



# Understanding Confidence Intervals

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# Understanding Confidence Intervals

- How to **interpret** confidence **intervals**?
- What does that **confidence level** really mean?
- What if we want to be **99% confident** instead?

# Car Seats for Toddlers Example

In a sample of 659 parents with a toddler, 540 (or **85%**) stated they **use a car seat** for all travel with their toddler.



95% confidence interval:  
**(0.8227, 0.8773) or about 82.3% to 87.7%**

Confidence Interval for \_\_\_\_???

We make a confidence interval for a parameter.

parameter

OR

statistic

# Car Seats for Toddlers Example



**(0.8227, 0.8773)** is a confidence interval for the  
**POPULATION PROPORTION**  
of all parents with toddlers who report  
they use a car seat for all travel with their toddler

Just reporting interval with **good context**  
**Improve?** more of interpretation that conveys  
is an estimate based on data, with confidence  
level

# Interpreting the Confidence Interval

We estimate, with 95% confidence, the population proportion of parents with toddlers who report they use a car seat for all travel with their toddler is somewhere between 0.8227 and 0.8773.

**OR**

Based on our sample of 659 parents with toddlers, with 95% confidence, we estimate between 82.3% and 87.7% of all such parents report they use a car seat for all travel with their toddler



# Think About It ...

Does our confidence interval of  $(0.8227, 0.8773)$  contain the ***sample proportion*** of parents with toddlers who report they use a car seat for all travel with their toddler?

**Yes**, it most certainly does ... our interval is centered at that sample proportion of 0.85 or 85%.

# Think About It ...

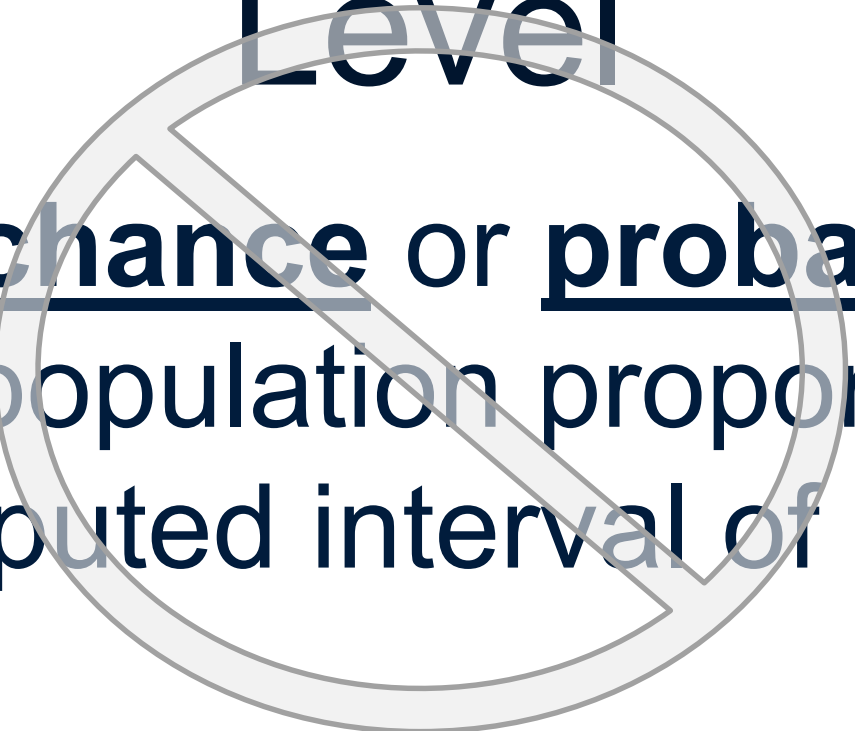
Does our confidence interval of  $(0.8227, 0.8773)$  contain the ***population proportion*** of parents with toddlers who report they use a car seat for all travel with their toddler?

