Name: Key Hour: _____ Date: _____

OREO

Learning Targets

- Determine the critical value for calculating a C% confidence interval for a population mean using a table or technology
- State and check the Random, 10%, and Normal/ Large Sample conditions for constructing a confidence interval for a population mean
- Construct and interpret a confidence interval for a population mean

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

Mrs. Cowells 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? $\bar{x} = 11.1921$

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

   Population: All oreos   Parameter: $\mu \rightarrow$ true mean weight

   Sample: 30 oreos   Statistic: $\bar{x} = 11.1921$ grams (sample mean weight)

3. Was the sample a random sample? Why is this important?

   Yes, it is important so we can generalize. } Condition #1 Random

4. What is the formula for calculating the standard deviation of the sampling distribution of $\bar{x}$?

   $\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}}$

5. What condition must be met to use this formula? Has it been met?

   10% condition (Independent Condition)

   10(30) < pop. of all oreos ✓

   } Condition #2 10% (Independent)

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.**

   $SE_{\bar{x}} = \frac{s_x}{\sqrt{n}} = \frac{0.0817}{\sqrt{30}} = .0149$

   $SE_{\bar{x}}$ describes how far $\bar{x}$ will be from μ on average, in repeated SRS's of size n.

7. Would it be appropriate to use a normal distribution to model the sampling distribution of $\bar{x}$? Justify your answer.

   Yes, because CLT is met. $n \geq 30$

   $30 \geq 30$ ✓

   } Condition #3 Normal

for $z = \dfrac{\bar{x} - \mu}{\sigma/\sqrt{n}}$ μ and σ unknown so we estimate σ with s_x so $t = \dfrac{\bar{x} - \mu}{s_x/\sqrt{n}}$

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8. When finding the margin of error for a confidence interval for a proportion we use z*. For a mean we will use t^* as the critical value. Why??? When trying to estimate μ the mean of a population, we also have to estimate the standard deviation σ of the population in order to understand the standardized distribution of sample means. Because we are now trying to estimate 2 parameters, we are introducing more variation into the standardized statistic. Thus the distribution of sample means follows a t-distribution, which is wider and shorter than a Normal Distribution.

9. What t^* is needed for this confidence interval? Use **Table B** and the **degrees of freedom = n - 1** to find it. $n = 30$

degrees of freedom $= n - 1 = 30 - 1 = 29$

Table 6 → 95% and df 29 $t^* = 2.045$

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

$M.E = t^* \dfrac{s_x}{\sqrt{n}} = 2.045\left(\dfrac{.0817}{\sqrt{30}}\right) \approx .0305$

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

$11.1921 \pm .0305 = (11.1616,\ 11.2226)$

12. Interpret the interval.

We are 95% confident that the interval from 11.16 to 11.22g captures the true mean weight of oreos.

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

$\bar{x} \pm t^* \dfrac{s_x}{\sqrt{n}}$

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.

Yes, our interval is below 11.3 grams.

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Lesson 8.3 Day 1– Constructing a Confidence Interval for μ

Important ideas:

L.T. #1 Conditions

① Random

② 10% Condition (Independent)

③ Normal:
- Population is approximately Normal
- $n \geq 30$ CLT
- sample data shows no strong skew or outliers

L.T. #2 Critical Values

$t^* \rightarrow$ use for means

degrees of freedom $= n-1$

Use table B with df and confidence level

* always round down if df isn't on table B. *

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.

   $\frac{1-.96}{2} = \frac{.04}{2}$

   (a) A 96% confidence interval based on a random sample of 22 observations

   Table B $\rightarrow$ df $= 22-1 = 21$ + 96% $t^* = 2.189$

   Calculator

   InvT(.02, 21) $= 2.189$

   (b) A 99% confidence interval from an SRS of 71 observations

   Table B $\rightarrow$ df $= 70$ + 99% $\rightarrow t^* = 2.660$

   InvT(.005, 70) $= 2.648$

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.

① Random: Random sample of 100 words ✓

② $10(100) <$ all words in journal ✓

1000

reasonable to assume

③ Normal: $n = 100$

$100 \geq 30$, so by CLT Normal ✓