5.32. a. \( P(-t_0 < t < t_0) = .95 \) where \( df = 16 \)
Because of symmetry, the statement can be written
\[ P(0 < t < t_0) = .475 \] where \( df = 16 \)
\[ \Rightarrow P(t \geq t_0) = .5 - .475 = .025 \]
\( t_0 = 2.120 \)

b. \( P(t \leq -t_0 \text{ or } t \geq t_0) = .05 \) where \( df = 16 \)
\[ \Rightarrow 2P(t \geq t_0) = .05 \]
\[ \Rightarrow P(t \geq t_0) = .025 \text{ where } df = 16 \]
\( t_0 = 2.120 \)

c. \( P(t \leq t_0) = .05 \) where \( df = 16 \)
Because of symmetry, the statement can be written
\[ P(t \geq -t_0) = .05 \] where \( df = 16 \)
\( t_0 = 1.746 \)

d. \( P(t \leq -t_0 \text{ or } t \geq t_0) = .10 \) where \( df = 12 \)
\[ \Rightarrow 2P(t \geq t_0) = .10 \]
\[ \Rightarrow P(t \geq t_0) = .05 \text{ where } df = 12 \]
\( t_0 = 1.782 \)

e. \( P(t \leq -t_0 \text{ or } t \geq t_0) = .01 \) where \( df = 8 \)
\[ \Rightarrow 2P(t \geq t_0) = .01 \]
\[ \Rightarrow P(t \geq t_0) = .005 \text{ where } df = 8 \]
\( t_0 = 3.355 \)

5.40.

a. The point estimate for the average annual rainfall amount at ant sites in the Dry Steppe region of Central Asia is \( \bar{x} = 183.4 \) milliliters.

b. For confidence coefficient .90, \( \alpha = .10 \) and \( \alpha/2 = .10/2 = .05 \). From Table IV, Appendix A, with \( df = n - 1 = 5 - 1 = 4 \), \( t_{.05} = 2.132 \).

c. The 90% confidence interval is:
\[ \bar{x} \pm t_{.05} \frac{s}{\sqrt{n}} \Rightarrow 183.4 \pm 2.132 \frac{20.6470}{\sqrt{5}} \Rightarrow 183.4 \pm 19.686 \Rightarrow (163.714, 203.086) \]
d. We are 90% confident that the average annual rainfall amount at ant sites in the Dry Steppe region of Central Asia is between 163.714 and 203.086 milliliters.

e. Using MINITAB, the 90% confidence interval is:

One-Sample T: DS Rain

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Mean</th>
<th>StDev</th>
<th>SE Mean</th>
<th>90% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>DS Rain</td>
<td>5</td>
<td>163.400</td>
<td>20.647</td>
<td>9.234</td>
<td>(163.715, 203.085)</td>
</tr>
</tbody>
</table>

The 90% confidence interval is (163.715, 203.085). This is very similar to the confidence interval calculated in part c.

f. The point estimate for the average annual rainfall amount at ant sites in the Gobi Desert region of Central Asia is $\bar{x} = 110.0$ milliliters. For confidence coefficient .90, $\alpha = .10$ and $\alpha/2 = .10/2 = .05$. From Table IV, Appendix A, with $df = n - 1 = 6 - 1 = 5$, $t_{0.05} = 2.015$.

The 90% confidence interval is:

$$
\bar{x} \pm t_{0.05} \frac{s}{\sqrt{n}} = 110.0 \pm 2.015 \frac{15.975}{\sqrt{6}} = 110.0 \pm 13.141 \Rightarrow (96.859, 123.141)
$$

We are 90% confident that the average annual rainfall amount at ant sites in the Gobi Desert region of Central Asia is between 96.859 and 123.141 milliliters.

Using MINITAB, the 90% confidence interval is:

One-Sample T: GD Rain

<table>
<thead>
<tr>
<th>Variable</th>
<th>N</th>
<th>Mean</th>
<th>StDev</th>
<th>SE Mean</th>
<th>90% CI</th>
</tr>
</thead>
<tbody>
<tr>
<td>GD Rain</td>
<td>6</td>
<td>110.000</td>
<td>15.975</td>
<td>6.522</td>
<td>(96.858, 123.142)</td>
</tr>
</tbody>
</table>

The 90% confidence interval is (96.858, 123.142). This is very similar to the confidence interval calculated above.

