

Inference testing using the χ^2 test

A teacher wishes to decide, at the 5% level of significance, whether the performance in a problem solving test is independent of the students' year at school. The teacher selected 120 students, 40 from each of Years 8, 9 & 10, and graded their performance in a test as either A or B.

Year	Grade awarded		Total
	A	B	
8	22	18	40
9	26	14	40
10	27	13	40
Total	75	45	120

The table above right shows the results of his testing and the hypotheses being tested are:

H_0 : There is no relationship between grades awarded and years at school. They are independent.

H_A : There is a relationship.

Year	Grade awarded		Total
	A	B	
8	25	15	40
9	25	15	40
10	25	15	40
Total	75	45	120

If H_0 is true then the expected frequencies should be those in the table on the right.

Enter the observed and expected frequencies into columns C1 and C2 of the Statistics applet.

In the HOME view, perform the calculation shown right. This calculates the individual χ^2 values ready for summing as per the formula $\chi^2 = \sum \frac{(O-E)^2}{E}$, where O and E are the observed and expected frequencies.

After first changing to the SYMB view to register C3, the required total for C3 can be found in the **STATS** view. In this case, 1.493.

Changing into the Solve applet we can enter a formula which will allow us to calculate values from the χ^2 distribution using the UTPC function.

With a 3x2 contingency table the number of degrees of freedom are 2. To find the critical $\chi^2_{0.05}$ value, we enter values of 2 for D (the degrees of freedom) and 0.05 for P (the probability) and then move the highlight to V (the value) and press **SOLVE**. As it turns out, the required critical value is 5.99 and so we would accept the null hypothesis and conclude no relationship.

n	C1	C2	C3	C4
1	22	25		
2	26	25		
3	27	15		
4	14	15		
5	13	15		
22				
EDIT INS SORT BIG IVAR STATS				
RAD STATISTICS				
$(C2-C1)^2/C2 \rightarrow C3$				
C: .36, .04, .16, .6, 6.666...				
STOP				
1-VAR	H1			
ME	1.493333333			
TOTΣ	1.493333333			
MEANΣ	.248888889			
PVARΣ	.0367037			
SVARΣ	.0441363			
PSDEV	.1917818			
1.493333333				
OK				
SOLVE SYMBOLIC VIEW				
E1: UTPC(D, V)=P				
E2:				
E3:				
E4:				
E5:				
EDIT CHK = SHOW EVAL				
SOLVE NUMERIC VIEW				
D: 2				
V: 5.99146454711				
P: .05				
ENTER VALUE OR PRESS SOLVE				
EDIT INFO DEFN SOLVE				