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.

The contingency table shows the results.

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

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

 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.

: the critical value is 7.81 {from the table of critical values}

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

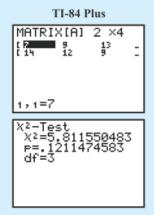
The 2×4 contingency table is:

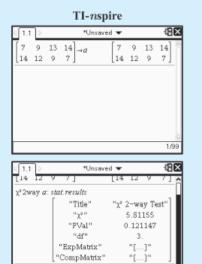
	Year group				
	9	10	11	12	sum
C	7	9	13	14	43
C'	14	12	9	7	42
sum	21	21	22	21	85

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







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?

Enjoy	
skiing?	

	Yes	No
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 $\chi^2_{calc} > 6.63$.

The 2×4 contingency table is:

The expected frequency table is:

Enjoy surfing?

Enjoy skiing?

	Yes	No	sum
Yes	17	15	32
No	8	40	48
sum	25	55	80

Enjoy surfing?

Enjoy	
skiing?	

	Yes	No
Yes	10	22
No	15	33

We will now find χ^2_{calc} 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
				Total	10.242	

So,
$$\chi^2_{calc} \approx 10.2$$

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