Confidence Intervals for a Proportion

Colby Community College

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Note

We have no indication of how *good* of an estimate 0.43 is, just that it is the best of the available options.

Definition

A **confidence interval** is a range of values around the point estimate used to estimate the true value of a population parameter.

$$[\text{point estimate} - \text{some value}, \text{point estimate} + \text{some value}]$$

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Round the confidence interval limits to three significant digits.

The Process Success Rate

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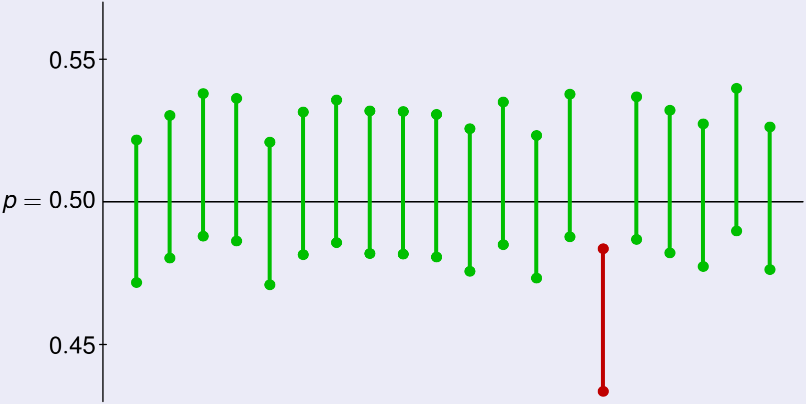
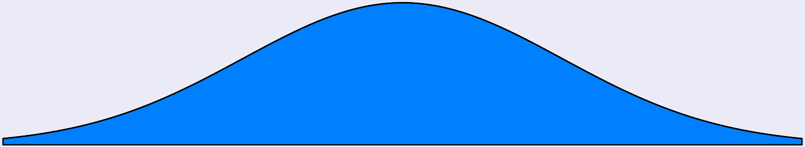
If the true population proportion is $p = 0.5$, then we expect around 19 of 20 confidence intervals to contain the true value of p.



A Few Observations



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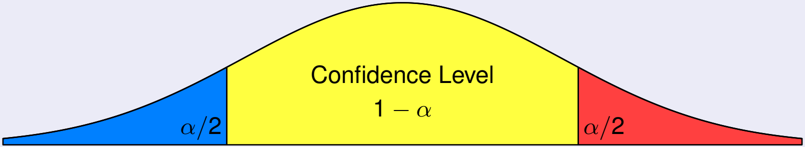

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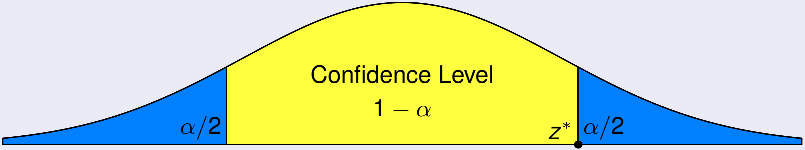

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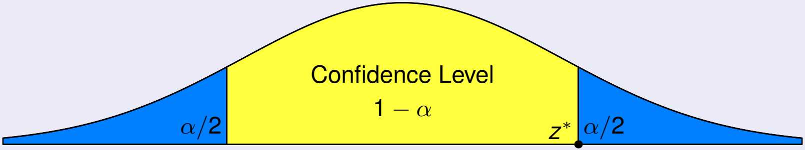

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Definition

The value z^* is called a **critical value**.

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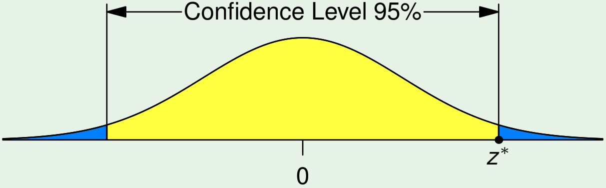
Let us find the critical value corresponding to a 95% confidence level.



