

## QUANTITATIVE METHODS

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# LAB 12

## Chi-Square Test

### Example

A random sample of 300 adults were selected and asked if they were in favor of legalizing mild drugs for medical purposes. Here are the results

	In favor	Against	No opinion
Men	93	70	12
Women	87	32	6

Test for the independence of Gender and Opinion at the 5% level of significance.

Make the usual heading (cells A1:A3).

The first thing to do is to reproduce our table. In cell A5 write “Observed Values” in bold and write the above table in cells A6:D8. Find all the row and column totals.

Next, we need to find the Expected values. In cell A12 write “Expected Values” in bold. Rewrite the headings of the table, then find the expected value for each cell using the formula

$$E = \frac{(\text{row total}) \times (\text{column total})}{(\text{grand total})}$$

Use cell references instead of writing the numbers, and use

the mouse to copy the content of the first cell to all the other ones. DO NOT rewrite the formula 6 times. Note that you will need to use \$ in appropriate places in the formula.

To calculate the  $\chi^2$ , we need to find  $\frac{(O-E)^2}{E}$  for each cell, then add them up. So in cell A18,

write “Chi-square Calculations”. In cells B19:D20, find the values using the formula just given.

For the test itself, make the following headings in cells G5:G14.

Assumptions:
H <sub>0</sub> :
H <sub>a</sub> :
α =
X <sup>2</sup> <sub>c</sub> =
X <sup>2</sup> =
<b>Decision :</b>

Fill in the information in column H. For Chi – Square, simply add all the cells in the Chi-square calculations with the  $\Sigma$  button. For the Critical Chi-Square value, use the function CHIN.V. For probability click in the cell for alpha, and for the degrees of freedom, calculate it from the table and write your answer (it should be 2 for this contingency table).

We can also calculate the  $p$ -value. For this we use the function CHITEST, where the ACTUAL RANGE is the set of observed values, B7:D8, and the EXPECTED RANGE the values you calculated, cells B14:D15. You should obtain an answer of 0.016. Note that for this we do not need to find  $\chi^2$ , hence we don't need the Chi-Square Calculations.

Your results should look like this, where the values in the shaded cells were calculated with Excel.

4																			
5	<b>Observed Values</b>								Assumptions:	Classes are mutually exclusive and all inclusive									
6		In favor	Against	No opinion					H <sub>0</sub> :	Opinion is independent of gender									
7	Men	93	70	12	175				H <sub>a</sub> :	Opinion is dependent of gender									
8	Women	87	32	6	125														
9		180	102	18	300				$\alpha =$	5%									
10									$\chi^2_c =$	5.99									
11																			
12	<b>Expected Values</b>								$\chi^2 =$	8.25									
13		In favor	Against	No opinion															
14	Men	105	59.5	10.5					<b>Decision :</b>	Reject H <sub>0</sub>									
15	Women	75	42.5	7.5															
16																			
17																			
18	<b>Chi-Square Calculations</b>																		
19		1.371429	1.852941	0.214286					$p$ -value =	0.016									
20		1.92	2.594118	0.3															
21																			