level of significance $\alpha$ based on the seriousness of making a Type 1 error

Step 3: Compute the test statistic

$$t = \frac{\bar{x} - \mu_0}{\frac{s}{\sqrt{n}}}$$

Step 4: If the P-value $< \alpha$, reject the null hypothesis
If the P-value $\geq \alpha$, fail to reject the null hypothesis

If the test statistics is in the critical region reject the null hypothesis
If the test statistics is not in the critical region fail to reject the null hypothesis

If p value is not within the confidence interval reject the null hypothesis
If p value is within the confidence interval fail to reject the null hypothesis

Step 5: State the conclusion

If we reject the null hypothesis then there is sufficient evidence to conclude (state the alternate hypothesis)

If we fail to reject the null hypothesis then there is insufficient evidence to conclude (state the alternate hypothesis) which indicates the sample evidence is consistent with the claim of the null hypothesis.
Example 1  The mean height of American males is 69.5 inches. The height of the 43 male US Presidents (Washington to Obama) have a mean 70.78 inches and a sample standard deviation of 2.77 in. Treating the 43 Presidents as a simple random sample determine if there is evidence to suggest that US Presidents are taller than the average American male. Use the $\alpha = 0.05$ for level of significance.

Step 1:

Step 2:

Step 3:

Step 4:
  Statement
Example 2

The fun size of a Snickers bar is supposed to weight 20 grams. Because the penalty for selling candy bars under their advertised weight is severe. The manufacturer calibrates the machine so the mean weight is 20.1 grams. The quality control engineer at M&M-Mars, the Snickers manufacturer, is concerned about the calibration. He obtains a random sample of 11 candy bars, weighs them, and obtains the data below. Should the machine be shut down and calibrated? Because shutting down the plant is very expensive, he decides to conduct the test at the $\alpha = 0.01$ level of significance.


Step 1:

Step 2:

Step 3:

Step 4:
Statement
Example 3  According to the American Community Survey, the mean travel time to work in Collin County, Texas, in 2008 was 2703 minutes. The Department of Transportation reprogrammed all the traffic lights in Collin County to attempt to reduce travel time. To determine if there is evidence that travel time has decreased as a result of the reprogramming the Department of Transportation obtains a random sample of 2500 commuters, records their travel time to work, and finds a sample mean of 27.0 minutes with a standard deviation of 8.5 minutes. Does this result suggest that travel time has decreased at the $\alpha = 0.05$ level of significance.

Step 1:

Step 2:

Step 3:

Step 4:
   Statement
SECTION 8.5

Step 1: Determine the null and alternative hypotheses.
The hypotheses can be structured in one of three ways

<table>
<thead>
<tr>
<th>Left - Tailed Test</th>
<th>Two – Tailed Test</th>
<th>Right - Tailed Test</th>
</tr>
</thead>
<tbody>
<tr>
<td>$H_0 : \sigma = \sigma_0$</td>
<td>$H_0 : \sigma = \sigma_0$</td>
<td>$H_0 : \sigma = \sigma_0$</td>
</tr>
<tr>
<td>$H_1 : \sigma &lt; \sigma_0$</td>
<td>$H_1 : \sigma \neq \sigma_0$</td>
<td>$H_1 : \sigma &gt; \sigma_0$</td>
</tr>
</tbody>
</table>

Step 2: Select the level of significance $\alpha$ based on the seriousness of making a Type I error

Step 3: Compute the test statistic

$$X^2 = \frac{(n - 1)s^2}{\sigma^2}$$

degrees of freedom = $n - 1$

Step 4: If the $P$-value < $\alpha$,
   reject the null hypothesis

   If the $P$-value \(\geq\) $\alpha$,
   fail to reject the null hypothesis

   If the test statistics is in the critical region
   reject the null hypothesis

   If the test statistics is not in the critical region
   fail to reject the null hypothesis

   If $p$ value is not within the confidence interval
   reject the null hypothesis

   If $p$ value is within the confidence interval
   fail to reject the null hypothesis

Step 5: State the conclusion

If we reject the null hypothesis then there is sufficient evidence to conclude (state the alternate hypothesis)

If we fail to reject the null hypothesis then there is insufficient evidence to conclude (state the alternate hypothesis) which indicates the sample evidence is consistent with the claim of the null hypothesis.
Example 1

Find the test statistic and critical value(s). Determine whether there is sufficient evidence to support the given alternative hypothesis

<table>
<thead>
<tr>
<th>Supermodel weights</th>
<th>H₁ : σ &lt; 0.25</th>
<th>α = 0.05</th>
</tr>
</thead>
<tbody>
<tr>
<td>n = 8</td>
<td>s = 7.5</td>
<td></td>
</tr>
</tbody>
</table>

Step 1:

Step 2:

Step 3:

Step 4:

Statement
Example 2  
Find the test statistic and critical value(s). Determine whether there is sufficient evidence to support the given alternative hypothesis

<table>
<thead>
<tr>
<th>Precipitation Amounts</th>
<th>$H_1 : \sigma \neq 0.25$</th>
<th>$\alpha = 0.01$</th>
</tr>
</thead>
<tbody>
<tr>
<td>$n = 26$</td>
<td></td>
<td>$s = 0.18$</td>
</tr>
</tbody>
</table>

Step 1:

Step 2:

Step 3:

Step 4:  
Statement
Example 3

With individuals lines at various windows, a post office finds that the standard deviation for normally distributed waiting times for customers on Friday afternoon is 7.2 minutes. The post office experiments with a single, main waiting line and finds that for a random sample of 25 customers, the waiting times for customers have a standard deviation, of 3.5 minutes. With a significance level of 5%, test the claim that a single line causes lower variation among waiting times (shorter waiting times) for customers.

Step 1:

Step 2:

Step 3:

Step 4:

Statement