1. In the game of chess, the first few moves play a very important role in determining the final outcome. Five different opening strategies are highly favored by chess experts. To determine whether one or more of these strategies is most preferred by grand masters in international competition, a random sample of 100 grand masters is taken, and each is asked which of the strategies he or she would prefer to employ. A summary of their responses is given below:

<table>
<thead>
<tr>
<th>Strategy</th>
<th>A</th>
<th>B</th>
<th>C</th>
<th>D</th>
<th>E</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observed Frequency</td>
<td>17</td>
<td>27</td>
<td>22</td>
<td>15</td>
<td>19</td>
</tr>
<tr>
<td>Expected</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
<td>20</td>
</tr>
</tbody>
</table>

Test the hypothesis that there is no preference between these strategies by grand masters in international competition.

**Null** : no preference; just chance variation

**$\chi^2$ test**, $df = 4$

$$\chi^2 = \sum \frac{(\text{observed} - \text{expected})^2}{\text{expected}}$$

$$= \frac{(17-20)^2}{20} + \frac{(27-20)^2}{20} + \frac{(22-20)^2}{20} + \frac{(15-20)^2}{20} + \frac{(19-20)^2}{20}$$

$$= 4.4$$

$p$-value : .35 or 35%  
Don't reject, could be just chance.
2. Many scientists believe that alcoholism is linked to social isolation. One measure of social isolation is marital status, i.e., whether a person is married or not. To test the notion that alcoholics are socially isolated, 280 adults were randomly selected and each was classified as a diagnosed alcoholic, undiagnosed alcoholic, or nonalcoholic and categorized according to his or her marital status. A summary of the responses is shown in the table. Can you conclude that there is a relationship between the marital status and alcoholic classifications?

<table>
<thead>
<tr>
<th></th>
<th>Diagnosed</th>
<th>Undiagnosed</th>
<th>Nonalcoholic</th>
</tr>
</thead>
<tbody>
<tr>
<td>Married</td>
<td>21 (33)</td>
<td>37 (41)</td>
<td>58 (42)</td>
</tr>
<tr>
<td>Not Married</td>
<td>59 (47)</td>
<td>63 (59)</td>
<td>42 (58)</td>
</tr>
<tr>
<td></td>
<td>80</td>
<td>100</td>
<td>164</td>
</tr>
</tbody>
</table>

Null: variables are independent

\( \chi^2 \) test for independence; \( df = (2-1)(3-1) = 2 \)

Expected frequencies

\[
\begin{align*}
\text{Married + Diagnosed: } & \quad \frac{80}{280} \times 116 = 33 \\
\text{Married + Undiagnosed: } & \quad \frac{100}{280} \times 116 = 41
\end{align*}
\]

\[
\chi^2 = \left( \frac{21-33}{33} \right)^2 + \left( \frac{37-41}{41} \right)^2 + \left( \frac{58-42}{42} \right)^2 + \left( \frac{63-59}{59} \right)^2 + \left( \frac{42-58}{58} \right)^2
\]

\( \approx 14.38 \)  \( p \text{ value} = .0006 \) \( \text{Reject null} \)