You may have seen or heard of confidence intervals before.

However, if you're not very confident about them, then you're not alone.

Many people misunderstand confidence intervals, but that's only because they didn't learn about bootstrapping first...

Bootstrap Refresher!

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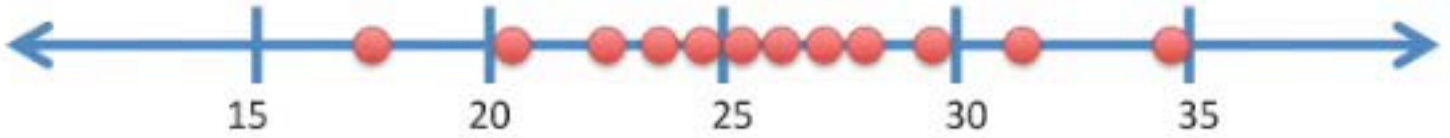

Imagine we weighed a bunch of female mice...

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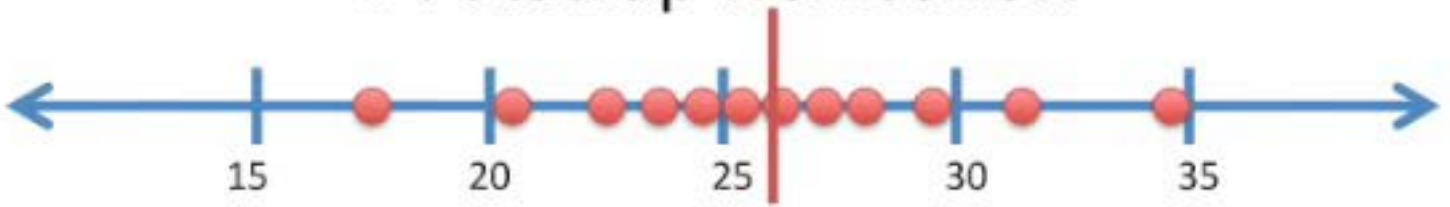

Imagine we weighed a bunch of female mice...

Calculate the the mean...

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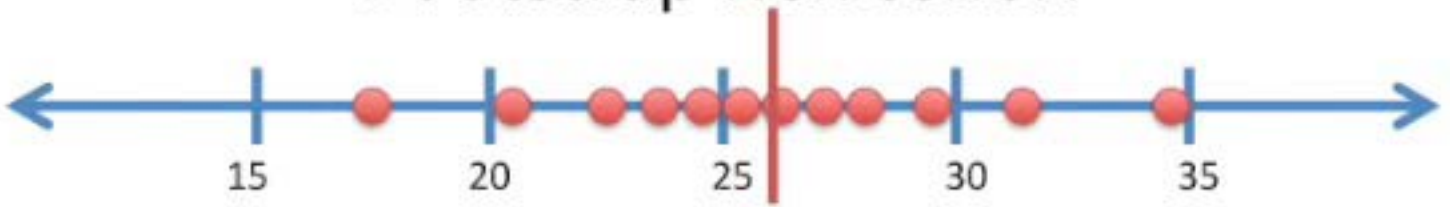
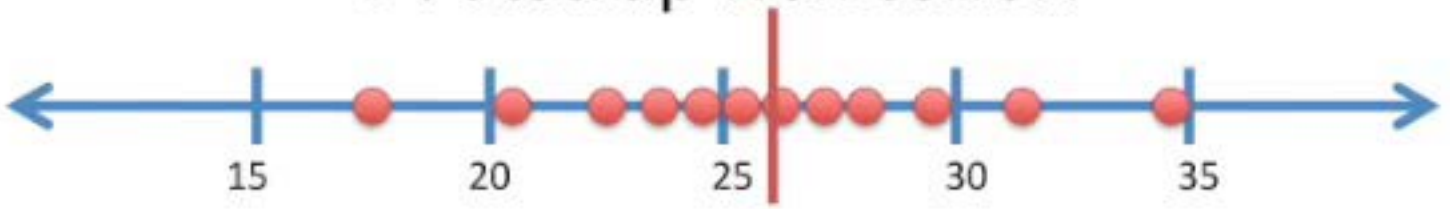


Imagine we weighed a bunch of female mice...

Calculate the the mean...

Now bootstrap the sample...

