When interpreting a confidence interval:

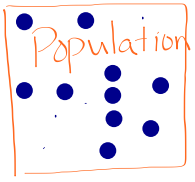
Say "You are 95% confident" the interval captures the parameter.

don't say "There is a 95% probability" / "there is a 95% chance"

AP Exam Tip

HL

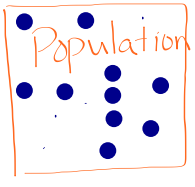
Homework Lottery



n = 25

Confidence level

95 %



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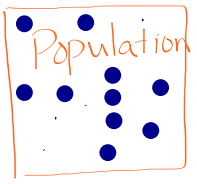


n = 10
n = 25
n = 50

Confidence level

90% ← ← 95% → → 98%

TODAY

- Interpret a Confidence Level
- Describe how the sample size and confidence level affect Margin of Error.
- How do practical Issues like non-response, undercoverage, and response bias affect the interpretation of confidence interval.

Use a Confidence Intervals applet, as a class, to learn what it means to say that we are

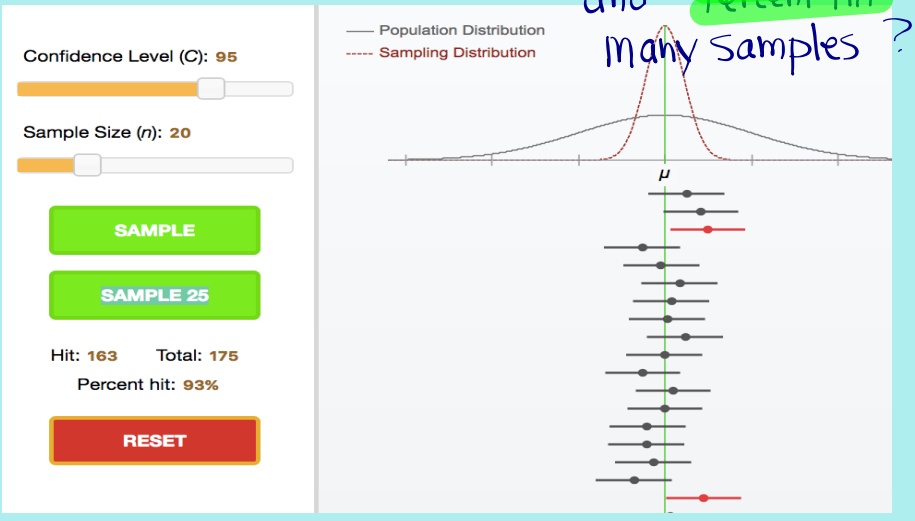
"95% confident"

later each of you will use the same applet with laptops

Mr. C to read p.499 Activity while a trusty volunteer navigates for us.

the rest of you can just observe

What's the relationship between confidence level and "Percent Hit" after taking many samples?

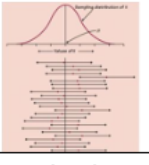


The activity confirms that the **confidence level** is the overall capture rate if the method is used many times.

What affects the Margin of Error

You will need a laptop

Lesson 8.1: Day 2: What does "95% confident" mean?



In this Activity, you will use the *Confidence Intervals* applet to learn what it means to say we are "95% confident" that our confidence interval captures the true mean.

1. Go to the *Confidence Intervals* applet which is on the textbook site. *There is a link for the statistical applets on the class website.* Set the confidence level to 95% and the sample size to 5.

2. Click "Sample" to choose an SRS and display the resulting **confidence interval**. The **confidence interval** is displayed as a horizontal line segment with a dot representing the sample mean in the middle of the interval. The true mean (μ) is the green vertical line.

   Did the first **confidence interval** capture the true mean?

   Repeat this 10 times and sketch what you see to the right. How many of the intervals capture the true mean?

In this Activity, you will use the *Confidence Intervals* applet to learn what it means to say we are "95% confident" that our confidence interval captures the true mean.

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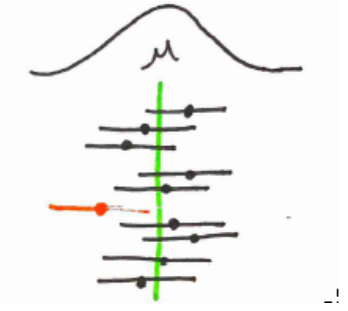

Your answer is probably around 95%.

3. "Reset" and then take a total of 100 **confidence intervals** (sample 25 four times). How many out of 100 captured the true mean? Is this surprising? Why?

4. Watch your **confidence intervals** as you drag the **confidence level** from 95% to 99% (don't "Reset). What happens to the intervals when the **confidence level** is increased? Why does this make sense?