**We Don't Know...**



# **Wrong** Understanding of Confidence Level

**95% chance or probability**  
that the population proportion is in  
this already computed interval of (0.8227, 0.8773)



# Correct Understanding of Confidence Level

95% confidence level refers to our **confidence in the statistical procedure** that was used to make this interval

# Understanding Confidence Level

**True Proportion**

0.01 0.5 0.99

0.01 0.11 0.21 0.31 0.41 0.51 0.61 0.71 0.81 0.91 0.99

Note: We generally do not know the True Proportion but we get to set the value here to see how well the confidence interval estimation process works

**Enter Your Sample Size ( $\geq 10$ )**

25

**What Confidence Level do you want to use?**

0.9 0.95 0.99

0.9 0.91 0.92 0.93 0.94 0.95 0.96 0.97 0.98 0.99

**How Many Confidence Interval Should We Make?**

10 100 200

10 29 48 67 86 105 124 143 162 181 200

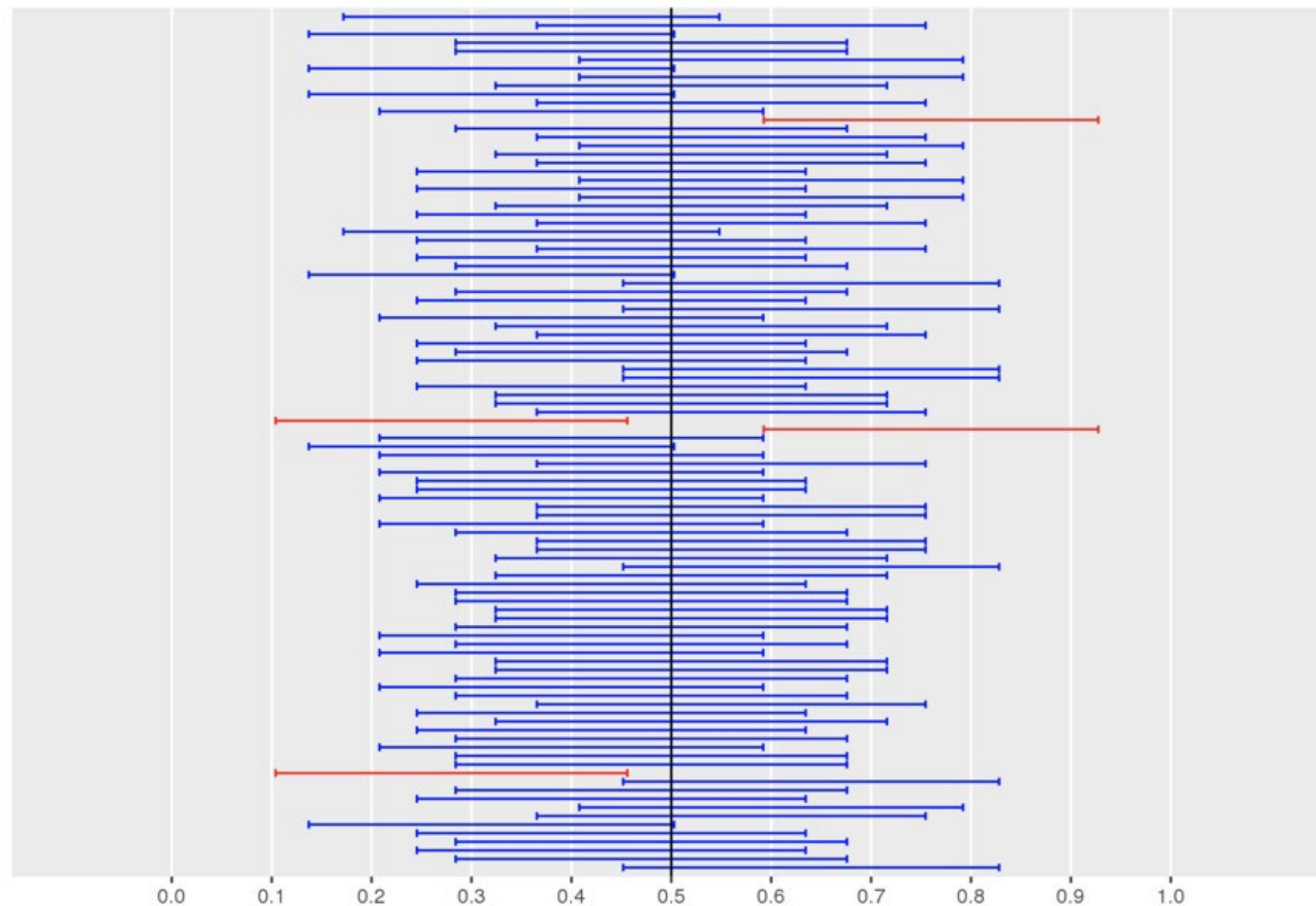
**Create Confidence Intervals**

Population Proportion = 0.50

Take 100 samples each of size 25

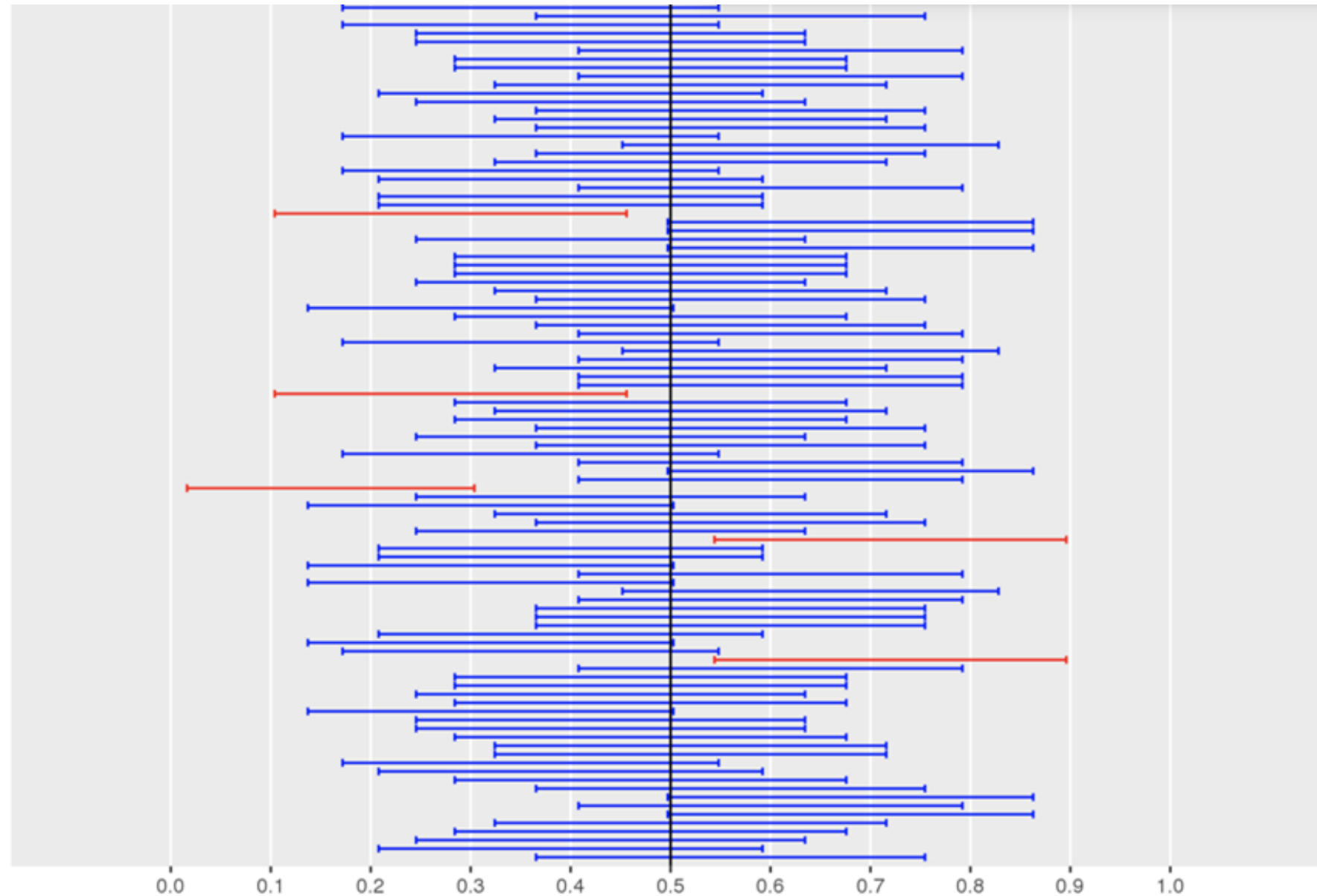
For each sample, create a 95% confidence interval for the population proportion

