

Name: _____ Hour: _____ Date: _____

Lesson 8.1: Day 1: Guess the Mystery Mean



Today, you will be making your best guess at the mean of the midterm exam scores by creating a *confidence interval* (*point estimate* \pm *margin of error*). The group who creates a confidence interval with the smallest margin of error that still captures the true mean exam score will win a prize!

1. Mrs. Gallas will give you a random sample of 5 scores. Record the 5 scores and then find the mean.

Scores: _____

Mean: _____. This is your *point estimate* for the true mean.

2. Identify the population, parameter, sample, and statistic.

Population: _____ Parameter: _____

Sample: _____ Statistic: _____

3. Now you are going to change your *point estimate* into an interval of values by adding and subtracting the same number from your *point estimate* (the number you add and subtract is called your **margin of error**.) What margin of error will you choose? Why?

4. Write your interval that you think contains the true mean midterm exam score.

5. How confident do you feel that your interval captures the true mean? Answer with a percentage.

6. One of the groups got (71, 79) as their interval. What was their point estimate? What was their margin of error?

7. Mrs. Gallas claims that the true mean exam score is 84. Does your interval support or deny this claim? Why?

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Lesson 8.1 Day 1– The Idea of a Confidence Interval

Important ideas:

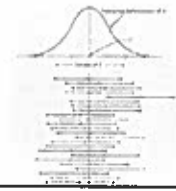
Check Your Understanding

The Pew Research Center and *Smithsonian* magazine recently quizzed a random sample of 1006 U.S. adults on their knowledge of science. One of the questions asked, “Which gas makes up most of the Earth’s atmosphere: hydrogen, nitrogen, carbon dioxide, or oxygen?” A 95% confidence interval for the proportion who would correctly answer nitrogen is 0.175 to 0.225.

1. Interpret the confidence interval.
2. Calculate the point estimate and the margin of error.
3. If people guess one of the four choices at random, about 25% should get the answer correct. Does this interval provide convincing evidence that less than 25% of all U.S. adults would answer this question correctly? Explain your reasoning.

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Lesson 8.1: Day 2: What does “95% confident” mean?



In this Activity, you will use the *Confidence Intervals* applet to learn what it means to say we are “95% confident” that our confidence interval captures the true mean.

1. Go to stapplet.com. Scroll down in the menu until you find the *Confidence Intervals* applet. Set the confidence level to 95% and the sample size to 5.
2. Click “Sample” to choose an SRS and display the resulting confidence interval. The confidence interval is displayed as a horizontal line segment with a dot representing the sample mean in the middle of the interval. The true mean (μ) is the green vertical line.

Did the first confidence interval capture the true mean?

Repeat this 10 times and sketch what you see to the right. How many of the intervals capture the true mean?

3. “Reset” and then take a total of 100 confidence intervals (sample 25 four times). How many out of 100 captured the true mean? Is this surprising? Why?
4. Watch your confidence intervals as you drag the confidence level from 95% to 99% (don’t “Reset”). What happens to the intervals when the confidence level is increased? Why does this make sense?
5. “Reset”, then sample 100 times at an 80% confidence interval. How many of the intervals capture the true mean?

Interpret the confidence level:

6. Now we will see what happens when we adjust the sample size. Change the sample size from 5 to 50 and sample for 1 interval. Then change it to 250 and sample for 1 interval. What happens to the interval when the sample size is increased? Why?

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Lesson 8.1 Day 2– Interpreting Confidence Level

Important ideas:

Check Your Understanding

As part of a project about response bias, Ellery surveyed a random sample of 25 students from her school. One of the questions in the survey required students to state their GPA aloud. Based on the responses, Ellery said she was 90% confident that the interval from 3.14 to 3.52 captures the mean GPA for all students at her school.

- (a) Interpret the confidence level.

- (b) Explain what would happen to the length of the interval if the confidence level were increased to 99%.

- (c) How would a 90% confidence interval based on a sample of size 200 compare to the original 90% interval?

- (d) Describe one potential source of bias in Ellery's study that is not accounted for by the margin of error.

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Lesson 8.2: Day 1: Which way will the Hershey Kiss land?



When you toss a Hershey Kiss, it sometimes lands flat and sometimes lands on its side. What proportion of tosses will land flat?

Each group of four selects a random sample of 50 Hershey's Kisses to bring back to their desks. Toss the 50 Kisses and then calculate the proportion that land flat. Let \hat{p} = the proportion of the Kisses that land flat.

