

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 independence

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

Interpretation: religious affiliation has no effect on whether one believes in life after death

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

- Chi square: based on comparison between frequencies observed in cells of table and the numbers you would expect if variables were statistically independent

$f_o = \text{observed frequencies}$

$f_e = \text{expected frequencies}$

Chi square test of independence

$$f_e = \frac{r \times c}{n}$$

where, r = row total

c = column total

n = # of cases

Calculating chi square: observed frequencies

Belief in life after death	Religious affiliation				Row totals
	Prot.	Cath.	Jewish	Other	
Yes	150	130	5	15	300
No	50	20	45	85	200
Column totals	200	150	50	100	500

Calculating expected frequencies:
for Catholics who say yes

$$f_e = \frac{rxc}{n} = \frac{(300)(150)}{500}$$

$$f_e = 90$$

Calculating chi square: expected frequencies

Belief in life after death	Religious affiliation				Row totals
	Prot.	Cath.	Jewish	Other	
Yes	150 (120)	130 (90)	5 (etc.)	15 (etc.)	300
No	50 (etc.)	20 (etc.)	45 (etc.)	85 (40)	200
Column totals	200	150	50	100	500

Chi square

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

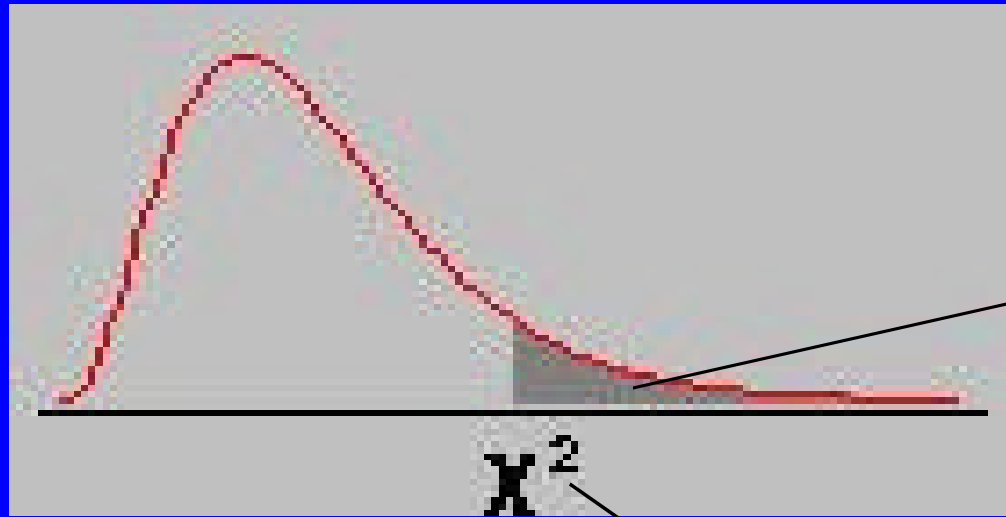
Chi square

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

$$= (150-120)^2/120 + (50-80)^2/80 + \dots (85-40)^2/40$$

$$\mathbf{c}^2 = 199.65$$

Chi square distribution: how big is $\chi^2 = 199.65$?



$$r = .05$$

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

Note: χ^2 never negative

Chi square test of independence

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
	(200)	(150)	(50)	(100)
	$\chi^2 : p \leq .0001$			