# Understanding Confidence Level



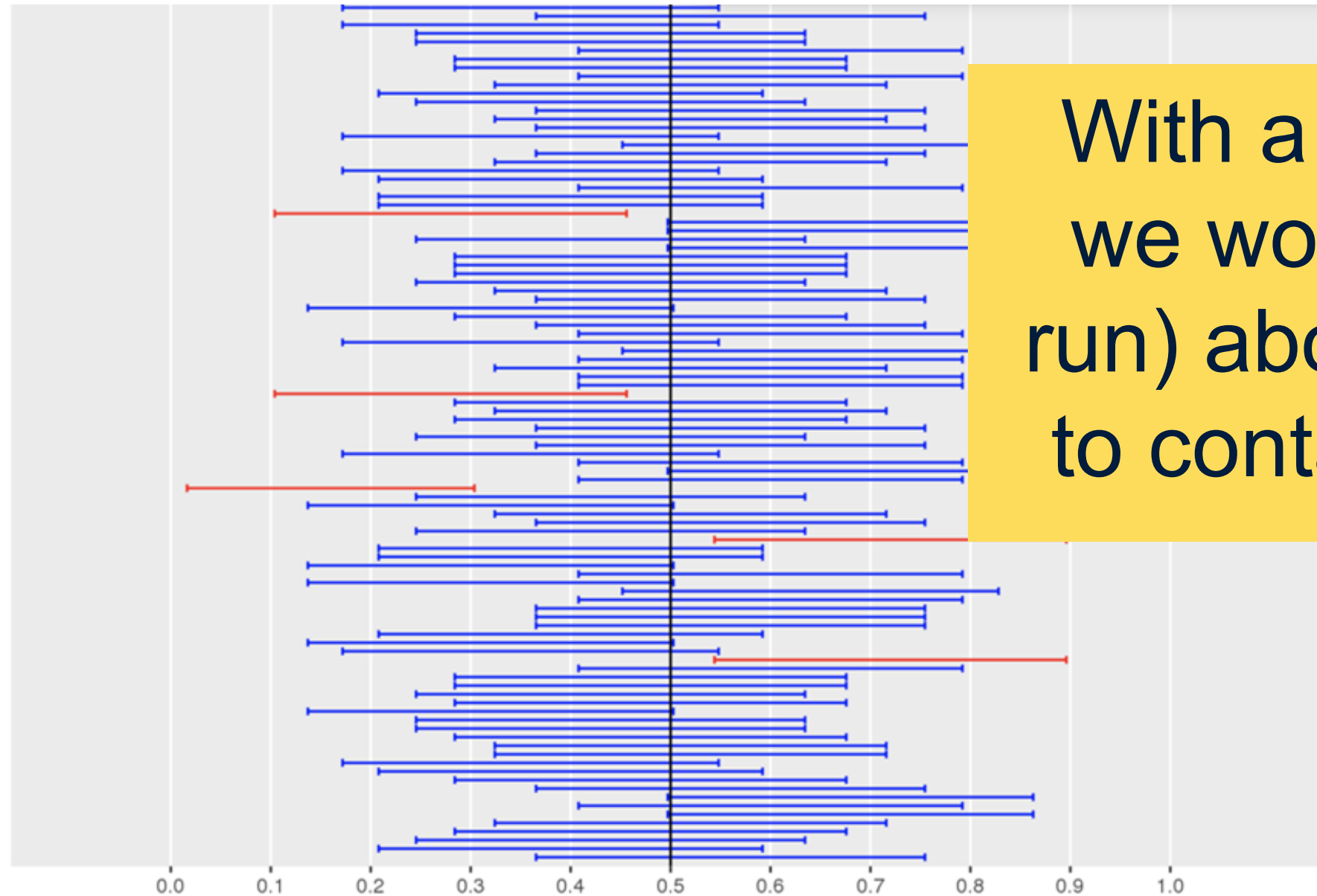
**96** of these **100**  
generated  
intervals  
**did** contain the true  
proportion of **0.5**  
while **4** did not.

# Understanding Confidence Level



**95** of these **100**  
generated  
intervals  
**did** contain the true  
proportion of **0.5**  
while **5** did not.

# Understanding Confidence Level



With a **95%** confidence level, we would expect (in the long run) about **95%** of the intervals s to contain the true proportion.

