

Welcome Back!

- please find your new seat
- have out your notebook/binder

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- sticks
- formula sheet
- table A
- iPad
- Dropbox (don't move!)
- Friday

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8.1

Confidence Intervals: The Basics (Day 1)

vocab

examples

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Objectives

- Interpret a confidence interval in context
- Determine the point estimate and margin error from a confidence interval
- Understand that a confidence interval gives a range of plausible values for the parameter
- Describe how the sample size and confidence level affect the length of a confidence interval
- Explain how practical issues like nonresponse, undercoverage, and response bias can affect the interpretation of a confidence interval

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Remember?

What did we learn in Chapter 7?



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Difference

In Chapter 8, we won't know the actual population values anymore....

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Mystery Mean Activity

I've made up a value for μ .

$$\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}} = \frac{20}{\sqrt{16}} = \frac{20}{4} = 5$$

Assuming the distribution is Normal with μ (my made up value) and $\sigma = 20$, I use my calculator to simulate randomly selecting 16 sample values and calculating the mean of those values.

Here's what I get...

```
mean(randNorm(M,
20, 16))
240.79
```

~~$$100.79 = 300.79$$~~

What is a reasonable range for μ ?!?!?!?

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Point Estimator

A point estimator is a statistic that provides an estimate of a population parameter.

$$\bar{x} \quad \hat{p}$$

Point Estimate

The value of that statistic from a sample is called a point estimate.

#

Ideally, a point estimate is our "best guess" at the value of an unknown parameter

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Point Estimate

A single value on the number line

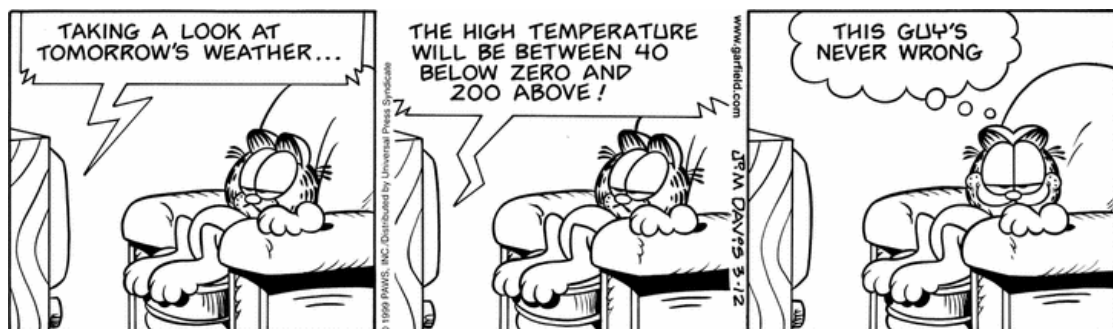
Is this value the correct value of the parameter?

So, what can we do to be more accurate in stating our guess?

Use an interval of values!

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Point Estimate



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From Batteries to Smoking

In each of the following settings, determine the point estimator you would use and calculate the value of the point estimate.

(a) Quality control inspectors want to estimate the mean lifetime μ of the AA batteries produced in an hour at a factory. They select a random sample of 30 batteries during each hour of production and then drain them under conditions that mimic normal use. Here are the lifetimes (in hours) of the batteries from one such sample:

16.91 18.83 17.58 15.84 17.42 17.65 16.63 16.84 15.63 16.37 15.80 15.93
15.81 17.45 16.85 16.33 16.22 16.59 17.13 17.10 16.96 16.40 17.35 16.37
15.98 16.52 17.04 17.07 15.73 16.74

Pt. estimator: \bar{x} , sample mean

Pt. estimate: $\bar{x} = 16.702$ hr

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From Batteries to Smoking

(a) Quality control inspectors want to estimate the mean lifetime μ of the AA batteries produced in an hour at a factory. They select a random sample of 30 batteries during each hour of production and then drain them under conditions that mimic normal use. Here are the lifetimes (in hours) of the batteries from one such sample:

16.91 18.83 17.58 15.84 17.42 17.65 16.63 16.84 15.63 16.37 15.80 15.93
15.81 17.45 16.85 16.33 16.22 16.59 17.13 17.10 16.96 16.40 17.35 16.37
15.98 16.52 17.04 17.07 15.73 16.74

point estimator: sample mean, \bar{x}

point estimate: $\bar{x} = 16.7023$

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From Batteries to Smoking

In each of the following settings, determine the point estimator you would use and calculate the value of the point estimate.