1. What is your **point estimate** for the true proportion that land flat? _____
2. Identify the population, parameter, sample and statistic.
Population: _____ Parameter: _____
Sample: _____ Statistic: _____
3. Was the sample a random sample? Why is this important?
4. What is the formula for calculating the standard deviation of the sampling distribution of \hat{p} ?
5. What condition must be met to use this formula? Has it been met?
6. We don't know the value of p (that's the whole point of a confidence interval) so we will use \hat{p} instead. Calculate the standard deviation.
7. Would it be appropriate to use a normal distribution to model the sampling distribution of \hat{p} ? Justify your answer.

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8. In a normal distribution, 95% of the data lies within _____ standard deviations of the mean. This value is called the **critical value**. Use table A or InverseNorm to find these critical values:

80% of the data lies within _____ standard deviations of the mean

90% of the data lies within _____ standard deviations of the mean

95% of the data lies within _____ standard deviations of the mean

99% of the data lies within _____ standard deviations of the mean

9. Calculate the **margin of error** for a 95% interval by multiplying the critical value and standard deviation you found. Show your work.

10. Find the 95% confidence interval using **point estimate +/- margin of error**.

11. Add your interval to the graph on the board. Sketch the graph below.

12. What do you think is the true proportion of kisses that land flat is?

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Lesson 8.2 Day 1– Constructing a Confidence Interval for p

Important ideas:

Check Your Understanding

Sleep Awareness Week begins in the spring with the release of the National Sleep Foundation's annual poll of U.S. sleep habits and ends with the beginning of daylight savings time, when most people lose an hour of sleep. In the foundation's random sample of 1029 U.S. adults, 48% reported that they "often or always" got enough sleep during the last 7 nights.

1. Identify the parameter of interest.
2. Check if the conditions for constructing a confidence interval for p are met.
3. Find the critical value for a 98% confidence interval. Then calculate the interval.
4. Interpret the interval in context.

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Lesson 8.2: Day 2: How much of the Earth is covered by water?



What proportion of the Earth is covered by water? We will investigate this question by taking a random sample of locations on the globe.

1. How many locations did your class sample? _____ How many locations were water? _____
2. Calculate the proportion of locations from your sample that are water. $\hat{p} =$ _____
3. Construct a 95% confidence interval to estimate the proportion of the Earth that is water.

STATE: State the parameter you want to estimate and the confidence level.

Parameter: _____ Confidence level: _____

PLAN: Identify the appropriate inference method and check conditions.

Name of procedure:

Check conditions:

DO: If the conditions are met, perform the calculations.

General Formula for any confidence interval:

Specific Formula for this confidence interval:

Plug numbers into the formula:

Answer:

CONCLUDE: Interpret your interval in the context of the problem.

Interpret:

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Lesson 8.2 Day 2 – The Four Step Process

Important ideas:

Check Your Understanding

A company has received complaints about its customer service. The managers intend to hire a consultant to carry out a survey of customers. Before contacting the consultant, the company president wants some idea of the sample size that she will be required to pay for. One value of interest is the proportion p of customers who are satisfied with the company's customer service. She decides that she wants the estimate to be within 3 percentage points (0.03) at a 95% confidence level.

1. Using a conservative estimate for \hat{p} , how large of a sample is needed?
2. In the company's prior-year survey, 80% of customers surveyed said they were satisfied. Using this value as a guess for \hat{p} , find the sample size needed for a margin of error of at most 3 percentage points with 95% confidence. How does this compare with the required sample size from question #1?
3. What if the company president demands 99% confidence instead of 95% confidence? Would this require a smaller or larger sample size, assuming everything else remains the same? Explain your answer.

State, Plan, Do, Conclude

Statistics Problems Demand Consistency

A format for understanding inference and success on the AP Exam

Confidence Intervals: A Four-Step Process

1. **State:** What parameter do you want to estimate and at what confidence level?
2. **Plan:** Identify the appropriate inference method and check conditions.
3. **Do:** Perform the calculations.
4. **Conclude:** Interpret your interval in the context of the problem.

Significance Tests: A Four-Step Process:

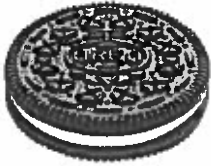
1. **State:** State your hypotheses, define your parameter, and identify your significance level.
2. **Plan:** Identify the type of significance test. Check conditions.
3. **Do:** Picture, general formula, specific formula, plug numbers in, find **test statistic** and **P-value**.
4. **Conclude:** Write a short novel.

