Example
\[ \hat{p} = 0.56 \]
\[ \sqrt{\frac{\hat{p}(1-\hat{p})}{n}} = \sqrt{\frac{0.56(0.44)}{1772}} = 0.012 \]
\[ 0.56 - 2(0.012) \text{ to } 0.56 + 2(0.012) \]
\[ 0.536 \text{ to } 0.584 \]

Interpretation

- We are 95% confident that the population proportion of all adults in the U.S. who believe abortion should be legal is between 53.6% and 58.4%.

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 1,772 adults and compute a 95% confidence interval for each sample, 95% of the intervals produced would contain, or capture, the population proportion $p$.

Simulation

http://statweb.calpoly.edu/chance/applets/Confsim/Confsim.html
Margin of Error

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

Is called the Margin of Error (ME).
This is the furthest \( \hat{p} \) can be from \( p \), with 95% confidence.

Margin of Error

- What if we want to be 99.7% confident?

$$ME = 3SE(\hat{p}) = 3\sqrt{\frac{\hat{p}(1-\hat{p})}{n}}$$

Margin of Error

$$ME = z^* SE(\hat{p}) = z^* \sqrt{\frac{\hat{p}(1-\hat{p})}{n}}$$

<table>
<thead>
<tr>
<th>Confidence</th>
<th>80%</th>
<th>90%</th>
<th>95%</th>
<th>98%</th>
<th>99%</th>
</tr>
</thead>
<tbody>
<tr>
<td>( z^* )</td>
<td>1.282</td>
<td>1.645</td>
<td>2 or 1.96</td>
<td>2.326</td>
<td>2.576</td>
</tr>
</tbody>
</table>
Another Example

- “Do you favor or oppose setting stricter emission limits on power plants in order to address climate change?”

Another Example

n=1,504 randomly selected adults.

<table>
<thead>
<tr>
<th>Favor</th>
<th>Oppose</th>
<th>Unsure/Refused</th>
</tr>
</thead>
<tbody>
<tr>
<td>52%</td>
<td>28%</td>
<td>10%</td>
</tr>
</tbody>
</table>

Another Example

- 90% confidence interval for $p$, the proportion of the population of all adults in the U.S. who would favor stricter emission limits on power plants in order to address climate change.
Calculation

\[ \hat{p} = 0.52 \quad \text{SE}(\hat{p}) = \sqrt{\frac{\hat{p}(1-\hat{p})}{n}} = 0.013 \quad z^* = 1.645 \]

\[ 0.52 - 1.645(0.013) \text{ to } 0.52 + 1.645(0.013) \]

\[ 0.52 - 0.021 \text{ to } 0.52 + 0.021 \]

\[ 0.499 \text{ to } 0.541 \]

What Sample Size?

- Conservative Formula

  - The sample size to be 95% confident that \( \hat{p} \), the sample proportion, will be within ME of the population proportion, \( p \).

  \[ n = \frac{1}{\text{ME}^2} \]

Example

- Suppose we want to be 95% confident that our sample proportion will be within 0.02 of the population proportion.

  \[ n = \frac{1}{\text{ME}^2} \Rightarrow n = \frac{1}{(0.02)^2} = 2,500 \]