Precalc14.5

Questions 14.4?

Find the standard error

Predict the true mean with a given level of confidence

population all seniors in US

μ

random sample representative

How could I determine the average GPA of all seniors???

$\bar{x}$

" inferential statistics "

" standard error " (of the mean)

confidence level

margin of error $\pm$

We might not know the true mean
(can't usually ask *everybody*)
How good is our estimate?

"Standard error"

Standard Error of the Mean

If a sample of data has N values and σ is the standard deviation, the standard error of the mean $\sigma_{\bar{x}}$ is

$$\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{N}}.$$

$$\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}}$$

- If the standard error of the mean is small, then the sample means are closer to (or approximately the same value as) the true mean.
- If the standard error of the mean is large, many of the sample means would be far from the true mean.

$\sigma = 1410$

1 **EDUCATION** **Refer to the application at the beginning of the lesson. What is the standard error of the mean?**

$\bar{x} = 6130$

$\frac{\sigma}{\sqrt{n}} = \frac{1410}{\sqrt{100}} = \frac{1410}{10} = 141$

Real World Application

EDUCATION Rosalinda Perez is doing some research for her doctoral thesis. She wants to determine the mean amount of money spent by a school district to educate one student for a year. Since there are 14,883 school districts in the United States, she cannot contact every school district. She randomly contacts 100 of these districts to find out how much money they spend per pupil. Using these 100 values, she computes the mean expenditure to be \$6130 with a standard deviation of \$1410. What is the standard error of the mean? *This problem will be solved in Example 1.*

$\sigma_{\bar{x}} = 141$

$\bar{x} = 6130$

2 **EDUCATION** **Refer to the application at the beginning of the lesson. Using Ms. Perez's first sample, determine the interval of per pupil expenditures such that the probability is 95% that the mean expenditure of the entire population lies within the interval.**

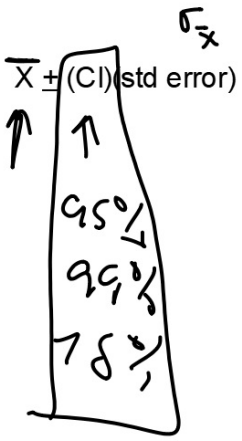
5%

I want to be 95% certain that the true mean lies in this interval:

$6130 \pm 1.96(141)$

6130 ± 276

$5854 < \mu < 6406$

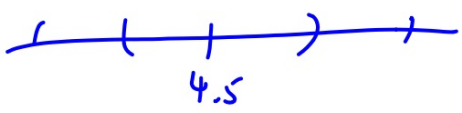


CI= how sure do I need to be?
"confidence interval"

ICE p. 928

$n = 50$ $\bar{x} = 4.5$ $\sigma = 1$ hr

$\sigma_{\bar{x}} = \frac{1}{\sqrt{50}} \approx 0.14$



$\pm 2.58(0.14)$

4.5 ± 0.36

$4.14 < \mu < 4.86$

99%

$4.5 \pm 1.65(0.14)$

4.5 ± 0.23

$4.27 < \mu < 4.73$

90%

19.94 < μ < 24.06

3 AUTOMOTIVE ENGINEERING The number of miles a certain sport utility vehicle can travel on open highway on one gallon of gasoline is normally distributed. You are to take a sample of vehicles, test them, and record the miles per gallon. You wish to have a 1% level of confidence that the interval containing the mean miles per gallon of the sample also contains the true mean.

99%

$\sigma_{\bar{x}} = \frac{4}{5} = 0.8$

a. Twenty-five sports utility vehicles are selected and tested. From this sample, the average miles per gallon is 22 with a standard deviation of 4 miles per gallon. Determine the interval about the sample mean that has a 1% level of confidence.

$n = 25$ $\quad \bar{x}$ $\quad \sigma = 4$

$\bar{x} \pm 2.58\sigma_{\bar{x}} = 22 \pm 2.58(0.8)$

22 ± 2.06

b. Four hundred sports utility vehicles are randomly selected and their miles per gallon are recorded. From this sample, the average miles per gallon is 22 with a standard deviation of 4 miles per gallon. Determine the interval about the sample mean that has a 1% level of confidence.

$n = 400$ $\quad \bar{x}$ $\quad \sigma$

c. What happens when the number of items in the sample is increased?

$\sigma_{\bar{x}} = \frac{4}{\sqrt{400}} = \frac{4}{20} = 0.2$

$21.484 < \mu < 22.516$

$22 \pm 2.58(0.2)$

22 ± 0.516

How can I shrink the size of my interval?