



## Confidence Interval

- Conceptual understanding
- Examples
- Stylized problem



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- ❑ Conceptual understanding
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## Confidence Interval

**A  $(1 - \alpha)$  confidence interval for the population mean...**

$$\bar{x} - |z_{\alpha/2}| \frac{\sigma}{\sqrt{n}} < \mu < \bar{x} + |z_{\alpha/2}| \frac{\sigma}{\sqrt{n}}$$



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$$\bar{x} - |z_{\alpha/2}| \frac{\sigma}{\sqrt{n}} < \underset{\uparrow}{\mu} < \bar{x} + |z_{\alpha/2}| \frac{\sigma}{\sqrt{n}}$$



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$$\bar{x} - |z_{\alpha/2}| \frac{\sigma}{\sqrt{n}} < \mu < \bar{x} + |z_{\alpha/2}| \frac{\sigma}{\sqrt{n}}$$

↑





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$$\bar{x} - \underbrace{|z_{\alpha/2}| \frac{\sigma}{\sqrt{n}}}_{\uparrow} < \mu < \bar{x} + |z_{\alpha/2}| \frac{\sigma}{\sqrt{n}}$$



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$$\bar{x} - |z_{\alpha/2}| \frac{\sigma}{\sqrt{n}} < \mu < \bar{x} + |z_{\alpha/2}| \frac{\sigma}{\sqrt{n}}$$
A diagram showing a horizontal dashed line. A red arrow points upwards from the line to the term  $|z_{\alpha/2}| \frac{\sigma}{\sqrt{n}}$  in the formula. A grey arrow points upwards from the line to the term  $|z_{\alpha/2}| \frac{\sigma}{\sqrt{n}}$  in the formula.



## Confidence Interval

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$$\bar{x} - |z_{\alpha/2}| \frac{\sigma}{\sqrt{n}} < \mu < \bar{x} + |z_{\alpha/2}| \frac{\sigma}{\sqrt{n}}$$

A dashed horizontal line is positioned below the  $|z_{\alpha/2}|$  term in the equation. A red arrow points upwards from the text  $z_{\alpha/2} = \text{NORM.INV}(\alpha/2, 0, 1)$  to this dashed line. A grey arrow points upwards from the text  $\text{NORM.INV}(\alpha/2, 0, 1)$  to the red arrow.

$z_{\alpha/2} = \text{NORM.INV}(\alpha/2, 0, 1)$



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$z_{\alpha/2} = \text{NORM.INV}(\alpha/2, 0, 1)$



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$z_{\alpha/2} = \text{NORM.INV}(\alpha/2, 0, 1)$



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A  $(1 - \alpha)$  confidence interval for the population mean...

$$\bar{x} - \underbrace{\left| z_{\alpha/2} \right| \frac{\sigma}{\sqrt{n}}}_{\substack{\uparrow \\ \text{margin of error}}} < \mu < \bar{x} + \left| z_{\alpha/2} \right| \frac{\sigma}{\sqrt{n}}$$



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$$\bar{x} - \left| z_{\alpha/2} \right| \frac{\sigma}{\sqrt{n}} < \mu < \bar{x} + \left| z_{\alpha/2} \right| \frac{\sigma}{\sqrt{n}}$$

 **margin of error** = CONFIDENCE.NORM( $\alpha$ ,  $\sigma$ , n)



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$$\bar{x} - \left| z_{\alpha/2} \right| \frac{\sigma}{\sqrt{n}} < \mu < \bar{x} + \left| z_{\alpha/2} \right| \frac{\sigma}{\sqrt{n}}$$

A green checkmark is placed above the first term of the interval. A red dashed line is drawn under the term  $\left| z_{\alpha/2} \right| \frac{\sigma}{\sqrt{n}}$ , with a red arrow pointing up to it from the text below.

margin of error = CONFIDENCE.NORM( $\alpha$ ,  $\sigma$ , n)



## Confidence Interval

A  $(1 - \alpha)$  confidence interval for the population mean...

$$\underbrace{\bar{x} - |z_{\alpha/2}| \frac{\sigma}{\sqrt{n}}}_{\text{Lower limit}} < \mu < \underbrace{\bar{x} + |z_{\alpha/2}| \frac{\sigma}{\sqrt{n}}}_{\text{Upper limit}}$$



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$$\bar{x} - |z_{\alpha/2}| \frac{\sigma}{\sqrt{n}} < \mu < \bar{x} + |z_{\alpha/2}| \frac{\sigma}{\sqrt{n}}$$

A red dashed line is drawn under the minus sign in the first term, with a red arrow pointing up to it.



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$$\bar{x} - \underset{\substack{\text{---} \\ \uparrow}}{|z_{\alpha/2}|} \frac{\sigma}{\sqrt{n}} < \mu < \bar{x} + |z_{\alpha/2}| \frac{\sigma}{\sqrt{n}}$$

When the population standard deviation ( $\sigma$ ) is not known,

- we replace it by the **sample standard deviation ( $s$ )**
- The z-statistic ( $z_{\alpha/2}$ ) gets replaced by the **t-statistic ( $t_{\alpha/2}$ )**

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$$\bar{x} - |t_{\alpha/2}| \frac{s}{\sqrt{n}} < \mu < \bar{x} + |t_{\alpha/2}| \frac{s}{\sqrt{n}}$$

When the population standard deviation ( $\sigma$ ) is not known,

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$\uparrow$   
 $t_{\alpha/2} = \text{T.INV}(\alpha/2, n-1)$



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# Confidence Interval

## Example

A person wishes to explore the size of single family houses that are typically available for purchase in a particular neighborhood of Houston in Texas. She manages to get hold of a list containing house sizes of a sample of 100 houses that were sold in the past two years.

The data is provided in the excel data file Home\_Sizes.xlsx, and given this data she wishes to assess the average size of houses typically available for purchase in this neighborhood.

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A 95% confidence interval for the average (population mean) house size:

**[3048.2, 3428.3] square feet**