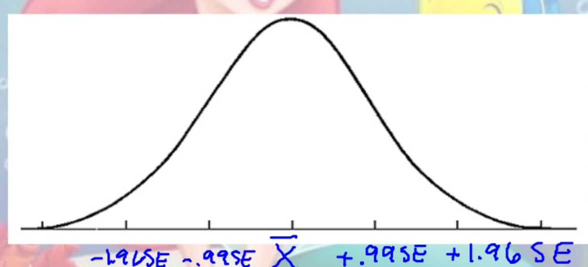
AP Statistics

Chapter 8:
Estimating with Confidence

Day 4

HW: Lesson 4 Practice Worksheet

How To Find Mean Confidence Intervals When σ Is Known



Standard Error: $$SE_{\bar{x}} = \frac{\sigma}{\sqrt{n}}$$

Confidence Interval: $$CI = \bar{x} \pm z * \frac{\sigma}{\sqrt{n}}$$

The Conditions for Mean Confidence Intervals

- Is it a random sample?
- 10% condition to use the standard error formula.

$n \le \frac{1}{10}N$

- Is the distribution normal or n ≥ 30 to use the z* scores.

According to the central limit theorem, we can assume that this sample is approx. normal because $n \ge 30$.

- $n < 30$, graph and check for outliers and skewness.

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*By hand

Example

A bottling machine is operating with a standard deviation of 0.12 ounce. Suppose that an SRS of 36 bottles, the machine inserted an average of 16.1 ounces into each bottle. Find the 95% confidence interval for the mean number of ounces in all the bottles this machine fills.

$\bar{x} = 16.1$

$z^* = 1.96$

$\sigma = .12$

$n = 36$

$CI = \bar{x} \pm z^* \frac{\sigma}{\sqrt{n}}$

$= 16.1 \pm 1.96 \cdot \frac{.12}{\sqrt{36}}$

$(16.06, 16.14)$

I am 95% confident that the ~~average~~ mean # of ounces in all the bottles this machine fills is between 16.06 and 16.14 ounces.

1. As stated, this is an SRS.
2. $36 \le \frac{1}{10}N \rightarrow 360$ we can assume that there are at least 360 bottles.
3. According to the central limit theorem we can assume that the sample is approx. normal because $n \ge 30$.

Choosing a Sample Size

What if we want to choose a sample size that allows us to estimate a population mean within a given margin of error?

Remember:

$$CI = \bar{x} \pm \underbrace{\boxed{z * \frac{\sigma}{\sqrt{n}}}}_{ME}$$

So:

$$z * \frac{\sigma}{\sqrt{n}} \leq ME$$

Example

Ball bearings are manufactured by a process that results in a standard deviation in diameter of 0.025 inch. What sample size should be chosen if we wish to be 99% sure of knowing the diameter to within 0.01 inch?

$z^* = 2.576$

$\sigma = .025$

$n = ?$

$ME = .01$

$$z^* \frac{\sigma}{\sqrt{n}} \leq ME$$

$$\frac{\cancel{2.576} \cdot \frac{.025}{\sqrt{n}}}{\cancel{2.576}} \leq \frac{.01}{2.576}$$

$$\cancel{\sqrt{n}} \cdot \frac{.025}{\cancel{\sqrt{n}}} \leq .0039 \cdot \sqrt{n}$$

$$\frac{.025}{.0039} \leq \frac{\cancel{.0039}\sqrt{n}}{\cancel{.0039}}$$

$$(6.41)^2 \leq (\sqrt{n})^2$$

$$41.47 \leq n$$

We should sample at least 42 ball bearings.