

## 11.5: Comparison of the Chi-Square Tests

You have seen the  $\chi^2$  test statistic used in three different circumstances. The following bulleted list is a summary that will help you decide which  $\chi^2$  test is the appropriate one to use.

- **Goodness-of-Fit:** Use the goodness-of-fit test to decide whether a population with an unknown distribution "fits" a known distribution. In this case there will be a single qualitative survey question or a single outcome of an experiment from a single population. Goodness-of-Fit is typically used to see if the population is uniform (all outcomes occur with equal frequency), the population is normal, or the population is the same as another population with a known distribution. The null and alternative hypotheses are:
  - $H_0$ : The population fits the given distribution.
  - $H_a$ : The population does not fit the given distribution.
- **Independence:** Use the test for independence to decide whether two variables (factors) are independent or dependent. In this case there will be two qualitative survey questions or experiments and a contingency table will be constructed. The goal is to see if the two variables are unrelated (independent) or related (dependent). The null and alternative hypotheses are:
  - $H_0$ : The two variables (factors) are independent.
  - $H_a$ : The two variables (factors) are dependent.
- **Homogeneity:** Use the test for homogeneity to decide if two populations with unknown distributions have the same distribution as each other. In this case there will be a single qualitative survey question or experiment given to two different populations. The null and alternative hypotheses are:
  - $H_0$ : The two populations follow the same distribution.
  - $H_a$ : The two populations have different distributions.

### Review

The goodness-of-fit test is typically used to determine if data fits a particular distribution. The test of independence makes use of a contingency table to determine the independence of two factors. The test for homogeneity determines whether two populations come from the same distribution, even if this distribution is unknown.

#### ? Exercise 11.5.1

Which test do you use to decide whether an observed distribution is the same as an expected distribution?

**Answer**

a goodness-of-fit test

#### ? Exercise 11.5.2

What is the null hypothesis for the type of test from [Exercise](#)?

#### ? Exercise 11.5.3

Which test would you use to decide whether two factors have a relationship?

**Answer**

a test for independence

#### ? Exercise 11.5.4

Which test would you use to decide if two populations have the same distribution?

### ? Exercise 11.5.5

How are tests of independence similar to tests for homogeneity?

#### Answer

Answers will vary. Sample answer: Tests of independence and tests for homogeneity both calculate the test statistic the same way  $\sum_{i,j} \frac{(O-E)^2}{E}$ . In addition, all values must be greater than or equal to five.

### ? Exercise 11.5.6

How are tests of independence different from tests for homogeneity?

## Bringing It Together

### ? Exercise 11.5.7

- Explain why a goodness-of-fit test and a test of independence are generally right-tailed tests.
- If you did a left-tailed test, what would you be testing?

#### Answer a

The test statistic is always positive and if the expected and observed values are not close together, the test statistic is large and the null hypothesis will be rejected.

#### Answer b

Testing to see if the data fits the distribution “too well” or is too perfect.

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