(b) What proportion p of U.S. high school students smoke? The 2007 Youth Risk Behavioral Survey questioned a random sample of 14,041 students in grades 9 to 12. Of these, 2808 said they had smoked cigarettes at least one day in the past month.

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From Batteries to Smoking

In each of the following settings, determine the point estimator you would use and calculate the value of the point estimate.

(b) What proportion p of U.S. high school students smoke? The 2007 Youth Risk Behavioral Survey questioned a random sample of 14,041 students in grades 9 to 12. Of these, 2808 said they had smoked cigarettes at least one day in the past month.

point estimator: sample proportion, \hat{p}

point estimate: $\hat{p} = 2808/14041 = .2$

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From Batteries to Smoking

In each of the following settings, determine the point estimator you would use and calculate the value of the point estimate.

(c) The quality control inspectors in part (a) want to investigate the variability in battery lifetimes by estimating the population variance σ^2 .

$$S = .7128$$

$$s^2 = .508$$

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From Batteries to Smoking

In each of the following settings, determine the point estimator you would use and calculate the value of the point estimate.

(c) The quality control inspectors in part (a) want to investigate the variability in battery lifetimes by estimating the population variance σ^2 .

point estimator: sample variance, s^2

point estimate: $s^2 = (.7128)^2 = .51$

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Idea of a Confidence Interval

I need 1 volunteer!

1 step to the left

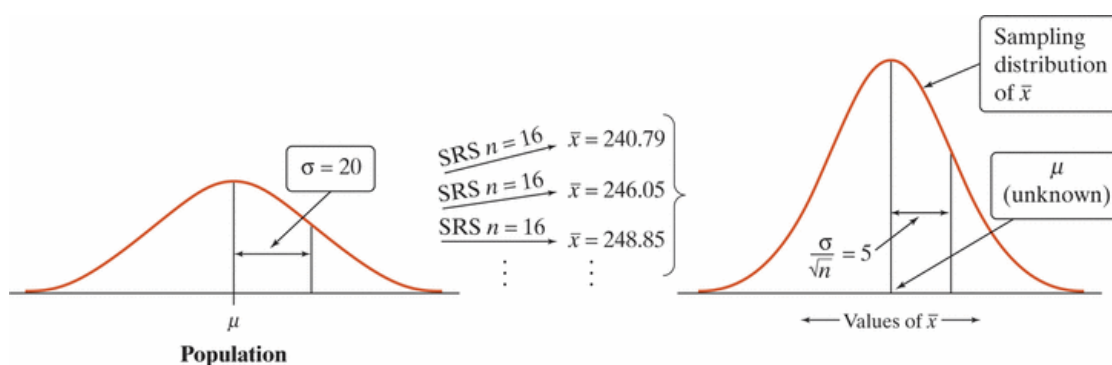
1 step to the right Are these the same distances from μ to \bar{x} ?

In what percent of samples will \bar{x} be within 2 SD of μ ?

So, in what percent of samples will μ be within 2 SD of \bar{x} ?

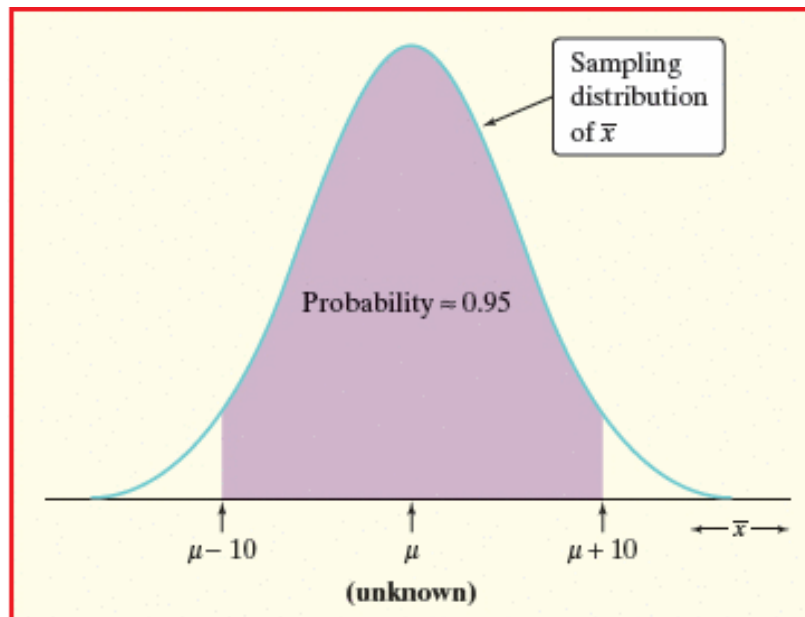
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Idea of a Confidence Interval



