The materials included in these files are intended for noncommercial use by AP teachers for course and exam preparation; permission for any other use must be sought from the Advanced Placement Program®. Teachers may reproduce them, in whole or in part, in limited quantities, for face-to-face teaching purposes but may not mass distribute the materials, electronically or otherwise. This permission does not apply to any third-party copyrights contained herein. These materials and any copies made of them may not be resold, and the copyright notices must be retained as they appear here.
5. A rural county hospital offers several health services. The hospital administrators conducted a poll to determine whether the residents' satisfaction with the available services depends on their gender. A random sample of 1,000 adult county residents was selected. The gender of each respondent was recorded and each was asked whether he or she was satisfied with the services offered by the hospital. The resulting data are shown in the table below.

<table>
<thead>
<tr>
<th></th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Satisfied</td>
<td>384</td>
<td>416</td>
<td>800</td>
</tr>
<tr>
<td>Not Satisfied</td>
<td>80</td>
<td>120</td>
<td>200</td>
</tr>
<tr>
<td>Total</td>
<td>464</td>
<td>536</td>
<td>1,000</td>
</tr>
</tbody>
</table>

(a) Using a significance level of 0.05, conduct an appropriate test to determine if, for adult residents of this county, there is an association between gender and whether or not they were satisfied with services offered by the hospital.

\[ H_0: \] Gender and satisfaction of services are independent
\[ H_a: \] Gender and satisfaction of services are dependent.

Assumptions:
1) The sample is random and we must assume independence
2) \[ \sum_{i=1}^{r} \sum_{j=1}^{c} E_{ij} = \text{Total} \]
   \[ \text{All expected counts } \geq 5. \]

Expected = \( \frac{\text{(row)(column)}}{\text{grand}} \)

\[ \text{Expected} = \frac{384 \times 800}{1000} = 311.2 \]
\[ \frac{416 \times 200}{1000} = 83.2 \]
\[ \frac{80 \times 800}{1000} = 64 \]
\[ \frac{120 \times 200}{1000} = 24 \]

Procedure: \( \chi^2 \) test for independence

\[ \chi^2 = \sum \frac{(\text{obs} - \text{exp})^2}{\text{exp}} \]

\[ \chi^2 = \frac{(384 - 311.2)^2}{311.2} + \frac{(416 - 83.2)^2}{83.2} + \frac{(80 - 64)^2}{64} + \frac{(120 - 24)^2}{24} = 4.117 \]

\[ p = 0.0424 \]

Unauthorized copying or reuse of any part of this page is illegal.
Conclusion: Since \( p \leq \alpha \), reject \( H_0 \). At the \( \alpha = 0.05 \) significance level, there is sufficient evidence to indicate that gender and satisfaction of services are not independent.

(b) \( \frac{800}{1,000} \) a reasonable estimate for the proportion of all adult county residents who are satisfied with the services offered by this hospital? Explain why or why not.

This is a reasonable estimate for the proportion of all adult county residents who are satisfied with the services offered by the hospital because it is a random sample. We were not notified in the given data of any bias (measurement, selection, etc.)
5. A rural county hospital offers several health services. The hospital administrators conducted a poll to determine whether the residents' satisfaction with the available services depends on their gender. A random sample of 1,000 adult county residents was selected. The gender of each respondent was recorded and each was asked whether he or she was satisfied with the services offered by the hospital. The resulting data are shown in the table below.

<table>
<thead>
<tr>
<th></th>
<th>Male</th>
<th>Female</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Satisfied</td>
<td>384</td>
<td>416</td>
<td>800</td>
</tr>
<tr>
<td>Not Satisfied</td>
<td>80</td>
<td>120</td>
<td>200</td>
</tr>
<tr>
<td>Total</td>
<td>464</td>
<td>536</td>
<td>1,000</td>
</tr>
</tbody>
</table>

(a) Using a significance level of 0.05, conduct an appropriate test to determine if, for adult residents of this county, there is an association between gender and whether or not they were satisfied with services offered by the hospital.

\[ \chi^2 \text{ test} \]

**H_0**: There is no association between gender and whether or not they were satisfied

**H_a**: There is an association between gender and whether or not they were satisfied

**Assumption**

All expected counts are greater than 5

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

\[ \chi^2 = \frac{(384 - 371.2)^2}{371.2} + \frac{(416 - 428.8)^2}{428.8} + \frac{(80 - 92.8)^2}{92.8} + \frac{(120 - 107.2)^2}{107.2} \]

\[ \chi^2 = 4.1173 \Rightarrow p = 0.0429 \]

\[ df = 1 \]

We reject \( H_0 \). Therefore, there is an association between gender and whether or not they were satisfied with services offered by the hospital.
If you need more room for your work to part (a), use the space below.

(b) Is $\frac{800}{1,000}$ a reasonable estimate for the proportion of all adult county residents who are satisfied with the services offered by this hospital? Explain why or why not.

Yes it is a reasonable estimate because it was a random sample of that population. Also $n=1000$ is a large sample so the resulting proportion is close to the true proportion.