Sample size practice

1. Edgar Martinez and Ingrid Gustafson are the candidates for mayor in a large city. We want to estimate the proportion p of all registered voters in the city who plan to vote for Gustafson with 95% confidence and a margin of error no greater than 0.03. How large a random sample do we need?
2. High school students who take the SAT Math exam a second time generally score higher than on their first try. Past data suggest that the score increase has a standard deviation of about 50 points. How large a sample of high school students would be needed to estimate the mean change in SAT score to within 2 points with 95% confidence?
3. A college student organization wants to start a nightclub for students under the age of 21. To assess support for the idea, the organization will select an SRS of students and ask each if he or she would patronize this type of establishment. What sample size is required to obtain a 90% confidence interval with a margin of error of at most 0.04 if they suspect $\hat{p} = .75$?

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Lesson 8.3: Day 1: How much does an Oreo weigh?



Mrs. Gallas wanted to estimate the average weight of an Oreo cookie to determine if the average weight was less than advertised. She selected a random sample of 30 cookies and found the weight of each cookie (in grams). The mean weight was $\bar{x} = 11.1921$ grams with a standard deviation of $s_x = 0.0817$ grams. Make a 95% confidence interval to estimate the true mean weight of an Oreo.

1. What is the point estimate for the true mean? _____
2. Identify the population, parameter, sample and statistic.
Population: _____ Parameter: _____
Sample: _____ Statistic: _____
3. Was the sample a random sample? Why is this important?
4. What is the formula for calculating the standard deviation of the sampling distribution of \bar{x} ?
5. What condition must be met to use this formula? Has it been met?
6. In the formula for the standard deviation of the sampling distribution of \bar{x} , we don't know the value of σ (if we did, we would have known μ) so we will use s_x instead. Find the **standard error**.
7. Would it be appropriate to use a normal distribution to model the sampling distribution of \bar{x} ? Justify your answer.
8. When finding the margin of error for a confidence interval for a proportion we use z^* . For a mean we will use _____ as the critical value. Why???

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9. What t^* is needed for this confidence interval? Use **Table B** and the **degrees of freedom = $n - 1$** to find it.

10. Calculate the **margin of error** using t^* and the standard error.

11. Calculate the 95% confidence interval using **point estimate \pm margin of error**.

12. Interpret the interval.

13. Write a specific formula for a confidence interval for a population mean.

14. According to Nabisco, an Oreo weighs 11.3 grams. Does our confidence interval provide convincing evidence that the true average weight is less than 11.3 grams? Explain.

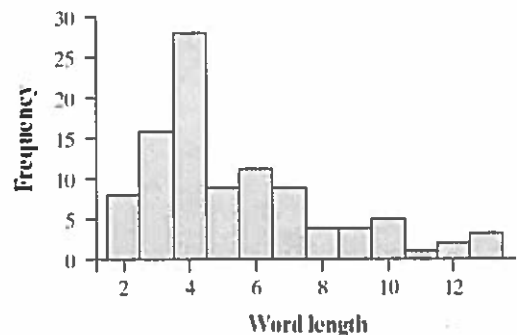
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Lesson 8.3 Day 1– Constructing a Confidence Interval for μ

Important ideas:

Check Your Understanding

1. Use Table B to find the critical value t^* that you would use for a confidence interval for a population mean m in each of the following settings. If possible, check your answer with technology.
 - (a) A 96% confidence interval based on a random sample of 22 observations
 - (b) A 99% confidence interval from an SRS of 71 observations
2. Judy is interested in the reading level of a medical journal. She records the length of a random sample of 100 words. The histogram displays the distribution of word length for her sample. Determine if the conditions for constructing a confidence interval for a mean have been met in this context.



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Lesson 8.3: Day 2: How many states can you name?



How many states can you name in one minute? We will use this class as a random sample of all AP Stats students to estimate a 95% confidence interval for the mean number of states an AP Stats student can name in one minute.

1. When the timer starts, list as many states as you can on a piece of paper. Write the number of states you listed on the board.

2. What type of data is this? Categorical or quantitative?

2. Enter the class data at stapplet.com. Find the sample mean and standard deviation. Sketch the dotplot of the sample data.

