CHI SQUARE TEST OF ASSOCIATION/INDEPENDENCE

This test is used to determine whether there is a significant association between 2 categorical variables from the same sample.

To determine if there was a relationship between smoking status and socioeconomic levels, researchers categorized 356 federal male employees:

<table>
<thead>
<tr>
<th>ACTUAL COUNTS</th>
<th>Socioeconomic Level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High</td>
</tr>
<tr>
<td>Current Smoker</td>
<td>51</td>
</tr>
<tr>
<td>Former Smoker</td>
<td>92</td>
</tr>
<tr>
<td>Never Smoked</td>
<td>68</td>
</tr>
</tbody>
</table>

DETERMINE EXPECTED COUNTS:

Expected Count = (Row Total)(Column Total)/ Sample Size

<table>
<thead>
<tr>
<th>EXPECTED COUNTS</th>
<th>Socioeconomic Level</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>High</td>
</tr>
<tr>
<td>Current Smoker</td>
<td>68.75</td>
</tr>
<tr>
<td>Former Smoker</td>
<td>83.57</td>
</tr>
<tr>
<td>Never Smoked</td>
<td>58.68</td>
</tr>
</tbody>
</table>

H STATE NULL AND ALTERNATIVE HYPOTHESES

H₀ : There is no association between smoking status and SES in the population of federal male employees

Hₐ : There is an association between smoking status and SES in the population of federal male employees

A DETERMINE THAT CONDITIONS FOR TEST ARE ACCEPTABLE:

- Random… yes (random samples used)

- Every expected count ≥ 5… yes (see above)

- Independent… yes (assuming responses were independent of each other and the number of federal male employees > (10)(356) > 3560)
FORMULA/TABLE C:

a) Chi-Square Statistic: \( X^2 = \sum \frac{(O_i - E_i)^2}{E_i} \)
\[= \frac{(51 - 68.75)^2}{68.75} + \frac{(22 - 16.94)^2}{16.94} + \ldots + \frac{(22 - 25.86)^2}{25.86}\]
\[= 18.51\]

b) Degrees of Freedom = \((r - 1)(c - 1) = (3 - 1)(3 - 1) = 4\)

i) Table C:

Any \( X^2 \) statistic > 18.51 (df = 4) has P-value < .001

ii) Calculator:

\[
\text{DISTR} \rightarrow 7: X^2 \text{ cdf (18.51, 100, 4)} \rightarrow p = .00098
\]

CALCULATOR:

a) Store observed counts in a \([R, C]\) matrix:

\[
\text{MATRIX} \rightarrow \text{EDIT} \rightarrow 1: [A] \rightarrow 3 \times 3 \rightarrow \text{Enter Counts} \rightarrow \text{QUIT}
\]

b) Perform \( X^2 \) Test:

\[
\text{STAT} \rightarrow \text{TESTS} \rightarrow C: X^2 - \text{Test} \rightarrow X^2 = 18.51, \text{P-value} = .0098
\]

NOTE:

If MATRIX \([A]\) = Observed Counts, MATRIX \([B]\) = Expected Counts

S STATE CONCLUSION IN CONTEXT:

There is very strong evidence (p < .001) to reject \( H_0 \) and conclude an association exists between smoking status and SES in the population of federal male employees… to determine direction and nature of associations, use 2-way table techniques.