

Name: _____ Hour: _____ Date: _____

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.

Answers will vary

1. How many locations did your class sample? 50 How many locations were water? 34
2. Calculate the proportion of locations from your sample that are water. $\hat{p} =$ 0.68
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: $p =$ true proportion of Earth covered by water Confidence level: 95%

~ **PLAN:** Identify the appropriate inference method and check conditions.

Name of procedure: one sample z interval for p

Check conditions:

Random: random sample of 50 locations \rightarrow so we can generalize to the population.

10%: $50 \leq \frac{1}{10}$ (all locations on Earth) \rightarrow so sampling without replacement is OK.

Large Counts: $50(0.68) = 34 \geq 10$ $50(0.32) = 16 \geq 10$ \rightarrow so the sampling distribution of \hat{p} is approximately Normal.

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

General Formula for any confidence interval: ~~point estimate~~ \pm margin of error

Specific Formula for this confidence interval: $\hat{p} \pm z^* \cdot \sqrt{\frac{\hat{p}(1-\hat{p})}{n}}$

Plug numbers into the formula: $0.68 \pm 1.96 \sqrt{\frac{(0.68)(0.32)}{50}}$

Answer: ~~0.68 ± 0.129~~ $\Rightarrow (0.551, 0.809)$

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

Interpret: We are 95% confident that the interval from 0.551 to 0.809 captures the true proportion of Earth covered by water.

Reveal truth: About 71% of Earth is covered by water ($p=0.71$)

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Estimating a Population Proportion: The 4-Step Process

Important ideas:

LT#1 Four Step Process

- STATE: Parameter and confidence level
 PLAN: Name the procedure
 Check conditions
 DO: General and specific formulas
 Plug numbers in, calculate interval
 CONCLUDE: Interpret interval in context
 "We are 95% confident..."

LT#2 Choosing a Sample Size

- $$ME = z^* \sqrt{\frac{\hat{p}(1-\hat{p})}{n}}$$
- Solve for n
 [Don't have to memorize]
 • When \hat{p} is unknown, use $\hat{p}=0.5$ for conservative calculation.
 • If n has a decimal, always round up.

Check Your Understanding

A community activist group in Austin, Texas wanted a particular issue to be placed on the ballot of the upcoming election. To make it on the ballot, 20,000 valid signatures were needed. The group turned in their petition with 24,598 signatures. To pass the validity test $20,000/24,598 = 81.3\%$ of the signatures must be valid. It is too time consuming to check all of the signatures, so a random sample of signatures are checked. The individual checking the signatures needs to be 95% confident that the true proportion of valid signatures are estimated with, at most, a 2% margin of error.

1. Using a conservative estimate for \hat{p} , how large of a sample is needed?

$$ME = z^* \sqrt{\frac{\hat{p}(1-\hat{p})}{n}} \quad 0.02 = 1.96 \sqrt{\frac{(0.5)(0.5)}{n}} \quad n = \frac{0.25}{\left(\frac{0.02}{1.96}\right)^2} = \boxed{2401}$$

2. In the activist group's previous petition, 85% of the signatures were valid. Using this value as a guess for \hat{p} , find the sample size needed for a margin of error of at most 2 percentage points with 95% confidence. How does this compare with the required sample size from Question 1?

$$0.02 = 1.96 \sqrt{\frac{(0.85)(0.15)}{n}} \quad n = \frac{0.1275}{\left(\frac{0.02}{1.96}\right)^2} = 1224.51 \quad \boxed{1225} \quad \text{This sample size is much smaller.}$$

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.

Larger sample size. To be more confident, they must check more signatures.

Assignment #8.2c

- (44) a) Sample at least 1817 adults
b) Sample at least 1844 adults

(50) d

(52) a