5.46 a. Some preliminary calculations are:

\[
\bar{x} = \frac{\sum x}{n} = \frac{196}{11} = 17.82
\]

\[
s^2 = \frac{\sum x^2 - (\sum x)^2}{n-1} = \frac{3,734 - 196^2}{11-1} = 24.1636
\]

\[
s = \sqrt{24.1636} = 4.92
\]

For confidence coefficient .95, $\alpha = .05$ and $\alpha/2 = .05/2 = .025$. From Table IV, with $df = n - 1 = 11 - 1 = 10$, $t_{0.025} = 2.228$. The 95% confidence interval is:

\[
\bar{x} \pm t_{0.025} \frac{s}{\sqrt{n}} = 17.82 \pm 2.228 \frac{4.92}{\sqrt{11}} \Rightarrow 17.82 \pm 3.31 \Rightarrow (14.51, 21.13)
\]
We are 95% confident that the mean FNE score of the population of bulimic female students is between 14.51 and 21.13.

b. Some preliminary calculations are:

\[ \bar{x} = \frac{\sum x}{n} = \frac{198}{14} = 14.14 \]

\[ s^2 = \frac{\sum x^2 - \left( \frac{\sum x}{n} \right)^2}{n-1} = \frac{3,164 - \frac{198^2}{14}}{14 - 1} = 27.9780 \]

\[ s = \sqrt{27.9780} = 5.29 \]

For confidence coefficient \( \alpha = .05 \) and \( \alpha/2 = .05/2 = .025 \). From Table IV, with df \( = n - 1 = 14 - 1 = 13 \), \( t_{.025} = 2.160 \). The 95% confidence interval is:

\[ \bar{x} \pm t_{\alpha/2} \frac{s}{\sqrt{n}} \Rightarrow 14.14 \pm 2.160 \frac{5.29}{\sqrt{14}} \Rightarrow 14.14 \pm 3.05 \Rightarrow (11.09, 17.19) \]

We are 95% confident that the mean FNE score of the population of normal female students is between 11.09 and 17.19.

c. We must assume that the populations of FNE scores for both the bulimic and normal female students are normally distributed.

Stem-and-leaf displays for the two groups are below:

Stem-and-leaf of Bulimia \( N = 11 \)
Leaf Unit = 1.0

1 1 0
3 1 33
4 1 4
5 1 6
1 (1) 1 9
5 2 0 11
2 2
2 2 4 5

Stem-and-leaf of Normal \( N = 14 \)
Leaf Unit = 1.0

2 0 6 7
3 0 8
5 3 0 1
7 1 3 3
7 1 5
6 1 6
5 1 8 9 9
2 2 0
1 2 3

From both of these plots, the assumption of normality is questionable for both groups. Neither of the plots look mound-shaped.
5.52 a. The sample size is large enough if both \( np \geq 15 \) and \( nq \geq 15 \).

\[ np = 144(.76) = 109.44 \quad \text{and} \quad nq = 144(.24) = 34.56 \]

Since both of these numbers are greater than or equal to 15, the sample size is sufficiently large to conclude the normal approximation is reasonable.

b. For confidence coefficient .90, \( \alpha = .10 \) and \( \alpha/2 = .05 \). From Table III, Appendix A, \( z_{.90} = 1.645 \). The 90\% confidence interval is:

\[ \hat{p} \pm z_{.90} \sqrt{\frac{pq}{n}} = \hat{p} \pm 1.645 \sqrt{\frac{.76(.24)}{144}} \Rightarrow .76 \pm .059 \]

\[ = (.701, .819) \]

c. We must assume the sample was randomly selected from the population of interest. We must also assume our sample size is sufficiently large to ensure the sampling distribution is approximately normal. From the results of part a, this appears to be a reasonable assumption.

5.58 a. The parameter of interest is the true proportion of fillets that are really red snapper.

b. The sample size is large enough if both \( np \geq 15 \) and \( nq \geq 15 \).

\[ np = 22(.23) = 5.06 \quad \text{and} \quad nq = 22(.77) = 16.94 \]

Since the first number is not greater than or equal to 15, the sample size is not sufficiently large to conclude the normal approximation is reasonable.

c. The Wilson adjusted sample proportion is

\[ \hat{p} = \frac{x + 2}{n + 4} = \frac{5 + 2}{22 + 4} = \frac{7}{26} = .269 \]

For confidence coefficient .95, \( \alpha = .05 \) and \( \alpha/2 = .025 \). From Table III, Appendix A, \( z_{.025} = 1.96 \). The Wilson adjusted 95\% confidence interval is:

\[ \hat{p} \pm z_{.025} \sqrt{\frac{\hat{p}(1 - \hat{p})}{n + 4}} \Rightarrow .269 \pm 1.96 \sqrt{\frac{.269(.731)}{22 + 4}} \Rightarrow .269 \pm .170 \Rightarrow (.099, .439) \]

d. We are 95\% confident that the true proportion of fish fillets purchased from vendors across the U.S. that are really red snapper is between .099 and .439.

