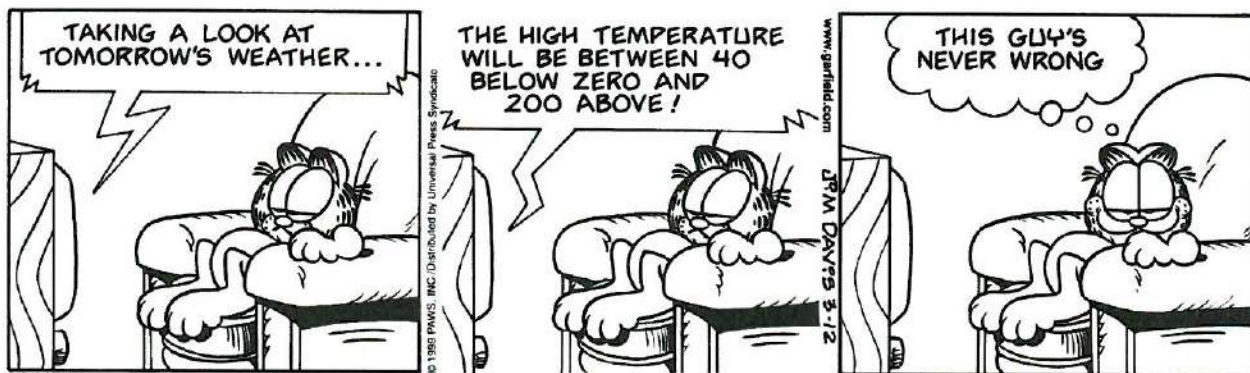


Chapter 8: Estimating with Confidence

Key Vocabulary:

- point estimator
- point estimate
- confidence interval
- margin of error
- interval
- confidence level
- random
- normal
- independent
- four step process
- level C confidence interval
- degrees of freedom
- standard error
- one-sample z interval
- t distribution
- t-procedures
- one-sample t interval
- robust



8.1 Confidence Intervals: The Basics (pp.615-643)

1. A *point estimator* is a statistic that...

A POINT ESTIMATE IS A STATISTIC THAT PROVIDES AN ESTIMATE OF A POPULATION PARAMETER.

2. The value of the point estimator statistic is called a POINT ESTIMATE and it is our

"best guess" at the value of the UNKNOWN POPULATION PARAMETER

3. **Example** "From Batteries to Smoking" Answer parts "a" and "b."

- a) Point Estimator is Sample mean (notation is $\bar{x}$) for the population mean (μ).

- The Point Estimate is $\bar{x} = 16.7$ Hours

- b) Point Estimator is Sample proportion (notation is $\hat{p}$) for the population proportion (p).

- The Point Estimate is $\hat{p} = \frac{2808}{14,041} = 0.20$

4. **Example** "The Mystery Mean" we will do as an activity next class.

5. Summarize the facts about *sampling distributions* learned in chapter 7:

<u>sampling distributions for means</u>	<u>sampling distributions for proportions</u>
• Shape <u>NORMAL</u> ① STATED NORMAL ② CLT $n \geq 30$ ③ Graph to verify • Center $\mu_{\bar{x}} = \mu$ • Spread $\sigma_{\bar{x}} = \sigma/\sqrt{n}$	• Shape <u>NORMAL</u>, IF $np \geq 10$ and $n(1-p) \geq 10$ • Center $\mu_{\hat{p}} = p$ • Spread $\sigma_{\hat{p}} = \sqrt{np(1-p)}$

6. "The Big Idea..." IS THAT THE sampling distribution of $\bar{x}$ tells us how close to μ the sample mean $\bar{x}$ is likely to be. Said a different way... "How close $\bar{x}$ is likely to be to the UNKNOWN Population mean (μ)."

7. A Confidence Interval for a parameter has 2 parts:

a) $\bar{x}$ and $\hat{p}$ is the "estimate $\pm$ margin of error"

b) Define margin of error:

"ME" tells how close the estimate tends to be to the UNKNOWN PARAMETER IN REPEATED SAMPLES

c) THE confidence level C IS A PERCENT. THAT IS, IN C% OF ALL POSSIBLE SAMPLES, THE METHOD WOULD YIELD AN INTERVAL THAT CAPTURES THE TRUE POPULATION PARAMETER VALUE.

8. What is the difference in interpretation between Confidence Interval and Confidence Level?

a) Interpret a Confidence Level: "To say that we are 95% confident is shorthand for

"95% of all possible samples of a given size from this population will result in an interval that captures the UNKNOWN Parameter."

b) Explain how to interpret a Confidence interval.