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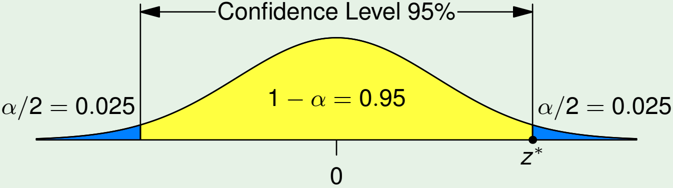
A 95% confidence interval gives $\alpha = 0.05$ and $\alpha/2 = 0.025$.



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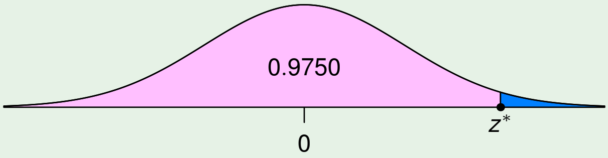

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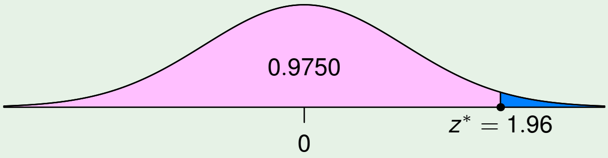

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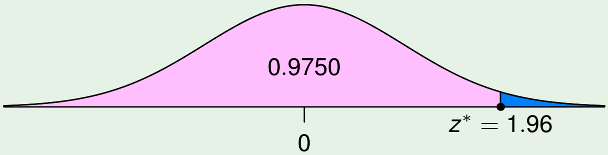

Common Confidence Levels

Confidence Level	α	Critical Value
90%	0.10	1.645
95%	0.05	1.960
99%	0.01	2.575

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Note

The margin of error for $\hat{p}$ is:

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

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Round the confidence interval limits to four digits.

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5. We are 90% confident that between 87.1% and 90.4% of American adults supported the expansion of solar power in 2018.

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Incorrect: "There is a 90% chance that the true value of p will fall between 0.8705 and 0.9035."

Reason: The population proportion p is a fixed value.

Incorrect: "90% of sample proportions will fall between 0.8705 and 0.9035."

Reason: The values 0.8705 and 0.9035 result from one sample, they are not parameters describing the behavior of all samples.

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Caution

Never think that poll results are unreliable if the sample size if a small percentage of the population size.

Finding $\hat{p}$ from a Confidence Interval

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> Of the 71 subjects, 70% were abstinent from smoking at 8 weeks (95% confidence interval [CI], 58% to 81%).

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$$E = z^* \sqrt{\frac{\hat{p}(1-\hat{p})}{n}} \quad \Rightarrow \quad n = \frac{(z^*)^2 \hat{p}(1-\hat{p})}{E^2}$$

We have $z^* = 1.96$ and $E = 0.03$, but what about $\hat{p}$?

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Rounding

If the computed sample size n is not a whole number, round the value of n up to the next larger whole number.

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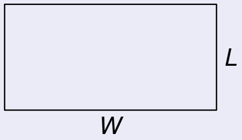
To see why, consider the rectangle:



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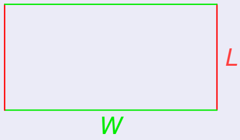

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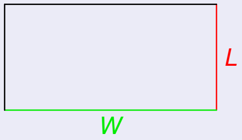

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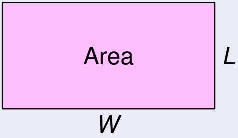

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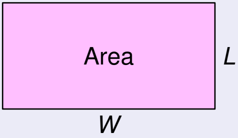

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Since this is a parabola that opens down, we know that the vertex, $(0.5, 0.5)$, is the maximum value.

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3. Be sure to *round up to the next highest integer*, do not round using the usual rounding rules.