How to Perform a Chi-Square Test of Independence in Excel to Analyze Relationships Between Data

Authored by

stats writer

March 13, 2026

A Chi-Square Test of Independence is a statistical test used to determine the relationship between two categorical variables. In order to perform this test in Excel, you will need to first organize your data in a contingency table. This table will have two rows representing the two categorical variables and several columns representing the different categories within each variable. Once your data is organized, you can use the CHISQ.TEST function in Excel to calculate the p-value, which will indicate the level of significance for your results. If the p-value is less than the chosen significance level, it can be concluded that there is a significant relationship between the two variables. This test can help to identify patterns, trends, and dependencies between categorical variables, making it a useful tool in many fields of study.

Perform a Chi-Square Test of Independence in Excel

A Chi-Square Test of Independence is used to determine whether or not there is a significant association between two categorical variables.

This tutorial explains how to perform a Chi-Square Test of Independence in Excel.

Example: Chi-Square Test of Independence in Excel

Suppose we want to know whether or not gender is associated with political party preference. We take a simple random sample of 500 voters and survey them on their political party preference. The following table shows the results of the survey:

	A	B	C	D	E	F
1		**Republican**	**Democrat**	**Independent**	**Total**	
2	**Male**	120	90	40	250	
3	**Female**	110	95	45	250	
4	**Total**	230	185	85	500	
5						
6						
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11						
12						
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Use the following steps to perform a Chi-Square test of independence to determine if gender is associated with political party preference.

Step 1: Define the hypotheses.

We will perform the Chi-Square test of independence using the following hypotheses:

H0: Gender and political party preference are independent.H1: Gender and political party preference are *not* independent.

Step 2: Calculate the expected values.

Next, we will calculate the expected values for each cell

in the contingency table using the following formula:

Expected value = (row sum * column sum) / table sum.

For example, the expected value for Male Republicans is: (230*250) / 500 = 115.

We can repeat this formula to obtain the expected value for each cell in the table:

	A	B	C	D	E	F	G	H	I	J	K
1		**Republican**	**Democrat**	**Independent**	**Total**						
2	**Male**	120	90	40	250						
3	**Female**	110	95	45	250						
4	**Total**	230	185	85	500						
5											
6	Expected values						Formulas				
7											
8		**Republican**	**Democrat**	**Independent**	**Total**			**Republican**	**Democrat**	**Independent**	**Total**
9	**Male**	115	92.5	42.5	250		**Male**	=B$4*$E2/$E$4	=C$4*$E2/$E$4	=D$4*$E2/$E$4	250
10	**Female**	115	92.5	42.5	250		**Female**	=B$4*$E3/$E$4	=C$4*$E3/$E$4	=D$4*$E3/$E$4	250
11	**Total**	230	185	85	500		**Total**	230	185	85	500
12											
13											
14											
15											
16											
17											

Step 3: Calculate (O-E)2 / E for each cell in the table.

Next we will calculate (O-E)2 / E for each cell in the table where:

O: observed valueE: expected value

We can repeat this formula for each cell in the table:

	A	B	C	D	E	F	G	H	I	J	K
1		Republican	Democrat	Independent	Total						
2	Male	120	90	40	250						
3	Female	110	95	45	250						
4	Total	230	185	85	500						
5											
6	Expected values						Formulas				
7											
8		Republican	Democrat	Independent	Total			Republican	Democrat	Independent	Total
9	Male	115	92.5	42.5	250		Male	=B$4*$E2/$E$4	=C$4*$E2/$E$4	=D$4*$E2/$E$4	250
10	Female	115	92.5	42.5	250		Female	=B$4*$E3/$E$4	=C$4*$E3/$E$4	=D$4*$E3/$E$4	250
11	Total	230	185	85	500		Total	230	185	85	500
12											
13											
14	$(O-E)^2/E$						Formulas				
15											
16		Republican	Democrat	Independent	Total			Republican	Democrat	Independent	Total
17	Male	0.2174	0.0676	0.1471	250		Male	=(B2-B9)^2/B9	=(C2-C9)^2/C9	=(D2-D9)^2/D9	250
18	Female	0.2174	0.0676	0.1471	250		Female	=(B3-B10)^2/B10	=(C3-C10)^2/C10	=(D3-D10)^2/D10	250
19	Total	230	185	85	500		Total	230	185	85	500
20											
21											

Step 4: Calculate the test statistic X2 and the corresponding p-value.

The test statistic X2 is simply the sum of the values in the last table.

The p-value that corresponds to the test statistic X2 can be found by using the formula :

=CHISQ.DIST.RT(x, deg_freedom)

where:

x: test statistic X2deg_freedom: degrees of freedom, calculated as (#rows-1) * (#columns-1)

The test statistic X2 turns out to be 0.8640 and the

corresponding p-value is 0.649198.

13					
14	$(O-E)^2/E$				
15					
16		**Republican**	**Democrat**	**Independent**	**Total**
17	**Male**	0.2174	0.0676	0.1471	250
18	**Female**	0.2174	0.0676	0.1471	250
19	**Total**	230	185	85	500
20					
21	$\mathbf{X^2}$	0.8640	=SUM(B17:D18)		
22	**p**	0.649198	=CHISQ.DIST.RT(B21, 2)		
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24					
25					
26					
27					

Step 5: Draw a conclusion.

Since this p-value is not less than 0.05, we fail to reject the null hypothesis. This means we do not have sufficient evidence to say that there is an association between gender and political party preference.

Note: You can also perform this entire test by using the Chi-Square Test of Independence Calculator.