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Idea of a Confidence Interval



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Margin of Error

shows how close we believe our guess is, based on variability of the estimate in repeated SRSs

accounts for variability due ONLY to random selection

- does not compensate for any bias in the data collection process

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Confidence Interval

A confidence interval for a parameter has two parts:

1. An **interval** calculated from the data, which has the form

estimate \pm margin of error

95% $240.79 \pm 2(5)$
 230.79 to 250.79

2. A confidence **level** C , which gives the overall success rate of the method for calculating the confidence interval.

(i.e. In $C\%$ of all possible samples, the method would yield an interval that captures the true parameter)

*note: a.k.a *interval estimate**

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8.1 Confidence Intervals: The Basics (Day 2)

vocab

examples

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Objectives

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Interpret a Confidence INTERVAL

"We are ____% confident that the interval from __ to __ contains the true ____."

Death Penalty

According to a Gallup poll published on January 9, 2013, a 95% confidence interval for the true percentage of American adults who support the death penalty is $63\% \pm 4\%$. This estimate was based on a random sample of 1038 American adults. Interpret this interval in context.

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Death Penalty

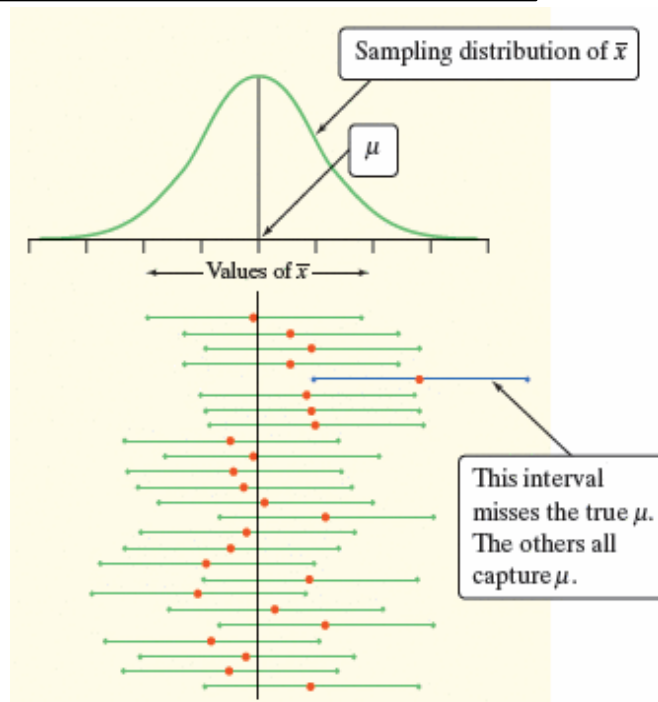
According to a Gallup poll published on January 9, 2013, a 95% confidence interval for the true percentage of American adults who support the death penalty is $63\% \pm 4\%$. This estimate was based on a random sample of 1038 American adults. Interpret this interval in context.

We are 95% confident that the interval from 59% to 67% contains the true percentage of American adults who support the death penalty.

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Interpret a Confidence LEVEL

Rossman Chance
Applet



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Interpret a Confidence LEVEL

"C% of all possible samples of a given size from this population will result in an interval that captures the unknown parameter."

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AP TIP!

Many students confuse interpreting a confidence *level* with a confidence *interval*.

Everytime you construct a confidence *interval* you are expected to interpret it.

You are only expected to interpret the confidence *level* when asked to do so. (Don't include endpoints when interpreting this)

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Do You Use Twitter?

