1) You are conducting research into the maze navigation behavior of rats. In your research, you use a Tolman radial maze (a maze with a central chamber and identical 4 arms that branch off from the central chamber). Before you explore the ability of your rats to navigate the maze in search of food, you want to check that the rats don’t prefer one of the arms of the maze more than another. You decide to test 28 rats in the maze without any food reward to determine if they naturally prefer one arm of the maze more than another. You find your rats choose arms of the maze as follows:

<table>
<thead>
<tr>
<th>Arm 1</th>
<th>Arm 2</th>
<th>Arm 3</th>
<th>Arm 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>6</td>
<td>9</td>
<td>6</td>
<td>7</td>
</tr>
</tbody>
</table>

Conduct the appropriate $\chi^2$ test and report the results. Report the effect size, if applicable.

2) You are studying the prevalence of depression among men and women. You decide to test if women are classified as depressed more frequently than men. However, because you realize that depression exists at many different levels, you decide to categorize your participants into “seriously depressed,” “moderately depressed,” and “not depressed” categories by gender. For men, you find 25 seriously depressed, 47 moderately depressed, and 356 not depressed individuals. For women, you find 74 seriously depressed, 110 moderately depressed, and 260 not depressed individuals.

Conduct the appropriate $\chi^2$ test and report the results. Report the effect size, if applicable.
Answers

1)  

<table>
<thead>
<tr>
<th></th>
<th>Arm 1</th>
<th>Arm 2</th>
<th>Arm 3</th>
<th>Arm 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>Observed</td>
<td>6</td>
<td>9</td>
<td>6</td>
<td>7</td>
</tr>
<tr>
<td>Expected</td>
<td>7</td>
<td>7</td>
<td>7</td>
<td>7</td>
</tr>
</tbody>
</table>

\[ \chi^2 = \sum \frac{(O - E)^2}{E} \]

\[ \chi^2 = \frac{(6 - 7)^2}{7} + \frac{(9 - 7)^2}{7} + \frac{(6 - 7)^2}{7} + \frac{(7 - 7)^2}{7} \]

\[ \chi^2 = \frac{(-1)^2}{7} + \frac{(2)^2}{7} + \frac{(-1)^2}{7} + \frac{(0)^2}{7} \]

\[ \chi^2 = \frac{1}{7} + \frac{4}{7} + \frac{1}{7} + \frac{0}{7} \]

\[ \chi^2 = \frac{6}{7} \]

\[ \chi^2 = .86 \]

df=(# observed -1) = (4-1) = 3

Since \( \chi^2_{\text{obs}} = .86 < \chi^2_{\text{crit}} = 7.82 \), fail to reject the null. The rats show no particular preference for one arm of the maze over another arm of the maze.
2)  | Seriously Dep. | Moderately Dep. | Not Depressed |
<table>
<thead>
<tr>
<th></th>
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</tr>
</thead>
<tbody>
<tr>
<td>Men</td>
<td>25</td>
<td>47</td>
<td>356</td>
</tr>
<tr>
<td>Women</td>
<td>74</td>
<td>110</td>
<td>260</td>
</tr>
</tbody>
</table>

\[ E_{ij} = \frac{R_i C_j}{N} \]

\[ E_{11} = \frac{(428)(99)}{872} = E_{11} = \frac{42372}{872} = E_{11} = 48.59 \]

\[ E_{12} = \frac{(428)(157)}{872} = E_{12} = \frac{67196}{872} = E_{12} = 77.06 \]

\[ E_{13} = \frac{(428)(616)}{872} = E_{13} = \frac{263648}{872} = E_{13} = 302.35 \]

\[ E_{21} = \frac{(444)(99)}{872} = E_{21} = \frac{43956}{872} = E_{21} = 50.41 \]

\[ E_{22} = \frac{(444)(157)}{872} = E_{22} = \frac{69708}{872} = E_{22} = 79.94 \]

\[ E_{23} = \frac{(444)(616)}{872} = E_{23} = \frac{273504}{872} = E_{23} = 313.65 \]

\[ \chi^2 = \frac{(25 - 48.59)^2}{48.59} + \frac{(47 - 77.06)^2}{77.06} + \frac{(356 - 302.25)^2}{302.25} + \frac{(74 - 50.41)^2}{50.41} + \frac{(110 - 79.94)^2}{79.94} + \frac{(260 - 313.65)^2}{313.65} \]

\[ \chi^2 = \frac{(-23.59)^2}{48.59} + \frac{(-30.06)^2}{77.06} + \frac{(53.75)^2}{302.25} + \frac{(23.59)^2}{50.41} + \frac{(30.06)^2}{79.94} + \frac{(-53.65)^2}{313.65} \]

\[ \chi^2 = \frac{(556.49)^2}{48.59} + \frac{(903.60)^2}{77.06} + \frac{(2889.06)^2}{302.25} + \frac{(556.49)^2}{50.41} + \frac{(903.60)^2}{79.94} + \frac{(2889.06)^2}{313.65} \]

\[ \chi^2 = 11.45 + 11.73 + 9.56 + 11.04 + 11.30 + 9.21 \]

\[ \chi^2 = 64.29 \]

\[ df = (row-1)(col-1) = (2-1)(3-1) = (1)(2) = 2 \]

Since \( \chi^2_{obs} = 64.29 > \chi^2_{crit} = 5.99 \), reject the null.
Size of the association:

\[ \phi_c = \sqrt{\frac{64.29}{872(2 - 1)}} \]

\[ \phi_c = \sqrt{\frac{64.29}{872(1)}} \]

\[ \phi_c = \sqrt{\frac{64.29}{872}} \]

\[ \phi_c = \sqrt{.07} \]

\[ \phi_c = .27 \]