# Different Z Multipliers

<b>90%</b>	<b>95%</b>	<b>98%</b>	<b>99%</b>
<b>1.645</b>	<b>1.96</b>	<b>2.326</b>	<b>2.576</b>

**Best Estimate  $\pm$  Margin of Error**

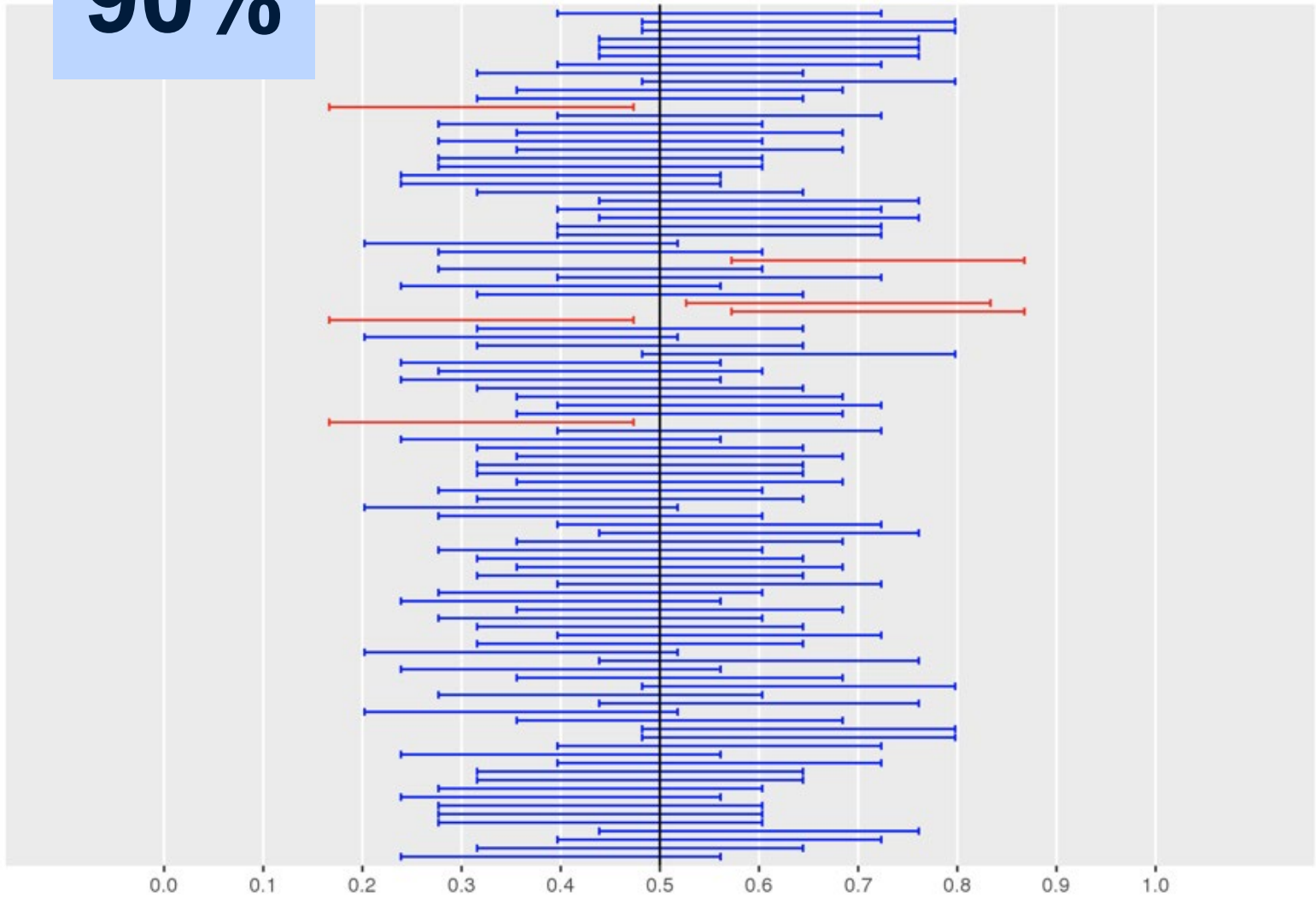
**Best Estimate  $\pm$  “a few” (estimated) standard errors**

