DATA 8

Fall 2016

# Lecture 23, October 19

## Confidence Intervals

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# Announcements

- Exams, solutions, score summary, and regrading policy have been released. See Gradescope and Piazza.
- Labs meet as usual this week.
- No homework due this week.
- Homework will be assigned on Friday.
- Later this week I will post a note about courses to take if you are interested in learning more about data science.
- As yet there is no clear timetable for a Data Science major or minor. But we're working on it.

# Variability of an Estimate

- One sample → One estimate

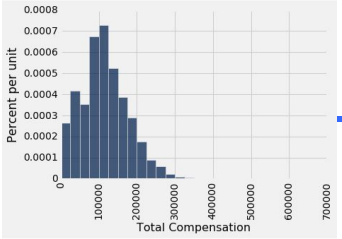
- But the random sample could have come out differently.
- Then the estimate would have been different.
- Main question:
  - **How different could the estimate have been?**
- The variability of the estimate tells us something about how accurate the estimate is.

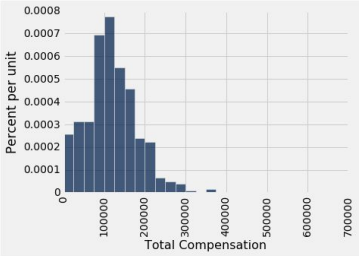
# The Bootstrap

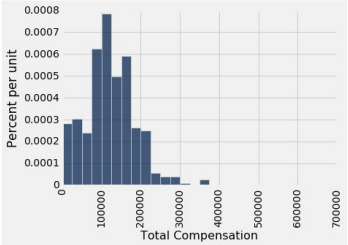
- Need another random sample that looks like the population

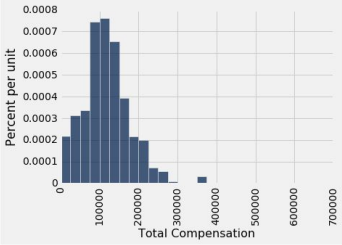
- All that we have is the original sample
  - which is large and random.
  - It’s a good bet that it resembles the population.

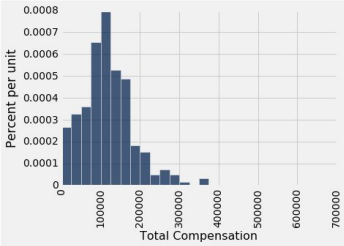
- So **sample at random from the original sample**!











# Why the Bootstrap Works

population

sample

resamples

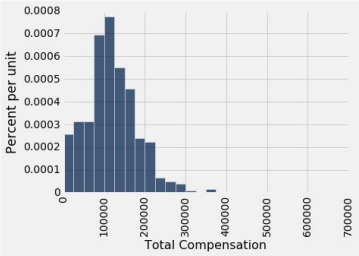
All of these look pretty similar, most likely.

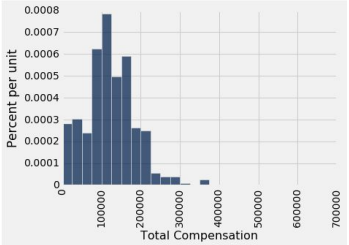
# Key to Resampling

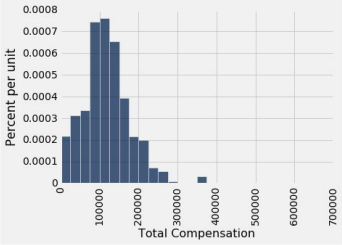
- From the original sample,
  - draw at random
  - **with** replacement
  - the **same number of times** as the original sample size.

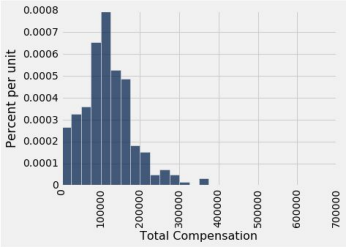
- The size of the new sample has to be the same as the original one, so that the two estimates are comparable.

(Demo)









# Inference Using the Bootstrap

population

?

sample

resamples

All of these look pretty similar, most likely.

# 95% Confidence Interval

- Interval of **estimates of a parameter**
- Based on random sampling
- 95% is called the **confidence level**
  - Could be any percent between 0 and 100
  - Bigger is better
- The **confidence is in the process** that generated the interval:
  - It generates a “good” interval about 95% of the time.

(Demo)

# How to Use a Confidence Interval

By our calculation, an approximate 95% confidence interval for the average age of the mothers in the population is (26.9, 27.6) years.

**True or False:**

- About 95% of the mothers in the population were between 26.9 years and 27.6 years old.

**Answer: False.** We're estimating that their **average age** is in this interval.

# Bootstrap Percentile Method

- For constructing a confidence interval for an unknown parameter
- Starting point: one large random sample
- One replication:
  - Bootstrap the sample to get a “resample”
  - Get an estimate based on the resample
- Repeat several thousand times (10,000 recommended)
- For an approximate 80% confidence interval, take the 10th and 90th percentiles of all the bootstrap estimates

# When *Not* to Use The Bootstrap

- If you're trying to estimate very high or very low percentiles, or min and max
- If you're trying to estimate any parameter that's greatly affected by rare elements of the population
- If the probability distribution of your statistic is not roughly bell shaped (the shape of the empirical distribution will be a clue)
- If the original sample is small