

Practice with Chi-Square tests

See page 2 for detailed answers.

See Chapter 9, Problem 11 in the textbook for another example (detailed answer available in the back of the book)

1. Trick or Treat

You are working with the following hypothesis:

Older People are more likely to give out Halloween candy.

Age is broken down into younger people (<30), middle-aged people (31-50), and older people (>51). Passing out Halloween candy is recorded as a Yes or No.

After taking a random sample of people in San Diego County on October 31st, 2017, you develop the following cross tabulation table:

	Age			
	Young	Middle Aged	Older	Total
Yes	67	84	210	361
No	212	200	95	507
Total	279	284	305	N=868

Is your hypothesis inferentially confirmed with a chi-square test? Show your work, compute the degrees of freedom, and conclude whether you can accept or reject the null hypothesis.

2. Marijuana Legalization

You are working with the following hypothesis:

Republicans are more likely to support legalizing marijuana than are Democrats or Independents.

Party ID, your Independent Variable, is broken down into (1) Republican, (2) Democrat, and (3) Independent. Your dependent variable, support for marijuana legalization, is recorded as Supports or Does Not Support.

After taking a random sample of U.S. adults between October 25-30, 2017, Pew Research Center has the following results: <http://www.pewresearch.org/fact-tank/2018/01/05/americans-support-marijuana-legalization/>

	Party ID			
	Republican	Democrat	Independent	Total
Supports	252	529	98	879
Does not Support	335	238	52	625
Total	587	767	150	N=1504

Is your hypothesis inferentially confirmed with a chi-square test? Show your work, compute the degrees of freedom, and conclude whether you can accept or reject the null hypothesis.

1. Trick or Treat Chi-Squared Test

Remember, H_0 : Proportional Halloween participation is the same for all age groups (the difference in the proportion of support among the younger, middle-aged and older respondents is 0%)

And H_1 : Proportional Halloween participation is different between age groups (the difference in the proportion of support among the younger, middle-aged, and older respondents is NOT 0%)

Step 1. Rewrite the table with each combination of IV and DV (If there are 6 cells, there should be 6 rows). Copy down the observed count in each cell.

Step 2. Calculate expected values using the column and row totals from the original table

- $(\text{Row Total} \times \text{Column Total}) / (\text{Total N})$

	Age			
	Young	Middle Aged	Older	Total
Yes	67	84	210	361
No	212	200	95	507
Total	279	284	305	N=868

Step 3. Subtract the expected value from the observed value (half of these values should be negative)

Step 4. To get rid of the negative sign, square each difference.

Step 5. To standardize, divide each squared difference by the expected value.

Step 6. Add up all of the standardized differences from step 5.

Step 1.		Step 2.	Step 3.	Step 4.	Step 5.
	f_o	f_e	$(f_o - f_e)$	$(f_o - f_e)^2$	$(f_o - f_e)^2 / f_e$
Young/Yes	67	$(279 \times 361) / 868 = 116.04$	-49.04	2404.9216	20.72
Young/No	212	$(279 \times 507) / 868 = 162.96$	49.04	2404.9216	14.76
Middle/Yes	84	$(284 \times 361) / 868 = 118.12$	-34.12	1164.1744	9.86
Middle/No	200	$(284 \times 507) / 868 = 165.88$	34.12	1164.1744	7.02
Older/Yes	210	$(305 \times 361) / 868 = 126.85$	83.15	6913.9225	54.50
Older/No	95	$(305 \times 507) / 868 = 178.15$	-83.15	6913.9225	38.81
				Total	Step 6. =145.67

Step 7. Degrees of freedom: $(\text{Rows}-1) \times (\text{Columns}-1)$

- $(2-1) \times (3-1) = 2$

Step 8: Using the χ^2 table find the critical value

- With 2 degrees of freedom, our critical value is 5.99

degrees of freedom	Threshold Value
--------------------	-----------------

1	3.84
2	5.99
3	7.81
4	9.49
5	11.07
6	12.59
7	14.07
8	15.51
9	16.92

Step 9: Can we confirm or reject the hypothesis?

- Our χ^2 statistic of 145.67 is greater than the critical value of 5.99. This means we can reject the null that of statistic independence with 95% confidence. We can be confident that proportional Halloween participation is different between age groups.

2. Marijuana Legalization Chi-Squared Test

Remember, H_0 : Proportional marijuana legalization support is the same for all parties (the difference in the proportion of support among Democrats, Republicans, and Independents is 0%)

And H_1 : Proportional support for marijuana legalization is different between political parties (the difference in the proportion of support among Democrats, Republicans, and Independents is NOT 0%)

Step 1. Rewrite the table with each combination of IV and DV (If there are 6 cells, there should be 6 rows). Copy down the observed count in each cell.

Step 2. Calculate expected values using the column and row totals from the original table

- $(\text{Row Total} \times \text{Column Total}) / (\text{Total N})$

Support for Legalization	Party ID				
	Republican	Democrat	Independent	Total	
	Supports	252	529	98	879
	Does not Support	335	238	52	625
Total	587	767	150	N=1504	

Step 3. Subtract the expected value from the observed value (half of these values should be negative)

Step 4. To get rid of the negative sign, square each difference.

Step 5. To standardize, divide each squared difference by the expected value.

Step 6. Add up all of the standardized differences from step 5.

Step 1.		Step 2.	Step 3.	Step 4.	Step 5.
	f_0	f_e	$(f_0 - f_e)$	$(f_0 - f_e)^2$	$(f_0 - f_e)^2 / f_e$
Republican/Support	252	$(587 * 879) / 1504 = 343.07$	-91.07	8293.7449	24.18
Republican/No Support	335	$(587 * 625) / 1504 = 243.93$	91.07	8293.7449	34.00
Democrat/Support	529	$(767 * 879) / 1504 = 448.27$	80.73	6517.3329	14.54
Democrat/No Support	238	$(767 * 625) / 1504 = 318.73$	-80.73	6517.3329	20.45
Independent/Support	98	$(150 * 879) / 1504 = 87.67$	10.33	106.7089	1.22
Independent/No Support	52	$(150 * 625) / 1504 = 62.33$	-10.33	106.7089	1.71
				Total	Step 6. =96.102

Step 7. Degrees of freedom: $(Rows-1) \times (Columns-1)$

- $(2-1) \times (3-1) = 2$

Step 8: Using the χ^2 table find the critical value

- With 2 degrees of freedom, our critical value is 5.99

degrees of freedom	Threshold Value
1	3.84
2	5.99

3	7.81
4	9.49
5	11.07
6	12.59
7	14.07
8	15.51
9	16.92

Step 9: Can we confirm or reject the hypothesis?

- **Our χ^2 statistic of 96.102 is greater than the critical value of 5.99.** This means we can reject the null that of statistic independence with 95% confidence. We can be confident that proportional support for marijuana legalization is different between parties.