Problem 1: Assume that 50% of the US population votes. Of those who vote, 50% vote Democrat and 50% vote Republican. From our survey, 23 report that they do not (or cannot) vote. Of the students who do vote, 62 students vote Democrat and 7 students vote Republican. Are these observed frequencies significantly different from what you’d expect from a random sample from the US population? We’ll run a $\chi^2$ test on frequencies using $\alpha = 0.01$.

a) Make bar graph showing these frequencies:

![Bar Graph](image)

b) Calculate the expected frequencies for those who vote ”Democrat”, ”Republican” and ”I never (or can’t) vote”.

There are a total of $62 + 7 + 23 = 92$ students.
We’d expect $0.25 \times 92 = 23$ to vote Democrat
$0.25 \times 92 = 23$ to vote Republican
and $0.5 \times 92 = 46$ not to vote.
e) Calculate the $\chi^2$ statistic using:

$$\chi^2 = \sum \frac{(f_o - f_e)^2}{f_e}$$

$$\chi^2_{obs} = \frac{(62-23)^2}{23} + \frac{(7-23)^2}{23} + \frac{(23-46)^2}{46} =$$

$$66.1304 + 11.1304 + 11.5 = 88.7608$$

d) Use table I to find the critical value of $\chi^2$

df = (3-1) = 2

$$\chi^2_{crit} = 9.21$$

e) Make your decision and state your conclusion using APA format

Our observed value of $\chi^2 = 88.76$ is greater than the critical value of 9.21. We reject $H_0$. The distribution of voting preference in our class is significantly different from the U.S. population, $\chi^2(2, N=92) = 88.76, p < 0.01$. 
Problem 2 Of the 68 students who vote, voter preference in our class breaks down into the following frequencies:

<table>
<thead>
<tr>
<th></th>
<th>Female</th>
<th>Male</th>
</tr>
</thead>
<tbody>
<tr>
<td>Democrat</td>
<td>47</td>
<td>14</td>
</tr>
<tr>
<td>Republican</td>
<td>5</td>
<td>2</td>
</tr>
</tbody>
</table>

We’ll use a $\chi^2$ test for independence with $\alpha = 0.05$ to determine if voting preference depends on gender for our class.

(a) Make a bar graph of the observed frequencies
b) Calculate the rows and column sums and the expected frequencies for the null hypothesis

<table>
<thead>
<tr>
<th></th>
<th>Female</th>
<th>Male</th>
<th>sum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Democrat</td>
<td>(61)(52)</td>
<td>(61)(16)</td>
<td>68</td>
</tr>
<tr>
<td></td>
<td>(\frac{61}{68} = 46.6471)</td>
<td>(\frac{61}{68} = 14.3529)</td>
<td>61</td>
</tr>
<tr>
<td>Republican</td>
<td>(7)(52)</td>
<td>(7)(16)</td>
<td>68</td>
</tr>
<tr>
<td></td>
<td>(\frac{7}{68} = 5.3529)</td>
<td>(\frac{7}{68} = 1.6471)</td>
<td>7</td>
</tr>
<tr>
<td>sum</td>
<td>52</td>
<td>16</td>
<td>68</td>
</tr>
</tbody>
</table>

c) Calculate the \(\chi^2\) statistic.

\[
\chi^2_{\text{obs}} = \frac{(47-46.6471)^2}{46.6471} + \frac{(5-5.3529)^2}{5.3529} + \frac{(14-14.3529)^2}{14.3529} + \frac{(2-1.6471)^2}{1.6471} = 0.0027 + 0.0233 + 0.0087 + 0.0756 = 0.1103
\]

d) Use table I to find the critical value of \(\chi^2\)

\(\text{df} = (2-1)(2-1) = 1\)

for \(\alpha = 0.05\), \(\chi^2_{\text{crit}} = 3.84\)

e) Use the \(\chi^2\) calculator in the excel spreadsheet to find the p-value for this test. Make your decision and state your conclusion using APA format.

Our observed value of \(\chi^2\) is 0.1103 which is not greater than the critical value of 3.84. We fail to reject \(H_0\).

The distribution of voting preference in our class does not vary with gender, \(\chi^2(1, N=68) = 0.1103, p = 0.7398\).