The Chi-Square Distribution: Summary of Formulas*

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Abstract

This module provides a summary on formulas used in Chi-Square Distribution as a part of Collaborative Statistics collection (col10522) by Barbara Illowsky and Susan Dean.

The Chi-Square Probability Distribution
$\mu = \text{df}$ and $\sigma = \sqrt{2 \cdot \text{df}}$

Goodness-of-Fit Hypothesis Test

- Use goodness-of-fit to test whether a data set fits a particular probability distribution.
- The degrees of freedom are number of cells or categories - 1.
- The test statistic is $\sum_{k} \frac{(O-E)^2}{E}$, where O = observed values (data), E = expected values (from theory), and k = the number of different data cells or categories.
- The test is right-tailed.

Test of Independence

- Use the test of independence to test whether two factors are independent or not.
- The degrees of freedom are equal to (number of columns - 1)(number of rows - 1).
- The test statistic is $\sum_{(i \cdot j)} \frac{(O-E)^2}{E}$ where O = observed values, E = expected values, i = the number of rows in the table, and j = the number of columns in the table.
- The test is right-tailed.
- If the null hypothesis is true, the expected number $E = \frac{(\text{row total})(\text{column total})}{\text{total surveyed}}$.

Test of Homogeneity

- Use the test for homogeneity to decide if two populations with unknown distributions have the same distribution as each other.
- The degrees of freedom are equal to number of columns - 1.
- The test statistic is $\sum_{(i \cdot j)} \frac{(O-E)^2}{E}$ where O = observed values, E = expected values, i = the number of rows in the table, and j = the number of columns in the table.

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- The test is right-tailed.
- If the null hypothesis is true, the expected number $E = \frac{(\text{row total})(\text{column total})}{\text{total surveyed}}$.

NOTE: The expected value for each cell needs to be at least 5 in order to use the Goodness-of-Fit, Independence and Homogeneity tests.

Test of a Single Variance

- Use the test to determine variation.
- The degrees of freedom are the number of samples - 1.
- The test statistic is $\frac{(n-1)\cdot s^2}{\sigma^2}$, where n = the total number of data, s^2 = sample variance, and σ^2 = population variance.
- The test may be left, right, or two-tailed.