

Example 7

Self Tutor

A survey was given to randomly chosen high school students from years 9 to 12 on possible changes to the school's canteen.

	Year group			
	9	10	11	12
change	7	9	13	14
no change	14	12	9	7

The contingency table shows the results.

At a 5% significance level, test whether the student's canteen preference depends on the year group.

H_0 is that year group and canteen preference are independent.

H_1 is that year group and canteen preference are not independent.

$df = (2 - 1)(4 - 1) = 3$ and the significance level is 5% or 0.05.

\therefore the critical value is 7.81 {from the table of critical values}

We reject H_0 if $\chi^2_{calc} > 7.81$.

The 2×4 contingency table is:

	Year group				
	9	10	11	12	sum
C	7	9	13	14	43
C'	14	12	9	7	42
sum	21	21	22	21	85

The expected frequency table is:

	Year group			
	9	10	11	12
C	10.6	10.6	11.1	10.6
C'	10.4	10.4	10.9	10.4

Casio fx-CG20

	1	2	3	4
1	7	9	13	14
2	14	12	9	7

χ^2 Test
 $\chi^2 = 5.81155048$
 $p = 0.12114745$
 $df = 3$

TI-84 Plus

MATRIX[A] 2 \times 4
 $\begin{bmatrix} 7 & 9 & 13 & 14 \\ 14 & 12 & 9 & 7 \end{bmatrix}$
 $1, 1 = 7$

χ^2 -Test
 $\chi^2 = 5.811550483$
 $P = .1211474583$
 $df = 3$

TI-nspire

	7	9	13	14
14	12	9	7	

χ^2 2way a: stat.results

"Title"	" χ^2 2-way Test"
" χ^2 "	5.81155
"PVal"	0.121147
"df"	3
"ExpMatrix"	"[...]"
"CompMatrix"	"[...]"

Using technology, $\chi^2_{calc} \approx 5.81$, which is < 7.81 .

Therefore, we do not reject H_0 .

$p \approx 0.121$ which is > 0.05 , providing further evidence to not reject H_0 .

We conclude that at a 5% level of significance, the variables year group and canteen preference are independent.

Example 8**Self Tutor**

80 people were surveyed to find whether they enjoyed surfing and skiing. The results are shown alongside.

Test, at a 1% level, whether there is an association between *enjoying surfing* and *enjoying skiing*.

		Enjoy surfing?	
		Yes	No
Enjoy skiing?	Yes	17	15
	No	8	40

H_0 : The variables *enjoying surfing* and *enjoying skiing* are independent.

H_1 : The variables *enjoying surfing* and *enjoying skiing* are not independent.

At a 1% level with $df = 1$, the critical value is 6.63. So, we reject H_0 if $\chi_{calc}^2 > 6.63$.

The 2×4 contingency table is:

		Enjoy surfing?		
		Yes	No	sum
Enjoy skiing?	Yes	17	15	32
	No	8	40	48
	sum	25	55	80

The expected frequency table is:

		Enjoy surfing?	
		Yes	No
Enjoy skiing?	Yes	10	22
	No	15	33

We will now find χ_{calc}^2 using Yates' continuity correction:

f_o	f_e	$f_o - f_e$	$ f_o - f_e $	$ f_o - f_e - 0.5$	$(f_o - f_e - 0.5)^2$	$\frac{(f_o - f_e - 0.5)^2}{f_e}$
17	10	7	7	6.5	42.25	4.225
15	22	-7	7	6.5	42.25	1.920
8	15	-7	7	6.5	42.25	2.817
40	33	7	7	6.5	42.25	1.280
<i>Total</i>						10.242

So, $\chi_{calc}^2 \approx 10.2$

Since $\chi_{calc}^2 > 6.63$, we reject H_0 and conclude that, at a 1% significance level, *enjoying surfing* and *enjoying skiing* are dependent.