Poll on the Environment
• Pew Research Center conducted March 13 – 17, 2013
• “From what you’ve read and heard, is there solid evidence that the average temperature on earth has been getting warmer over the past few decades, or not?”

Poll on the Environment
• Population – all adults in the United States.
• Population Parameter – proportion of all adults in the U.S. who would say the earth is getting warmer mostly because of human activity.
Poll on the Environment

• Sample – 1,501 adults in the United States.
• Sample Statistic – proportion of the 1,501 who believed the earth is getting warmer mostly because of human activity.

Parameter – population proportion
0.39 ≤ p ≤ 0.45

Inference

Statistic – sample proportion
\[ \hat{p} = 0.42 \]

Poll on the Environment

• Description – 42% of the sample answered yes and believed the earth is getting warmer mostly because of human activity.
• Inference – between 39% and 45% of the entire population of U.S. adults would say the earth is getting warmer mostly because of human activity.
Margin of Error

• The approximate margin of error is given by

\[
\frac{1}{\sqrt{n}} \times 100\%
\]

68-95-99.7 Rule

• 95% of the time a sample proportion, \( \hat{p} \), will be within 2 standard deviations of the population proportion, \( p \).

\[
\hat{p} \pm 1.96 \sqrt{\frac{p(1-p)}{n}}
\]

68-95-99.7 Rule

• 95% of the time the sample proportion, \( \hat{p} \), will be between

\[
p - 2\sqrt{\frac{p(1-p)}{n}} \quad \text{and} \quad p + 2\sqrt{\frac{p(1-p)}{n}}
\]
Standard Deviation

- Because \( p \), the population proportion is not known, the standard deviation is also unknown.

\[
SD(\hat{p}) = \sqrt{\frac{p(1-p)}{n}}
\]

Standard Error

- Substitute \( \hat{p} \) as our estimate (best guess) of \( p \).
- The standard error of \( \hat{p} \) is:

\[
SE(\hat{p}) = \sqrt{\frac{\hat{p}(1-\hat{p})}{n}}
\]

- About 95% of the time the sample proportion, \( \hat{p} \), will be within

\[
2SE(\hat{p}) = 2\sqrt{\frac{\hat{p}(1-\hat{p})}{n}}
\]
two standard errors of \( p \).
• About 95% of the time the population proportion, \( p \), will be within

\[
2SE(\hat{p}) = 2\sqrt{\frac{\hat{p}(1-\hat{p})}{n}}
\]

two standard errors of \( \hat{p} \).

Confidence Interval for \( p \)

• We are 95% confident that \( p \) will fall between

\[
\hat{p} - 2\sqrt{\frac{\hat{p}(1-\hat{p})}{n}} \quad \text{and} \quad \hat{p} + 2\sqrt{\frac{\hat{p}(1-\hat{p})}{n}}
\]

Example

\( \hat{p} = 0.42 \)

\[
\sqrt{\frac{\hat{p}(1-\hat{p})}{n}} = \sqrt{\frac{0.42(0.58)}{1501}} = 0.01274
\]

0.42 - 2(0.01274) to 0.42 + 2(0.01274)

0.3945 to 0.4455
Interpretation

• We are 95% confident that the population proportion of all adults in the U.S. who believe the earth is getting warmer because of human activity is between 39.4% and 44.6%.

Interpretation

• Plausible values for the population parameter $p$.
• 95% confidence in the process that produced this interval.

95% Confidence

• If one were to repeatedly sample at random 1501 adults in the U.S. and compute a 95% confidence interval for each sample, 95% of the intervals produced would contain the population proportion $p$. 
Simulation

http://statweb.calpoly.edu/chance/applets/Confsim/Confsim.html

Margin of Error

• The approximate margin of error is 2 standard errors with 95% confidence and $\hat{p} = 0.5$

$$2 \sqrt{\frac{0.5(1-0.5)}{n}} = \frac{1}{\sqrt{n}} \times 100\%$$