$n =$ $\bar{x} =$ $s_x =$

3. Construct a 95% confidence interval to estimate the mean # of states a senior can name.

STATE: State the parameter you want to estimate and the confidence level.

Parameter: _____ Confidence level: _____

PLAN: Identify the appropriate inference method and check conditions.

Name of procedure:

Check conditions:

DO: If the conditions are met, perform the calculations.

General Formula for any confidence interval:

Specific Formula for this confidence interval:

Plug numbers into the formula:

Answer:

CONCLUDE: Interpret your interval in the context of the problem.

Interpret:

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Lesson 8.3 Day 2 – The Four Step Process

Important ideas:

Check Your Understanding

1. Administrators at your school want to estimate how much time students spend on homework, on average, during a typical week. They want to estimate μ at the 90% confidence level with a margin of error of at most 30 minutes. A pilot study indicated that the standard deviation of time spent on homework per week is about 154 minutes. How many students need to be surveyed to meet the administrators' goal?
2. Biologists studying the healing of skin wounds measured the rate at which new cells closed a cut made in the skin of an anesthetized newt. Here are data from a random sample of 18 newts, measured in micrometers (millionths of a meter) per hour:

29 27 34 40 22 28 14 35 26 35 12 30 23 18 11 22 23 33

Calculate and interpret a 95% confidence interval for the mean healing rate μ .

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AP Stats Chapter 8 Formula Study Sheet

Lesson	8.2	8.3
What are we trying to estimate?		
Symbol for statistic		
Symbol for parameter		
Name of the procedure		
RANDOM condition		
10% condition		
NORMAL condition		
Formula for standard deviation		
z^* or t^*		
Formula for margin of error		
General formula for confidence interval		
Specific formula for confidence interval		

4 STEP PROCESS

STATE: State the parameter you want to estimate and the confidence level.

PLAN: Identify the appropriate inference method and check conditions.

DO: If the conditions are met, perform the calculations.

General Formula, Specific Formula, Plug numbers into the formula, Answer.

CONCLUDE: Interpret your interval in the context of the problem.

Intro Stats Chapter 8 Big Ideas

Concept	Which Lesson?	Definition, Formula, Example or Interpret.
Confidence Interval		Point Estimate: Margin of Error: Interpret:
Confidence Level		
What affects Margin of Error?		Sample Size: Confidence Level:
Conditions for constructing a confidence interval		
Confidence Interval for a Proportion		
Critical Values for Proportions		
4 Step Process		
Confidence Interval for a Mean		
Critical Values for Means		
Solving for sample size		

Sample size practice

1. Edgar Martinez and Ingrid Gustafson are the candidates for mayor in a large city. We want to estimate the proportion p of all registered voters in the city who plan to vote for Gustafson with 95% confidence and a margin of error no greater than 0.03. How large a random sample do we need?
2. High school students who take the SAT Math exam a second time generally score higher than on their first try. Past data suggest that the score increase has a standard deviation of about 50 points. How large a sample of high school students would be needed to estimate the mean change in SAT score to within 2 points with 95% confidence?
3. A college student organization wants to start a nightclub for students under the age of 21. To assess support for the idea, the organization will select an SRS of students and ask each if he or she would patronize this type of establishment. What sample size is required to obtain a 90% confidence interval with a margin of error of at most 0.04 if they suspect $\hat{p} = .75$?

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4-step practice questions

1. Suppose we are interested in finding out the proportion of the population at EKHS that has seen The Office. We contact an SRS of 100 students in the school. Of these 100 students, 63 report seeing The Office. Find a 95% confidence interval for the true proportion of EKHS students who have seen The Office.
2. Mr. Wilcox has done over 50 track days at Gingerman Raceway in South Haven Michigan. He keeps track of each lap time (in seconds) and has found that they follow an approximately normal distribution. A random sample of 9 laps shows a mean laptime of $\bar{x} = 102.4$ seconds with a standard deviation of $s_x = 3.2$ seconds. Create a 90% confidence interval for Mr. Wilcox's career average lap time.
3. Mrs. Gallas was an all-star basketball player in high school. To prove that she still has skills, she took 50 free throws and made 31 of them. Think of these 50 shots as being a random sample of all the free throws she has ever taken. Find a 99% confidence interval for the true proportion of free throws Mrs. Gallas would make.

Activity Name:

<p>Describe the activity or context:</p>	
<p>What important statistical concepts did we learn?</p>	

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