5. "Reset", then sample 100 times at an 80% confidence interval. How many of the intervals capture the true mean?

Your answer is probably around 95%.

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As you increase the confidence level the interval gets wider so we "hit" μ more.

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Interpret the **confidence level**:

6. Now we will see what happens when we adjust the sample size. Change the sample size from 5 to 50 and sample for 1 interval. Then change it to 250 and sample for 1 interval. *What happens to the interval when the sample size is increased? Why?*

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Interpret the **confidence level**: If we make many many 80% confidence intervals, we expect about 80% to capture the mean.

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another possible definition

In 80% of all possible samples, the confidence interval computed from the sample data will capture the true parameter.

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the interval narrows.

- As the sample size rises we expect less variability

Let's

Summarize

Your answer is probably around 95%.

3. "Reset" and then take a total of 100 **confidence intervals** (sample 25 four times). How many out of 100 captured the true mean? Is this surprising? Why?

4. Watch your **confidence intervals** as you drag the **confidence level** from 95% to 99% (don't "Reset). What happens to the intervals when the **confidence level** is increased? Why does this make sense?

↑ confidence

↑ width

As you increase the confidence level the interval gets wider so we "hit" μ more

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sample size ↑ the interval narrows.

width ↓ - As the sample size rises we expect less variability

Interpreting **Confidence Level**

Important ideas:
Interpret
Confid. Level

Interpreting **Confidence Level**

Important ideas:

Interpret Confid. Level

If we make many many 95 % confid. intervals, we expect about 95 % to capture the true parameter

Note

We don't need an actual sample to interpret the confidence level. Interpreting the confid. level is about describing the method for calculating it; not about interpreting a specific confidence interval calculated from an actual sample

Interpreting **Confidence Level**

Important ideas:

Interpret Confid. Level

If we make many many 95 % confid. intervals, we expect about 95 % to capture the true parameter

What affects margin of error?

Interpreting **Confidence Level**

Important ideas:

Interpret Confid. Level

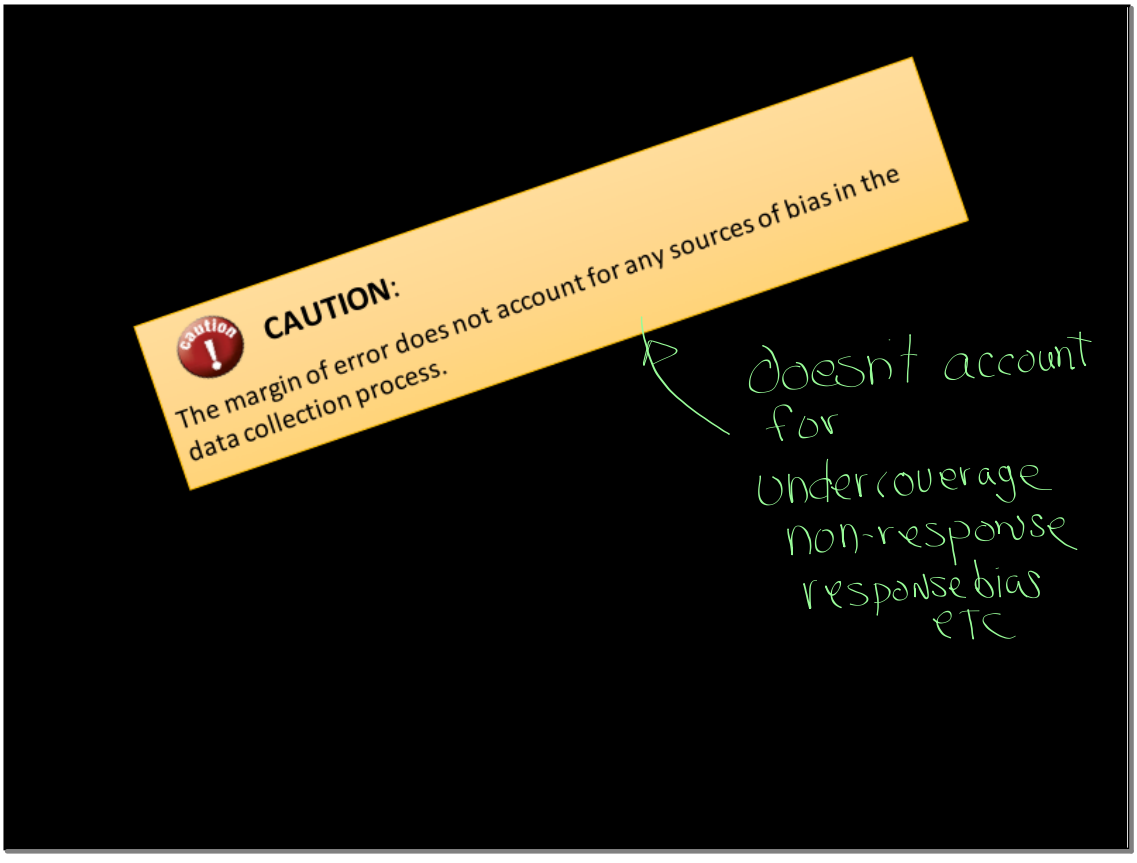
If we make many many ___ % confid. intervals, we expect about ___ % to capture the true parameter

What affects margin of error?

