# Sampling and Standard Error

#### Means and Standard Deviations

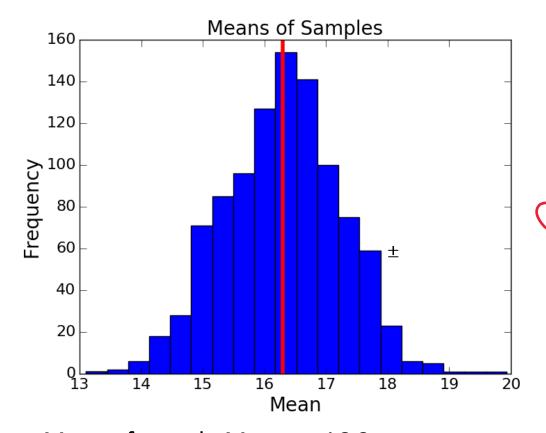
- ■Population mean = 16.3
- Sample mean = 17.1
- Standard deviation of population = 9.44
- Standard deviation of sample = 10.4
- A happy accident, or something we should expect?
- Let's try it 1000 times and plot the results

2

#### Notice in Code

- pylab.axvline(x = popMean, color = 'r') draws a red vertical line at popMean on the x-axis
- There's also a pylab.axhline function

#### Try It 1000 Times



What's the 95% confidence interval?

16.28 +- 1.96\*0.94 14.5 - 18.1 95 con Includes population

Suppose we want a tighter bound?

Mean of sample Means = 16.3

Standard deviation of sample means = 0.94

Maximum difference in means = 3.63

Maximum difference in standard deviations = 2.46

6.00.2X LECTURE

mean

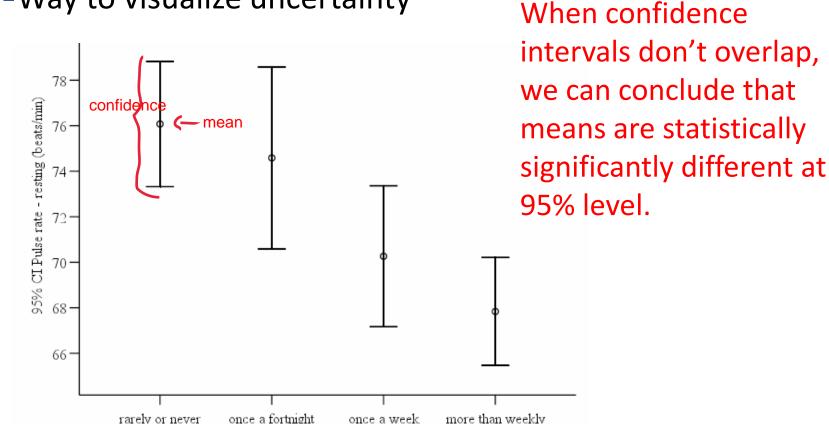
## Getting a Tighter Bound

- Will drawing more samples help?
  - Let's try increasing from 1000 to 2000
- •How about larger samples?
  - Let's try increasing sample size from 100 to 200
  - Standard deviation of sample means drops from 0.94 to 0.66

#### Error Bars, a Digression

Graphical representation of the variability of data

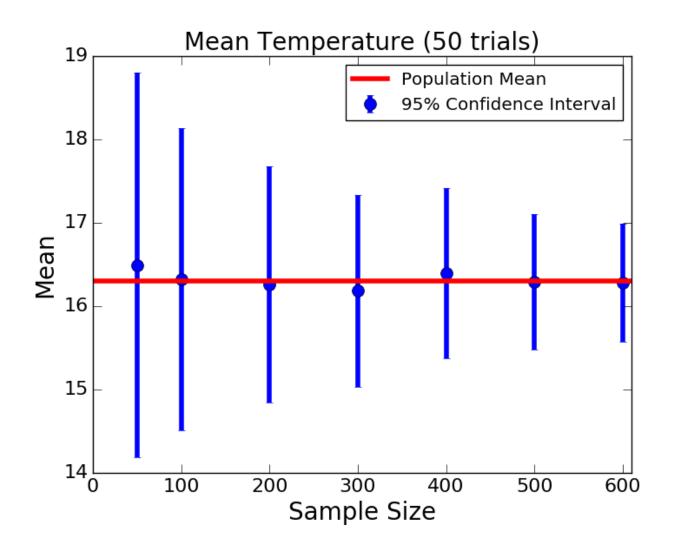
Way to visualize uncertainty



https://upload.wikimedia.org/wikipedia/commons/1/1d/Pulse\_Rate\_Error\_Bar\_By\_Exercise\_Level.png

#### Key Line of Code

## Sample Size and Standard Deviation



#### Bigger Seems to Be Better

- •Going from a sample size of 100 to 400 reduced the confidence interval from 1.8C to about 1C.
- But we are now looking at 400,000 examples
  - What has sampling bought us?
  - Absolutely Nothing!

## What Can We Conclude from 1 Sample?

•More than you might think

