## How do sociologists use chi-square tests of independence?

The chi-square test of independence is one of many statistical techniques available to sociologists. We discussed how the chi-square test is appropriate for determining whether two nominal and/or ordinal variables are independent of one another. We also discussed that chi-square tests tell us whether the differences we observed are *significant* - that is, not by chance.

So how do sociologists use chi-square tests?

### Did religiosity play into the 2016 Presidential Election?

**Presidential vote by religious attendance**

*% who say they voted for...*

|  | Clinton % | Trump % |
| --- | --- | --- |
| Attend worship services... |  |  |
| At least once a week | 40 | 56 |
| Monthly | 46 | 49 |
| Few times a year | 48 | 47 |
| Never | 62 | 31 |

Source: National Election Pool national exit polls, as reported at NBCnews.com. Comparisons with previous years are not available because the way the religious attendance question is asked changed in 2016.

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Many commentators have discussed the role of gender and race in the 2016 presidential election, but what about religiosity? Data from Pew Research Center (Smith, Martínez, Posts, & Bio, 2016) shows a general trend in which those who attended religious services more often were more likely to vote for Trump. But is there truly a relationship between attending worship services and voting? Or is this pattern by chance?

> What is the independent variable? Is it nominal, ordinal, interval, or ratio?
>
> What is the dependent variable? Is it nominal, ordinal, interval, or ratio?
>
> Based on your answers, is a chi-square test appropriate?

Pew researchers collected this data because they thought frequency of attending worship services (the independent variable, ordinal) might be related to voting preference (the dependent variable, nominal, specifically binary or dummy).[1] Because both of these variables are categorical, a chi-square test could be used to determine if they are independent of one another.

> What is the null hypothesis for this test?
>
> What is the alternative hypothesis for this test?

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[1] We could imagine the opposite causal direction: because one voted for Trump, one feels compelled to go to religious services. Arguing for this causal relationship would necessitate a compelling story. Of course, which variable causes which is not relevant to the chi-square test for independence.

The null hypothesis for this test (and every other chi-square test for independence) is that the two variables - frequency of attending worship services and voting preference - are independent of one another. The alternative hypothesis is that they are not independent. The test gives a chi-square statistic of 12.7 (with degrees of freedom equal to 3) and a p-value of 0.005.[2]

How would you interpret this chi-square statistic?

Because $p < 0.050$, the test indicates that we can reject the null hypothesis. This means that frequency of attending worship services was not independent of voting preference in the 2016 election.

What limitations does this data or data analysis have?

### Presidential vote by religious affiliation and race

| | 2000 | | 2004 | | 2008 | | 2012 | | 2016 | | Dem change '12-'16 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | Gore | Bush | Kerry | Bush | Obama | McCain | Obama | Romney | Clinton | Trump | |
| | % | % | % | % | % | % | % | % | % | % | |
| Protestant/other Christian | 42 | 56 | 40 | 59 | 45 | 54 | 42 | 57 | 39 | 58 | -3 |
| Catholic | 50 | 47 | 47 | 52 | 54 | 45 | 50 | 48 | 45 | 52 | -5 |
| White Catholic | 45 | 52 | 43 | 56 | 47 | 52 | 40 | 59 | 37 | 60 | -3 |
| Hispanic Catholic | 65 | 33 | 65 | 33 | 72 | 26 | 75 | 21 | 67 | 26 | -8 |
| Jewish | 79 | 19 | 74 | 25 | 78 | 21 | 69 | 30 | 71 | 24 | +2 |
| Other faiths | 62 | 28 | 74 | 23 | 73 | 22 | 74 | 23 | 62 | 29 | -12 |
| Religiously unaffiliated | 61 | 30 | 67 | 31 | 75 | 23 | 70 | 26 | 68 | 26 | -2 |
| White, born-again/evangelical Christian | n/a | n/a | 21 | 78 | 24 | 74 | 21 | 78 | 16 | 81 | -5 |
| Mormon | n/a | n/a | 19 | 80 | n/a | n/a | 21 | 78 | 25 | 61 | +4 |

Note: "Protestant" refers to people who described themselves as "Protestant," "Mormon" or "other Christian" in exit polls; this categorization most closely approximates the exit poll data reported immediately after the election by media sources. The "white, born-again/evangelical Christian" row includes both Protestants and non-Protestants (e.g., Catholics, Mormons, etc.) who self-identify as born-again or evangelical Christians.
Source: Pew Research Center analysis of exit poll data. 2004 Hispanic Catholic estimates come from aggregated state exit polls conducted by the National Election Pool. Other estimates come from Voter News Service/National Election Pool national exit polls. 2012 data come from reports at NBCnews.com and National Public Radio. 2016 data come from reports at NBCnews.com and CNN.com.

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Of course, this test ignores with which religion respondents identify, which might play an even bigger role in voting preference than frequency of attendance at religious services. Judging from this table - note that Hispanic Catholics, Jews, and people of other faiths voted for Clinton at higher rates - this may be the case. The chi-square test for independence ignores this. We will have to turn to another statistical technique - regression - to "control for" or net out the effects of other variables, like religious affiliation, in our analyses.

**References**

Smith, G. A., Martínez, J., Posts, & Bio. (2016, November 9). How the faithful voted: A preliminary 2016 analysis. Retrieved February 8, 2017, from http://www.pewresearch.org/fact-tank/2016/11/09/how-the-faithful-voted-a-preliminary-2016-analysis/

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[2] In my calculation of this test, I simply converted the percentages in the Pew data to frequencies.