↑ Confid. Level
↑ MOE

↑ sample size ↓ MOE

B B


CAUTION:
The margin of error does not account for any sources of bias in the data collection process.
doesn't account for
undercoverage
non-response
response bias
ETC

Interpreting **Confidence Level**

Important ideas:

Interpret Confid. Level

If we make many many ___% confid. intervals, we expect about ___% to capture the true parameter

What affects margin of error?

↑ Confid. Level
↑ MOE

↑ sample size ↓ MOE

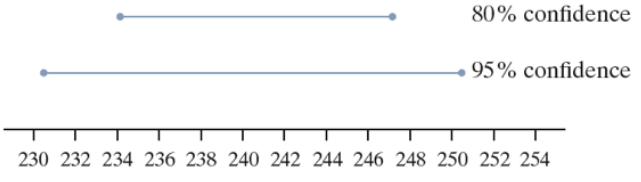
Margin of Error

Never accounts for bias in data collection

Decreasing the Margin of Error

In general, we prefer an estimate with a small margin of error. The margin of error gets smaller when:

- *The confidence level decreases*. To obtain a smaller margin of error from the same data, you must be willing to accept less confidence.



- *The sample size n increases*. In general, increasing the sample size *n* reduces the margin of error for any fixed confidence level.

The margin of error also depends on the standard deviation of the statistic. As you learned in Chapter 7, the sampling distribution of a statistic will have a smaller standard deviation when the sample size is larger. This is why the margin of error decreases as you increase the sample size.

Other Tidbits

For a normal sampling distribution, extending about **2** standard deviations in each direction from the statistic produces an approximate **95%** confidence interval.

For a normal sampling distribution, extending about **3** standard deviations in each direction from the statistic produces and approximate **99.7%** confidence interval.

The more general formula for a confidence interval is:
statistic ± (critical value) · (standard deviation of statistic)

The **critical value** is a multiplier that makes the interval wide enough to have the stated capture rate.

point estimate ± margin of error

example $\bar{x} \pm 2\sigma_{\bar{x}}$

$240.80 \pm 2 \cdot \frac{20}{\sqrt{n}}$

Std. error of the statistic

statistic ± (critical value) · (Std. dev. of the statistic)

A critical value is a multiplier that makes the interval wide enough to have the stated capture rate.

Check Your Understanding: As part of a project about response bias, Ellery surveyed a random sample of 25 students from her school. One of the questions in the survey required students to state their GPA aloud. Based on the responses, Ellery said she was 90% confident that the interval from 3.14 to 3.52 captures the mean GPA for all students at her school.

(a) Interpret the confidence level.

If we make many many 90% confidence intervals, we expect about 90% to capture the true mean GPA of students from her school.

(b) Explain what would happen to the length of the interval if the confidence level were increased to 99%.

the intervals would also increase

Check Your Understanding: As part of a project about response bias, Ellery surveyed a random sample of 25 students from her school. One of the questions in the survey required students to state their GPA aloud. Based on the responses, Ellery said she was 90% confident that the interval from 3.14 to 3.52 captures the mean GPA for all students at her school.

(a) Interpret the confidence level.

If we make many 90% confidence intervals, about 90% will capture the true mean GPA

(b) Explain what would happen to the length of the interval if the confidence level were increased to 99%.

The interval would widen because the margin of error increases.

(c) How would a 90% confidence interval based on a sample of size 200 compare to the original 90% interval?

The interval would decrease, with a larger sample size the MOE decreases

(d) Describe one potential source of bias in Ellery's study that is not accounted for by the margin of error.

Since the GPAs were not colleted annonymasly, people might have lied

(c) How would a 90% confidence interval based on a sample of size 200 compare to the original 90% interval?

It would be more narrow because an increase in sample decrease the margin of error.

(d) Describe one potential source of bias in Ellery's study that is not accounted for by the margin of error.

Students might not tell the truth about their GPA.

8.1 .... 11, 15, 17, 19, 21, 23-26

study pp. 499-505