Exam Regrades

- Submit regrade requests to me for Exam 1 by class on Friday
- Include a cover page stating what you believe was graded incorrectly and why
- I will not regrade for partial credit; only submit a regrade request if you believe your answer is entirely correct but marked wrong (or if points were added incorrectly)

The larger the SE, the larger the interval

Distance from parameter to statistic gives distance from statistic to parameter

SE can be used to determine width of interval!

The larger the SE, the larger the interval

The larger the SE, the larger the interval

Confidence Interval

A confidence interval for a parameter is an interval computed from sample data by a method that will capture the parameter for a specified proportion of all samples

- The success rate (proportion of all samples whose intervals contain the parameter) is known as the confidence level
- A 95% confidence interval will contain the true parameter for 95% of all samples
95% of 95% confidence intervals will contain the true parameter value

Confidence Level
Suppose you each go out, collect a good random sample of data, compute the sample statistic, and correctly create a 95% confidence interval.
What percentage of you will have intervals that miss the truth?

a) 100%
b) 0%
c) 95%
d) 5%

Margin of Error
One common form for an interval estimate is
\[ \text{statistic} \pm \text{margin of error} \]
where the margin of error reflects the precision of the sample statistic as a point estimate for the parameter.

Margin of Error
For estimating \( \mu_1 - \mu_2 \), we have \( \bar{x}_1 - \bar{x}_2 = 2 \) and a margin of error of 1. Give a confidence interval for \( \mu_1 - \mu_2 \):

a) (1, 2)
b) (1, 3)
c) (0, 4)
d) (-1, 3)

Margin of Error
The higher the standard deviation of the sampling distribution, the

a) higher
b) lower

the margin of error.

Sampling Distribution
If you had access to the sampling distribution, how would you find the margin of error to ensure that intervals of the form
\[ \text{statistic} \pm \text{margin of error} \]
would capture the parameter for 95% of all samples?
(Hint: remember the 95% rule from Chapter 2)
95% of statistics will be within 2SE of the true parameter value

The interval statistic ± 2SE will include the parameter 95% of the time

95% Confidence Interval

If the sampling distribution is relatively symmetric and bell-shaped, a 95% confidence interval can be estimated using

\[ \text{statistic} \pm 2 \times \text{SE} \]

Margin of Error

For estimating \( \mu \), we have \( \bar{x} = 5 \) and \( \text{SE} = 1 \). Give a 95% confidence interval for \( \mu \):

(a) (4, 6)
(b) (3, 7)
(c) (-4, 6)
(d) (-9, 12)

Carbon in Forest Biomass

- Scientists hoping to curb deforestation estimate that the carbon stored in tropical forests in Latin America, sub-Saharan Africa, and southeast Asia has a total biomass of 247 gigatons.
- To arrive at this estimate, they first estimate the mean amount of carbon per square kilometer.
- Based on a sample of size \( n = 4079 \) inventory plots, the sample mean is 7 tons with a standard error of 1000 tons.
- Give a 95% CI for the average amount of carbon per sq km of tropical forest.

Interpreting a Confidence Interval

- 95% of all samples yield intervals that contain the true parameter.
- We say we are “95% sure” or “95% confident” that one interval contains the truth.
- “We are 95% confident that the average amount of carbon stored in each square kilometer of tropical forest is between 9,600 and 13,600 tons.”

Common Misinterpretations

- Misinterpretation 1: “A 95% confidence interval contains 95% of the data in the population.”
- Misinterpretation 2: “I am 95% sure that the mean of a sample will fall within a 95% confidence interval for the mean.”
- Misinterpretation 3: “The probability that the population parameter is in this particular 95% confidence interval is 0.95.”
- Misinterpretation 4: “95% of all sample means will fall within this 95% confidence interval.”

Confidence Intervals

If context were added, which of the following would be an appropriate interpretation for a 95% confidence interval:

a) “we are 95% sure the interval contains the parameter”
b) “there is a 95% chance the interval contains the parameter”
c) Both (a) and (b)
d) Neither (a) or (b)

Animal Behavior: Fish Democracies

- Do uncommitted members of a group make it more or less democratic?
- Let’s answer this with fish! (Golden shiners)
- Golden shiners are small freshwater fish with a strong tendency to stick together in schools.

The Golden Shiner Experiment

- Trained to swim to a particular color (yellow or blue) with treats
- Golden shiners have natural preference for yellow, so those trained to yellow had stronger opinions/preferences

How Long to Yellow?

- One the fish learn which color to go to, how fast can they get there?
- Parameter: average time for fish to get to their yellow target.
- The sample mean is $\bar{x} = 51$ seconds and the standard error for this statistic is 2.4.
- Give and interpret a 95% confidence interval in context.
How Long to Yellow?

Does Minority or Majority Win?

- Fish are pooled together with a majority blue trained (weak opinion) and a minority yellow trained (strong opinion)
- Which color target will the fish swim towards?
- Parameter: \( p \) = proportion of trials in with the majority wins (proportion in which fish go to blue)
- The sample proportion is \( \hat{p} = 0.17 \) and the standard error for this statistic is 0.04.
- Give and interpret a 95% confidence interval in context.

What's the Effect of Indifferent Fish?

- Same as before, but now they also add 10 indifferent fish to the trained fish
- What is the effect of the indifferent fish on the proportion of times the majority wins?
- Parameter: \( p_1 - p_2 = \) proportion of trials in which the majority wins with indifferent fish minus proportion of trials in which the majority wins without indifferent fish
- \( \hat{p}_1 = 0.61, \hat{p}_2 = 0.17, SE = 0.14 \)
- Give and interpret a 95% confidence interval in context.

Confidence Intervals

1) What parameter are you estimating?
2) What is the relevant sample statistic?
3) What is the standard error of this statistic?
4) Calculate a 95% interval with statistic 2 SE.
5) Interpret in context.
Confidence Intervals

Population → Sample → Sample → Sample → Sample

Calculate statistic for each sample

Sampling Distribution

Confidence Interval

statistic ± ME

Margin of Error (ME)
(95% CI: ME = 2×SE)

Standard Error (SE):
standard deviation of sampling distribution

Summary

• To create a plausible range of values for a parameter:
  o Take many random samples from the population, and compute the sample statistic for each sample
  o Compute the standard error as the standard deviation of all these statistics
  o Use statistic ± 2×SE

• One small problem...

To Do

• Read Section 3.2
• Do HW 3.1, 3.2 (due Monday, 2/23)