In late 2009, the Pew Internet and American Life Project asked a random sample of 2253 U.S. adults, "Do you ever...use Twitter or another service to share updates about yourself or to see updates about others?" Of the sample, 19% said "Yes." According to Pew, the resulting 95% confidence interval is (0.167, 0.213).

Interpret the confidence interval and the confidence level.

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Do You Use Twitter?

In late 2009, the Pew Internet and American Life Project asked a random sample of 2253 U.S. adults, "Do you ever...use Twitter or another service to share updates about yourself or to see updates about others?" Of the sample, 19% said "Yes." According to Pew, the resulting 95% confidence interval is (0.167, 0.213).

confidence interval: *We are 95% confident that the interval from .167 to .213 contains the true proportion of US adults who use Twitter or another service to share updates about themselves or view updates about others.*

confidence level: *95% of all possible samples of size 2253 from the population of US adults will result in an interval that captures the unknown population proportion.*

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Dolla Dolla Bills Yo!

According to www.gallup.com, in December 2012, Americans spent an average of \$83 per day in stores, online and in restaurants. This estimate was based on a random sample of 13,217 adults and has a margin of error of $\pm \$4$ with 95% confidence.

- (a) What is the name for the value \$83?
- (b) Interpret the confidence interval in context.
- (c) Interpret the confidence level.

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Dolla Dolla Bills Yo!


According to www.gallup.com, in December 2012, Americans spent an average of \$83 per day in stores, online and in restaurants. This estimate was based on a random sample of 13,217 adults and has a margin of error of $\pm \$4$ with 95% confidence.

- (a) What is the name for the value \$83? *sample mean, \bar{x}*
- (b) Interpret the confidence interval in context. *We are 95% confident that the interval from \$81 to \$87 contains the true mean amount spent by Americans in stores, online, and in restaurants per day.*
- (c) Interpret the confidence level. *95% of all possible samples of size 13,217 from the population of Americans will result in an interval that captures the unknown population mean.*

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Confidence Interval Activity

Why 95% !?!?

 Rossman Chance Applet

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Confidence Interval Formula

statistic \pm (critical value).(standard deviation of statistic)

where the statistic we use is the point estimator for the parameter and the critical value is the number of standard deviations you want to be within

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Confidence Interval Formula

statistic \pm (critical value).(standard deviation of statistic)

margin of error

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How Can We Decrease our MoE?

If the confidence level decreases, the MoE will also decrease.

If we increase our sample size the MoE will decrease.

*With a better MoE comes drawbacks in other areas....

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Conditions for Constructing a Confidence Interval

Random: The data must come from a well designed random sample or randomized experiment

Normal: The sampling distribution is approximately Normal

Independent: Individual observations are independent. When sampling without replacement, the sample size n has to be no more than 10% of the population size N (the 10% condition)

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Social Networking

In a 2009 survey, researchers asked random samples of US teens and adults if they use social networking sites. Overall, 73% of the teens said yes and 47% of the adults said yes. A 90% confidence interval for the true difference in the proportion of teens and adults who would say yes is .229 to .291.

- Interpret the confidence interval
- Interpret the confidence level
- Based on the interval, is there convincing evidence that the proportion of teens who would say yes is higher than the proportion of adults who would say yes? Explain.
- How would the interval be affected if we used a 99% confidence level instead of a 90% confidence level?

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Social Networking

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(a) Interpret the confidence interval

We are 90% confident that the interval from .229 to .291 contains the true difference in the population proportion of teens and adults who use social networking sites.

(b) Interpret the confidence level

90% of all possible samples from the population of US teens and adults will result in an interval that captures the unknown difference in population proportion.

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Social Networking

In a 2009 survey, researchers asked random samples of US teens and adults if they use social networking sites. Overall, 73% of the teens said yes and 47% of the adults said yes. A 90% confidence interval for the true difference in the proportion of teens and adults who would say yes is .229 to .291.

(c) Based on the interval, is there convincing evidence that the proportion of teens who would say yes is higher than the proportion of adults who would say yes? Explain.

Yes, this would be convincing due to our high confidence level (90%) and positive interval (.229, .291) which shows a higher proportion for teens.

(d) How would the interval be affected if we used a 99% confidence level instead of a 90% confidence level?

By using a higher confidence level, our margin of error would increase and we would have a wider interval.

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Homework

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Jan 2-3:46 PM