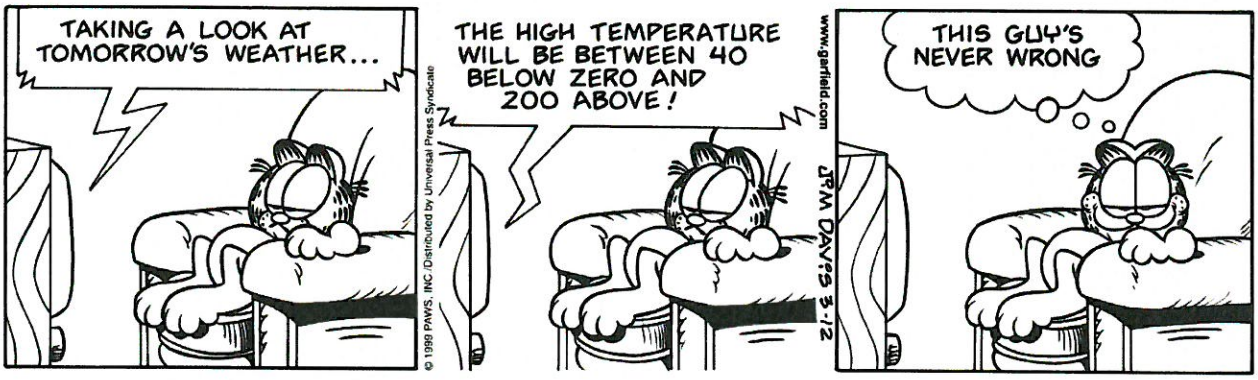
Chapter 8: Estimating with Confidence

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:

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

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 "**estimate ± 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?

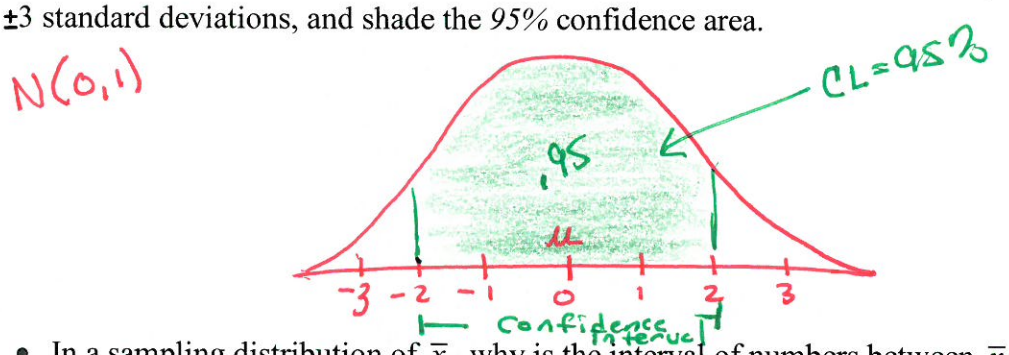
No, the confidence level is not a probability.

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

- What does it mean by "***plausible vales***?"

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

68 - 95 - 99.7 (±1SD, ±2SD, ±3SD)

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

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

statistic ± (critical value) • (standard deviation of the statistic) ← ME

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

ME = Critical Value • SD 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?

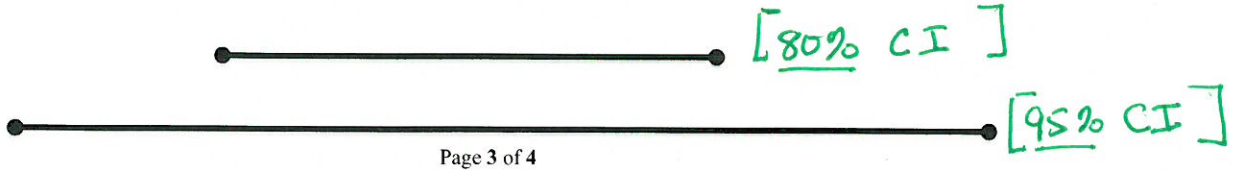
"STANDARD DEVIATION" DEPENDS ON THE SAMPLE SIZE (n)

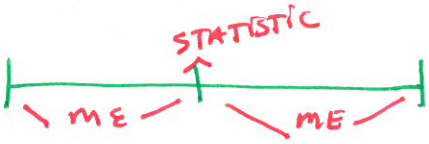
11. What happens when the **sample size (n)** increases?

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.