Chapter 11 Homework Solutions

1. $H_0$: The data fit a Uniform Distribution (The die is fair)  
   $H_a$: The data does not fit a Uniform Distribution (The die is not fair)

   Distribution is $\chi^2$

   \[
   \begin{array}{|c|c|c|c|}
   \hline
   \text{Outcome} & \text{O} & \text{E} & \frac{(O-E)^2}{E} \\
   \hline
   1 & 15 & 20 & 1.25 \\
   2 & 29 & 20 & 4.05 \\
   3 & 16 & 20 & 0.8 \\
   4 & 15 & 20 & 1.25 \\
   5 & 30 & 20 & 5 \\
   6 & 15 & 20 & 1.25 \\
   \hline
   \text{Total} & 120 & 120 & 13.6 \\
   \hline
   \end{array}
   \]

   TS: $\chi^2 = 13.6$
   
   \[
   \begin{align*}
   \text{P-value} &= P(\chi^2 > 13.6) = 0.0184 < 0.05 \\
   \text{Reject } H_0 \\
   \end{align*}
   \]

   There is sufficient evidence to conclude the data does not fit a Uniform Distribution and the die is not fair.

2. $H_0$: The observed class grades fit the expected grades  
   $H_a$: The observed class grades do not fit the expected grades

   Distribution is $\chi^2$

   \[
   \begin{array}{|c|c|c|c|c|}
   \hline
   \text{Outcome} & \text{p} & \text{E} & \frac{(O-E)^2}{E} \\
   \hline
   A & 6 & 0.25 & 5 & 0.20 \\
   B & 9 & 0.30 & 6 & 1.5 \\
   C & 4 & 0.35 & 7 & 1.2857 \\
   D & 1 & 0.10 & 2 & 0.50 \\
   \hline
   \text{Total} & 20 & & & 3.4857 \\
   \hline
   \end{array}
   \]

   TS: $\chi^2 = 3.4857$
   
   \[
   \begin{align*}
   \text{P-value} &= P(\chi^2 > 3.4857) = 0.3226 > 0.05 \\
   \text{Do Not Reject } H_0 \\
   \end{align*}
   \]

   There is not sufficient evidence to conclude that the observed test scores are significantly different than the expected test scores.
3. \( H_0 \): Honeymoon location is independent of bride’s age  
\( H_a \): Honeymoon location is dependent on bride’s age  

df = \((4–1)(4–1) = 9\)  
Distribution is \( \chi^2 \)  

<table>
<thead>
<tr>
<th>O</th>
<th>E</th>
<th>((O - E)^2 / E)</th>
</tr>
</thead>
<tbody>
<tr>
<td>15</td>
<td>18.2143</td>
<td>0.5672</td>
</tr>
<tr>
<td>25</td>
<td>30.3571</td>
<td>0.9454</td>
</tr>
<tr>
<td>25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>10</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5</td>
<td></td>
<td></td>
</tr>
<tr>
<td>20</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>15</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

TS: \( \chi^2 = 15.7027 \)  
P–value = \( P(\chi^2 > 15.7027) = 0.0734 > 0.05 \)  
Do Not Reject \( H_0 \)  
There is not sufficient evidence to conclude that honeymoon location is dependent on the age of the bride.

5. \( H_0 \): \( \sigma = 0.50 \)  
\( H_a \): \( \sigma > 0.50 \)  

\[ n = 84 \]  
\[ s = 0.54 \]  

Distribution is \( \chi^2_{83} \)  

TS: \( \chi^2 = \frac{83(0.54)^2}{0.50^2} = 96.8112 \)  
P–value = \( P(\chi^2 > 96.8112) = 0.1426 > 0.05 \)  
Do Not Reject \( H_0 \)  
There is not sufficient evidence to conclude that the standard deviation of the weights of the cereal boxes is more than 1/2 oz. It cannot be determined whether the equipment needs to be recalibrated or not.
6. \( H_0: \sigma = 2 \)
\( H_a: \sigma \neq 2 \)

\[ n = 15 \]
\[ s = 1.2228 \]

Distribution is \( \chi^2_{14} \)

\[
\text{TS: } \chi^2 = \frac{14(1.2228)^2}{2^2} = 5.2333
\]

\[
P\text{-value} = 2P(\chi^2 < 5.2333) = 0.0354 < 0.05
\]

Reject \( H_0 \)

There is sufficient evidence to conclude that the standard for the number of fish in a 20-gallon tank is not 2.

It appears the standard deviation for the number of fish in a 20-gallon tank is less than 2.