

Summary of Chi-Square Tests

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Finding the Observed Chi-Square

- The observed value of the chi-square statistic is found as follows:

$$\chi^2 = \sum \frac{(O - E)^2}{E}, \text{ where } E = \frac{\text{row total} * \text{col total}}{\text{grand total}}$$

where O is the observed quantity in a cell and E is the expected quantity in a cell.

- Each cell should have at least five observations.

Degrees of Freedom

- Use degrees of freedom (df) equal $(r-1)(c-1)$, where r is the number of rows and c is the number of columns.
- (Note: when $r = 1$, as in some goodness of fit tests, then $df = (c-1)$, not zero.)

Table of Critical Values

Chi-Square $\alpha=.05$	
df	CV
1	3.841
2	5.991
3	7.815
4	9.488
5	11.070
6	12.592
7	14.067
8	15.507
9	16.919
10	18.307
11	19.675
12	21.026

In general, we will reject H_0 when the observed value of the test statistic is greater than the CV in this table.

Example

- 100 shoppers at a large suburban mall were asked two questions --
 - Did you see a television ad for the sale at department store X during the past two weeks, and
 - Did you shop at department store X during the past two weeks.
- The results of this survey are as follows...

	Shopped	Did not shop	Totals
Saw ad	45	25	70
Expected:	$(70*60)/100$	$(70*40)/100$	
Not see ad	15	15	30
Expected:	$(30*60)/100$	$(30*40)/100$	
Totals	60	40	100

$$\begin{aligned} \chi^2 &= \sum \frac{(O - E)^2}{E} \\ &= \frac{(45 - 42)^2}{42} + \frac{(25 - 28)^2}{28} + \frac{(15 - 18)^2}{18} + \frac{(15 - 12)^2}{12} \\ &= \frac{9}{42} + \frac{9}{28} + \frac{9}{18} + \frac{9}{12} = 1.786 \end{aligned}$$

Answer: $\chi^2 = 1.786$, $p\text{-value} = 0.181$, cannot reject H_0

Finding the p-value using the TI-83

- Press [2ND][VAR] for DISTR.
- Choose option 7 for $\chi^2\text{cdf}$
- Enter the **left bound**, the **right bound** (999 for our purposes), and the **degrees of freedom**.
- Example: $\chi^2\text{cdf}(1.786, 999, 1)$ gives .18141428
- As always, **reject H_0 if $p\text{-value} < \alpha$** .
Reminder: we are (generally) looking for small p's.