"We are C% confident that the interval from _____ to _____ captures the actual value of the [population parameter in context]."

c) Does the confidence level tell us the chance that a particular confidence interval captures the population parameter? If not, what does it tell us?

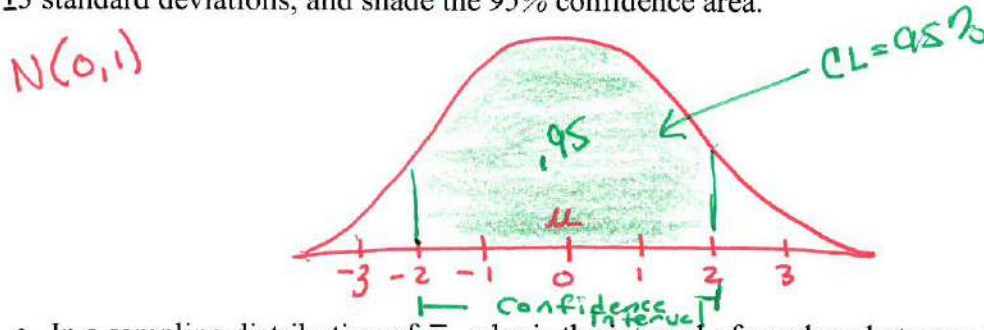
No, the confidence level is not a probability.

The confidence interval gives us a set of plausible values for the parameter

• What does it mean by "plausible values?"

The "plausible values" are all the possible values of the true population parameter.

9. Sketch and label a 95% confidence interval for the standard normal curve $N(0,1)$. Label the mean, ± 3 standard deviations, and shade the 95% confidence area.



- In a sampling distribution of $\bar{x}$, why is the interval of numbers between $\bar{x} \pm 2s$ called a 95% confidence interval? HINT: Think Empirical Rule.

Interval: $\bar{x} \pm 2s$

2 S.D.'S REPRESENTS APPROX 95% OF AREA

$\pm 1SD$ 68-95-99.7
 $\pm 2SD$
 $\pm 3SD$

10. General form to calculate a confidence interval is on the Green Sheet:

statistic $\pm$ (critical value) $\bullet$ (standard deviation of the statistic)

- a) From this formula, what is the "margin of error?"

$ME = \text{Critical Value} \bullet SD \text{ of statistic}$

- b) What does the "critical value" depend on?

"Critical Value" depends on the confidence Level (C)

- c) What does the "standard deviation" depend on?

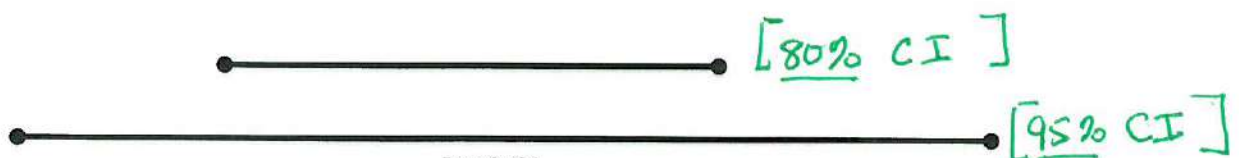
"STANDARD DEVIATION" DEPENDS ON THE SAMPLE SIZE (n)

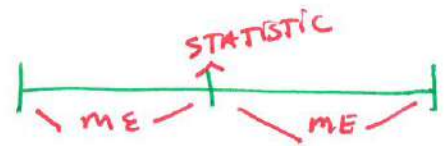
11. What happens when the sample size (n) increases?

Increasing "n", reduces the margin of error (ME)
for any fixed confidence level (CL)

12. When the confidence level increases, what happens to the confidence interval?

When the confidence level (C%) increases
then the confidence interval increases.





13. Explain the two conditions when the margin of error gets smaller.

- #1 ME gets smaller when the CL decreases
- #2 ME gets smaller when the sample size increases

14. State the 3 **conditions for constructing a confidence interval** for population parameters p or μ .

- Random Data comes from (1) random sample; or
(2) well-designed randomized experiment (random assignment of treatments)
- Normal The sampling distribution is approximately Normal.
- Independent
 - (1) Individual observations are independent
 - (2) Sampling without replacement meets the 10% condition to calculate the S.D.
 - (3) Treatments are randomly assigned

19. What are the two important reminders for constructing and interpreting confidence intervals?

- #1 Our method of calculation assumes data comes from SRS. other sampling methods (cluster, stratified) require more complex calculations.
- #2 The margin of error in a confidence interval covers only chance variation due to random sampling or random assignment.