

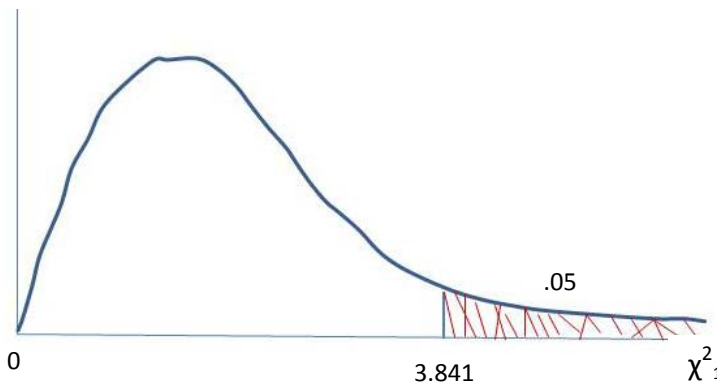
SOLUTIONS TO HOMEWORK: χ^2 Distribution

In a random sample of 300 individuals asked to respond a survey, 100 (randomly selected) received the request by email and 200 by regular mail. Is there a difference in the rate of response to the two types of surveys? (a) Test at $\alpha=.05$. (b) Test at $\alpha=.01$.

	EMAIL	SNAIL MAIL	
RESPONDED	90	90	180
DID NOT RESPOND	10	110	120
	100	200	300

$H_0: P_1 = P_2$

$H_1: P_1 \neq P_2$



Degrees of freedom = $(r-1)(c-1) = 1$

Calculated chi-square value: $\chi^2 = \frac{(f_o - f_e)^2}{f_e}$

Expected Frequencies (in red) = $f_e = \frac{\text{row total} * \text{column total}}{n}$

	MALE	FEMALE	
USER	60	120	180
NON-USER	40	80	120
	100	200	300

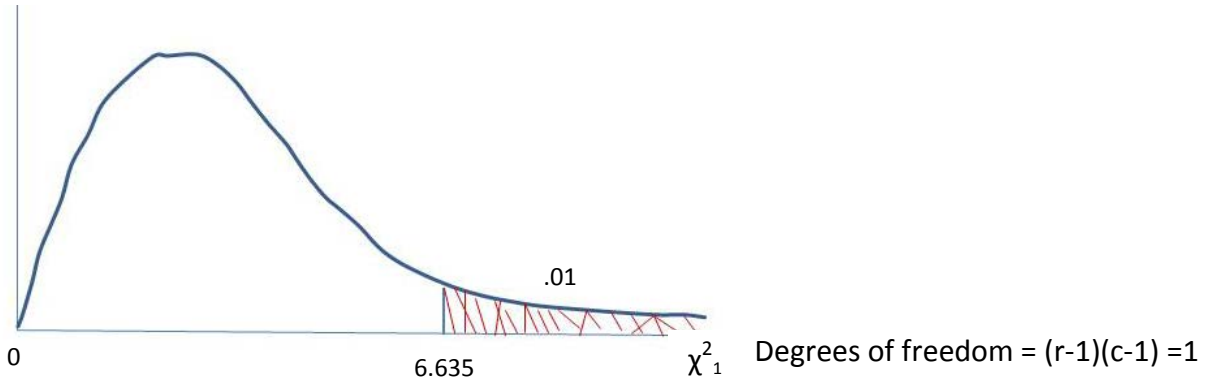
f_o	f_e	$f_o - f_e$	$(f_o - f_e)^2$	$(f_o - f_e)^2 / f_e$
90	60	30	900	15.00
10	40	-30	900	22.50
90	120	-30	900	7.50
110	80	30	900	11.25
	0	0		56.25

Reject H_0

(b) Test at $\alpha = .01$.

$H_0: P_1 = P_2$

$H_1: P_1 \neq P_2$



The calculated value of X is the same, 56.25.

Reject H_0

NOTE: We can also do this problem using the Z test for the difference between 2 proportions:

$$Z = \frac{.90 - .45}{\sqrt{(.6)(.4)\left(\frac{1}{100} + \frac{1}{200}\right)}} = \frac{.45}{.06} = 7.5$$

At $\alpha = .05$ and a two-tail test, the critical values of Z are ± 1.96 .

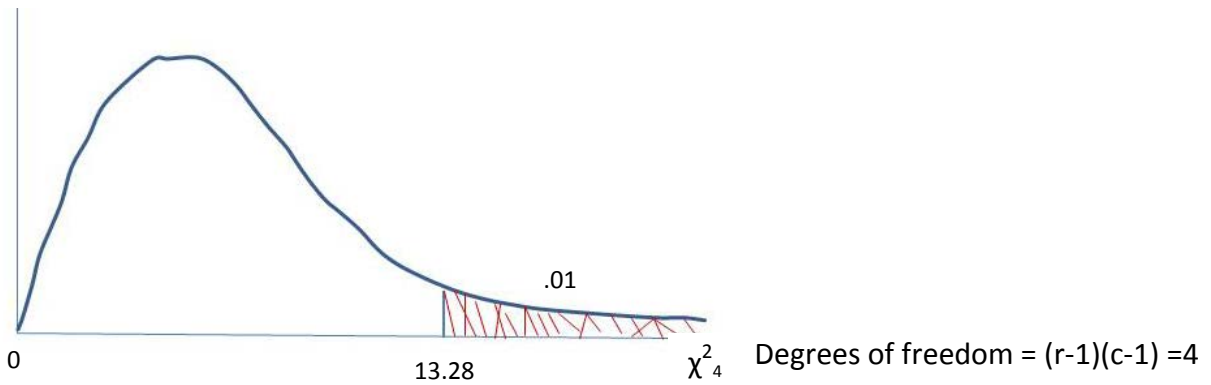
At $\alpha = .01$ and a two-tail test, the critical values of Z are ± 2.575 .

Reject H_0 .

2. Using the Data below, can you conclude that there is a relationship between ability in mathematics and interest in statistics? Use $\alpha=.01$.

		Ability in Mathematics		
		Low	Average	High
Interest in Statistics	Low	63	42	15
	Average	58	61	31
	High	14	47	29

H_0 : There is no relationship between ability in mathematics and interest in statistics
 H_1 : Yes, there is a relationship between ability in mathematics and interest in statistics



		Ability in Mathematics			
		Low	Average	High	
Interest in Statistics	Low	(45) 63	(50) 42	(25) 15	120
	Average	(62.5) 58	(62.5) 61	(31.25) 31	150
	High	(37.75) 14	(37.75) 47	(18.75) 29	90
		135	150	75	360

Calculated value of $\chi^2_4 = 32.14$

Reject H_0 . Yes, there is a relationship between ability in mathematics and interest in statistics.