Lecture 19

Hypothesis Testing
Announcements
Jury Panels
Section 197 of California's Code of Civil Procedure says, "All persons selected for jury service shall be selected at random, from a source or sources inclusive of a representative cross section of the population of the area served by the court." (Demo)
Statistics

A statistic is a number calculated from a sample
Total Variation Distance

Every distance has a computational recipe

Total Variation Distance (TVD):

● For each category, compute the difference in proportions between two distributions
● Take the absolute value of each difference
● Sum & divide by 2
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
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
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%