



Quantitative Statistics: Chi-Square

ScWk 242 – Session 7 Slides

+ *Chi-Square Test of Independence*

Chi-Square (X^2) is a statistical test used to determine whether your experimentally observed results are consistent with your hypothesis.

Test statistics measure the agreement between actual counts and expected counts assuming the null hypothesis. It is a non-parametric test.

The chi-square test of independence can be used for any variable; the group (independent) and the test variable (dependent) can be nominal, dichotomous, ordinal, or grouped interval.



Chi-Square Limits & Problems

- **Implying cause rather than association**
- **Overestimating the importance of a finding, especially with large sample sizes**
- **Failure to recognize spurious relationships**
- **Nominal variables only (both IV and DV)**



Chi-Square Attributes

- ❑ A chi-square analysis is not used to prove a hypothesis; it can, however, refute one.
- ❑ As the chi-square value increases, the probability that the experimental outcome could occur by random chance *decreases*.
- ❑ The results of a chi-square analysis tell you: Whether the difference between what you observe and the level of difference is due to sampling error.
- ❑ The greater the deviation of what we observe to what we would expect by chance, the greater the probability that the difference is NOT due to chance.



Critical Chi-Square Values

- **Critical values for chi-square are found on tables, sorted by degrees of freedom and probability levels. Be sure to use $p < 0.05$.**
- **If your calculated chi-square value is greater than the critical value calculated, you “reject the null hypothesis.”**
- **If your chi-square value is less than the critical value, you “fail to reject” the null hypothesis**



Hypothesis Testing with X^2

- To test the null hypothesis, compare the frequencies which were observed with the frequencies we expect to observe if the null hypothesis is true
- If the differences between the observed and the expected are small, that supports the null hypothesis
- If the differences between the observed and the expected are large, we will be inclined to reject the null hypothesis



Chi-Square Use Assumptions

Normally requires sufficiently large sample size:

- In general $N > 20$.
- No one accepted cutoff – the general rules are
 - No cells with observed frequency = 0
 - No cells with the expected frequency < 5
 - Applying chi-square to very small samples exposes the researcher to an unacceptable rate of Type II errors.

Note: chi-square must be calculated on actual count data, not substituting percentages, which would have the effect of pretending the sample size is 100.



Using SPSS for Calculating X^2

- **Conceptually, the chi-square test of independence statistic is computed by summing the difference between the expected and observed frequencies for each cell in the table divided by the expected frequencies for the cell.**
- **We identify the value and probability for this test statistic from the SPSS statistical output.**
- **If the probability of the test statistic is less than or equal to the probability of the alpha error rate, we reject the null hypothesis and conclude that our data supports the research hypothesis. We conclude that there is a relationship between the variables.**
- **If the probability of the test statistic is greater than the probability of the alpha error rate, we fail to reject the null hypothesis. We conclude that there is no relationship between the variables, i.e. they are independent.**