



DSFA

Spring 2020

Lecture 15

Hypothesis Testing

Announcements

Empirical Distributions

Distribution of a Statistic

statistic: A quantity computed for a particular sample

Distribution: The chance of each outcome of sampling

Sampling distribution: Chance of each value of a statistic
(computed from all possible samples)

Also known as the *probability distribution of the statistic*

Empirical distribution: Observations of a statistic
(computed from some samples drawn at random)

Simulating a Statistic

Fix a sample size and choose your statistic.

- Simulate the statistic once:
 - Draw a random sample of the size you fixed.
 - Calculate the statistic and keep a record of the value
- Repeat previous step numerous times (as many times as you have patience for; thousands are good).
- You now have one value of the statistic for each repetition. Visualize the results.

(Demo)

The sample vs the distribution

To assess if sample was drawn randomly from distribution:

- Decide on a statistic that measures the distance between two distributions
 - Compute the statistic from the sample; that is, the distance between distributions of sample and known population
 - Sample at random and from the population and compute the statistic from the random sample; repeat numerous times
 - Compare
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Hypothesis Testing

Testing a Hypothesis

Step 1: The Hypotheses

- A test chooses between two views of how data were generated
- *Null hypothesis* proposes that data were generated at random
- *Alternative hypothesis* proposes some effect other than chance

Step 2: The Test Statistic

- A value that can be computed for the data and for samples

Step 3: The Sampling Distribution of the Test Statistic

- What the test statistic might be if the null hypothesis were true
 - Approximate the sampling distribution by an empirical distribution
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Conclusion of a Test

Resolve choice between null and alternative hypotheses

- Compare observed test statistic to its empirical distribution under the null hypothesis
- If the observed value is **consistent** with the distribution, then the test *does not* support the alternative hypothesis

Whether a value is consistent with a distribution:

- A visualization may be sufficient
- Convention: The observed significance level (P-value)

(Demo)

Observed Significance Level

P-Value: The chance, under the null hypothesis, that the test statistic is equal to the value that was observed or is even further in the direction of the alternative.

Statistically Significant: The P-value is less than 5%

Highly Statistically Significant: The P-value is less than 1%
