

Chi square test of independence

- *Eyeball* differences between percentages: big enough to be “important”?
- Better: Are differences in percentages *statistically significant*?
- *Statistical significance*: are observed differences significantly different from zero that they could not occur by chance?

Chi square test of independence

- For cross classification tables
- Are two variables *statistically associated*?
- Are differences likely to persist in the population?

Association

- *Association*: two variables covary, either positively or negatively
- Test for *significant* association: compare observed frequencies to a model that assumes *statistical independence*

Statistical independence

Belief in life after death	Religious affiliation (hypothetical)			
	Protestant	Catholic	Jewish	Other
Yes	120	90	30	60
No	80	60	20	40
	200	150	50	100

Statistical association (statistical dependence)

Percentage believing in life after death by religious affiliation				
Belief in life after death	Religious affiliation			
	Protestant	Catholic	Jewish	Other
Yes	75.0	86.7	10.0	15.0
N	(200)	(150)	(50)	(100)

Chi square test of independence

- Do these differences reflect true differences in the population?
- Are observed differences large enough so not due purely to chance?

Chi square test of independence

- Nominal (or ordinal) variables
- H_0 : statistical independence (no differences across religious affiliation)
- H_a : statistical dependence (association between religious affiliation and attitudes toward life after death)

Chi square

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

f_o = observed frequencies

f_e = expected frequencies

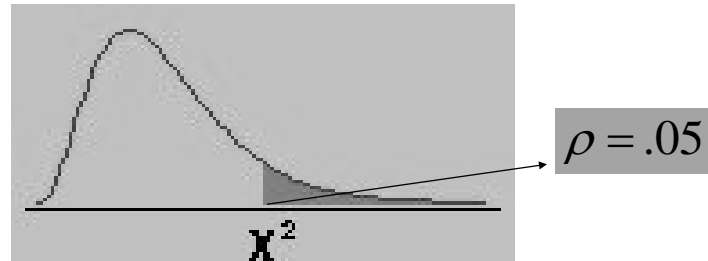
Chi square: evaluation

- If H_0 of no association is *true*: f_o and f_e will be close and chi square value small
- If H_0 of no association is *false*: f_o and f_e will be relatively farther apart, and chi square value larger
- Chi square value = 0 when $f_o = f_e$

Chi square distribution

- GSS provides p values for you
- Want $p \leq .05$ (indicates significance)
- p = probability, when H_0 is true, of getting a value at least as large as the observed χ^2

Chi square distribution



Note: χ^2 never negative

$$\chi^2(.05) = 7.8$$

Chi square test of independence

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Belief in life after death	Religious affiliation			
	Protestant	Catholic	Jewish	Other
Yes	75.0	86.7	10.0	15.0
	(200)	(150)	(50)	(100)
	$\chi^2 : p \leq .0001$			

Interpretation

Substantively:

Religious affiliation is *significantly* associated with belief in life after death