5.62 First, we compute \( \hat{p} \):

\[ \hat{p} = \frac{x}{n} = \frac{88}{504} = .175 \]
The sample size is large enough if both \( np \geq 15 \) and \( nq \geq 15 \).

\[ np = 504(.175) = 88.2 \quad \text{and} \quad nq = 504(.825) = 415.8. \]

Since both of the numbers are greater than or equal to 15, the sample size is sufficiently large to conclude the normal approximation is reasonable.

For confidence coefficient .90, \( \alpha = .10 \) and \( \alpha/2 = .05 \). From Table III, Appendix A, \( z_{05} = 1.645 \). The 90\% confidence interval is:

\[ \hat{p} \pm z_{05} \sqrt{\frac{pq}{n}} \Rightarrow \hat{p} \pm 1.645 \sqrt{\frac{.175 \cdot .825}{504}} \Rightarrow .175 \pm .058 \Rightarrow (.117, .203) \]

We are 90\% confident that the true proportion of all ice melt ponds in the Canadian Arctic that have first-year ice is between .147 and .203.

5.74  

a. For confidence coefficient .95, \( \alpha = .05 \) and \( \alpha/2 = .025 \). From Table III, Appendix A, \( z_{025} = 1.96 \).

The sample size is

\[ n = \frac{(z_{025})^2 pq}{(SE)^2} = \frac{(1.96)^2(.3X.7)}{.06^2} = 224.1 \approx 225 \]

You would need to take \( n = 225 \) samples.

b. To compute the needed sample size, use:

\[ n = \frac{(z_{025})^2 pq}{(SE)^2} = \frac{(1.96)^2(5)(.5)}{.06^2} = 266.8 \approx 267 \]

You would need to take \( n = 267 \) samples.
5.80  

a. The confidence level desired by the researchers is .95.

b. The sampling error desired by the researchers is SE = .001.

c. For confidence coefficient .95, \( \alpha = .05 \) and \( \alpha/2 = .025 \). From Table III, Appendix A, \( z_{.025} = 1.96 \).

The sample size is

\[
\begin{align*}
 n &= \frac{(z_{.025})^2 \sigma^2}{SE^2} \\
 &= \frac{1.96^2(.005)^2}{.001^2} \\
 &= 96.04 \approx 97.
\end{align*}
\]

6.18  

a. A Type I error is rejecting the null hypothesis when it is true. In a murder trial, we would be concluding that the accused is guilty when, in fact, he/she is innocent.

A Type II error is accepting the null hypothesis when it is false. In this case, we would be concluding that the accused is innocent when, in fact, he/she is guilty.

b. Both errors are bad. However, if an innocent person is found guilty of murder and is put to death, there is no way to correct the error. On the other hand, if a guilty person is set free, he/she could murder again.

c. In a jury trial, \( \alpha \) is assumed to be smaller than \( \beta \). The only way to convict the accused is for a unanimous decision of guilt. Thus, the probability of convicting an innocent person is set to be small.

d. In order to get a unanimous vote to convict, there has to be overwhelming evidence of guilt. The probability of getting a unanimous vote of guilt if the person is really innocent will be very small.

e. If a jury is prejudiced against a guilty verdict, the value of \( \alpha \) will decrease. The probability of convicting an innocent person will be even smaller if the jury is prejudiced against a guilty verdict.

f. If a jury is prejudiced against a guilty verdict, the value of \( \beta \) will increase. The probability of declaring a guilty person innocent will be larger if the jury is prejudiced against a guilty verdict.

6.28  

a. The rejection region requires \( \alpha = .01 \) in the lower tail of the \( z \) distribution. From Table III, Appendix A, \( z_{.01} = 2.33 \). The rejection region is \( z < -2.33 \).

b. The test statistic is

\[
\begin{align*}
 z &= \frac{\bar{x} - \mu_0}{\sigma_x} = \frac{19.3 - 20}{11.9/\sqrt{46}} = -.40
\end{align*}
\]

c. Since the observed value of the test statistic does not fall in the rejection region \((z = -.40 \not< -2.33)\), \( H_0 \) is not rejected. There is insufficient evidence to indicate the mean number of latex gloves used per week by hospital employees diagnosed with a latex allergy from exposure to the powder on latex gloves is less than 20 at \( \alpha = .01 \).