**More confident  $\rightarrow$  Larger Multiplier  $\rightarrow$  Wider Interval**

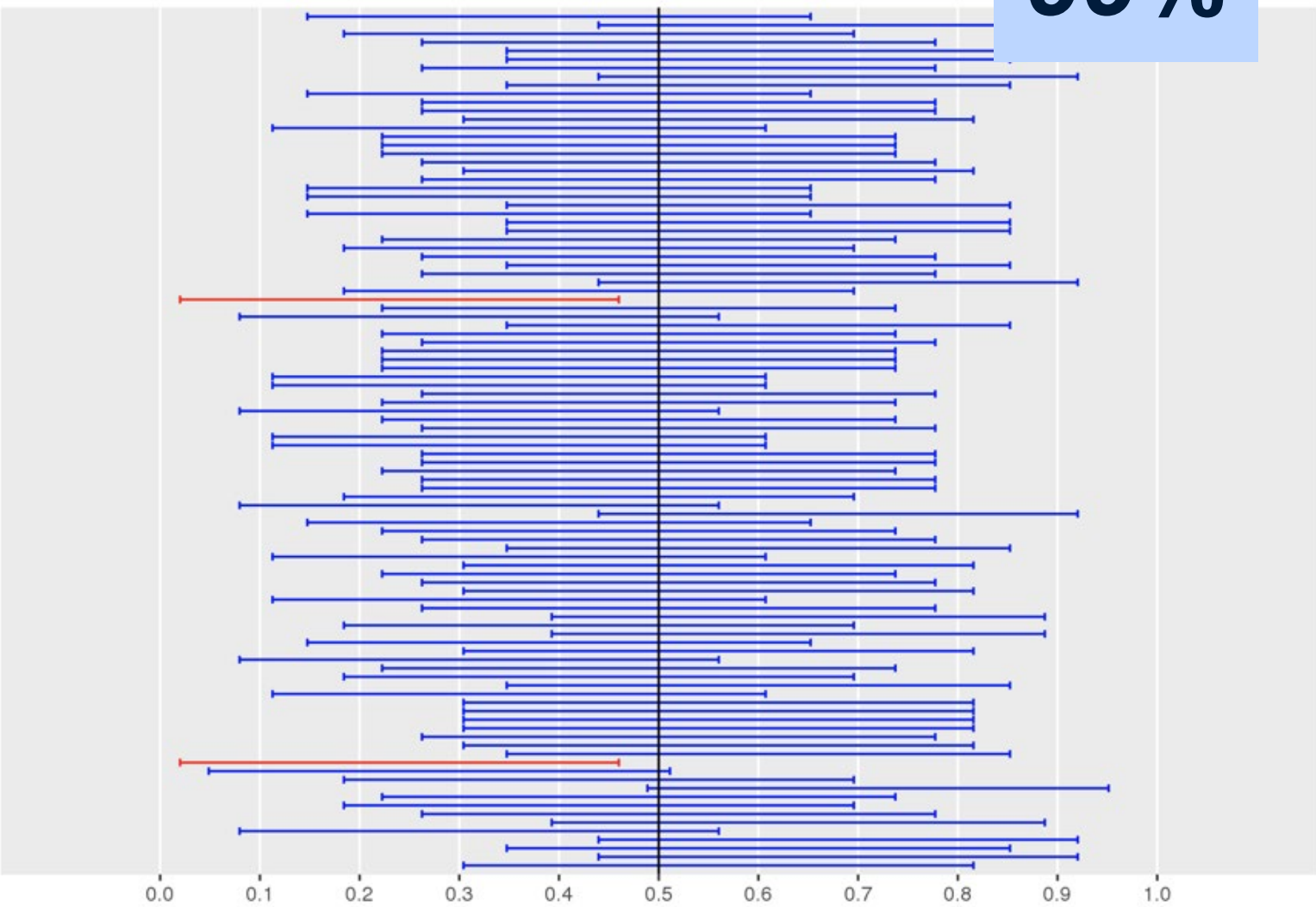


# Changing Confidence Level

90%



99%



# Car Seats for Toddlers Example

In a sample of 659 parents with a toddler, 540 (or **85%**) stated they **use a car seat** for all travel with their toddler.



**90% CI:**  
 **$0.85 \pm 0.0229$**   
**82.7% to 87.3%**

**95% CI:**  
 **$0.85 \pm 0.0273$**   
**82.3% to 87.7%**

**99% CI:**  
 **$0.85 \pm 0.0358$**   
**81.4% to 88.6%**

# Understanding Confidence Intervals

- We know how to **interpret** confidence **intervals**
- We understand what that **confidence level** really means
- We have options for the desired **confidence level**