

## 2 X 2 Contingency Chi-square

The 2 X 2 contingency chi-square is used for the comparison of two groups with a dichotomous dependent variable. We might compare males and females on a yes/no response scale, for instance.

The contingency chi-square is based on the same principles as the simple chi-square analysis in which we examine the expected vs. the observed frequencies. The computation is quite similar, except that the estimate of the expected frequency is a little harder to determine.

### 2008 Election Poll Example

	McCain	Obama	
Republicans	180	90	270
Democrats	60	170	230
	240	260	500

### Computing the expected frequency

$f_e = \frac{(N_r)(N_c)}{N}$ , where  $N_r$  is the total number of cases in the respective row,  $N_c$  is the total number in the respective column, and  $N$  is the number in the full sample.

	McCain	Obama
Republicans	$f_e = \frac{(270)(240)}{500} = 129.6$	$f_e = \frac{(270)(260)}{500} = 140.4$
Democrats	$f_e = \frac{(230)(240)}{500} = 110.4$	$f_e = \frac{(260)(230)}{500} = 119.6$

### The Significance Test

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

$$= \frac{(180 - 129.6)^2}{129.6} + \frac{(90 - 140.4)^2}{140.4} + \frac{(60 - 110.4)^2}{110.4} + \frac{(170 - 119.6)^2}{119.6}$$

$$= 19.6 + 18.09 + 23.00 + 21.24$$

$$= 81.93$$

$$df = (r - 1)(c - 1) = (2 - 1)(2 - 1) = 1$$

$r$  = the number of rows and  $c$  = the number of columns. The chi-square critical value with  $df = 1$  and  $\alpha = .05$  is 3.84. Because the calculated value exceeds this critical value, the difference is significant.

**Example write-up.** A chi-square test was used to determine whether there was a significant difference between Republicans and Democrats in the presidential candidate they favor. Only 26.1% of Democrats voted for McCain, whereas 66.7% of Republicans supported McCain. This difference was statistically significant,  $\chi^2(1) = 81.93, p < .001$ .

## SPSS Contingency Chi-square Example

1. Analyze → Descriptive statistics → Crosstabs
2. Move variables over
3. Click on “statistics”
4. Check chi-square box, click “continue,” click “ok”
5. Click on “cells” and choose row and column percentages.

**party voters party \* candidat candidate Crosstabulation**

		candidat candidate		Total	
		.00 McCain	1.00 Obama		
party voters party	.00 Republican	Count	180	90	270
		% within party voters party	66.7%	33.3%	100.0%
		% within candidat candidate	75.0%	34.6%	54.0%
	1.00 Democrat	Count	60	170	230
		% within party voters party	26.1%	73.9%	100.0%
		% within candidat candidate	25.0%	65.4%	46.0%
Total		Count	240	260	500
		% within party voters party	48.0%	52.0%	100.0%
		% within candidat candidate	100.0%	100.0%	100.0%

### Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)	Exact Sig. (2-sided)	Exact Sig. (1-sided)
Pearson Chi-Square	81.940(b)	1	.000		
Continuity Correction(a)	80.322	1	.000		
Likelihood Ratio	84.606	1	.000		
Fisher's Exact Test				.000	.000
Linear-by-Linear Association	81.776	1	.000		
N of Valid Cases	500				

a Computed only for a 2x2 table

b 0 cells (.0%) have expected count less than 5. The minimum expected count is 110.40.