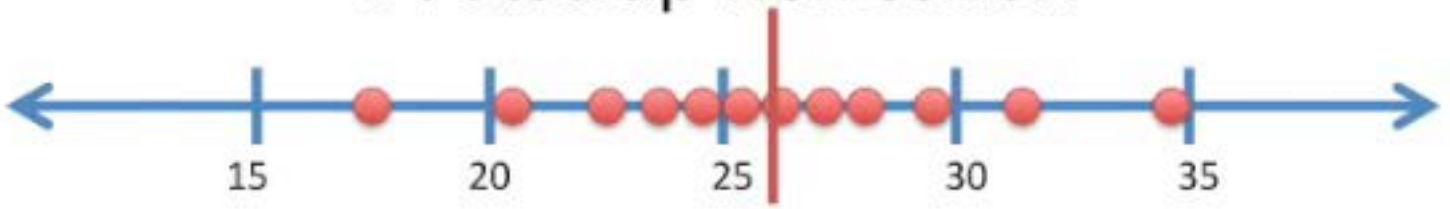
Bootstrap Refresher!



To bootstrap this sample of 12 weights:

1) Randomly select 12 weights from the original sample (duplicates are OK).

Bootstrap Refresher!



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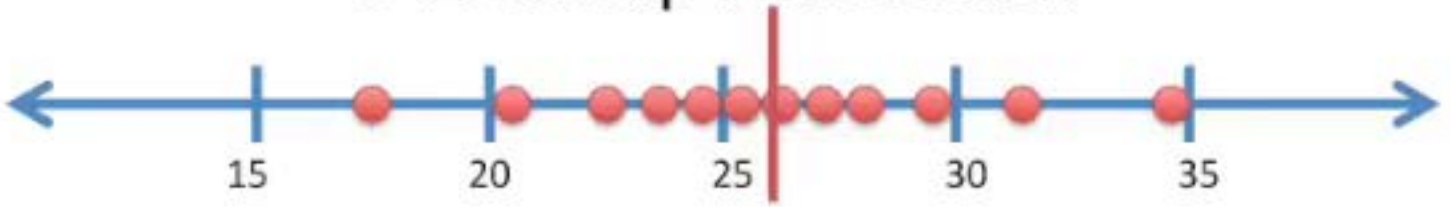

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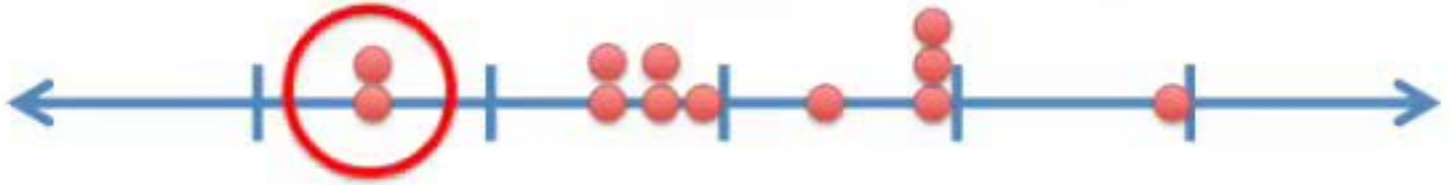

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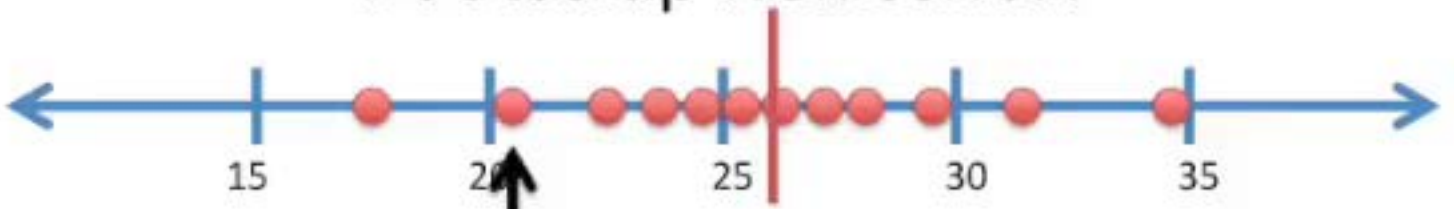

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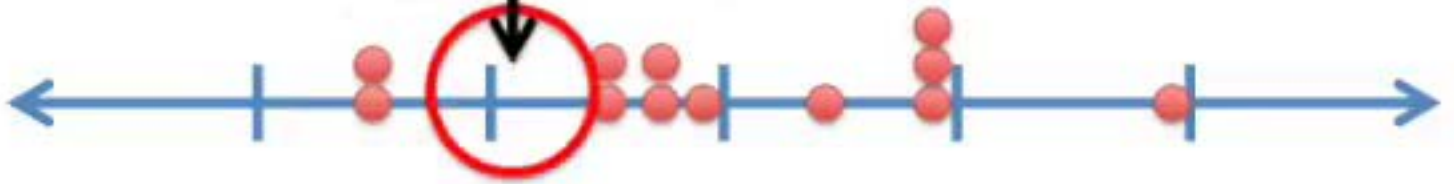

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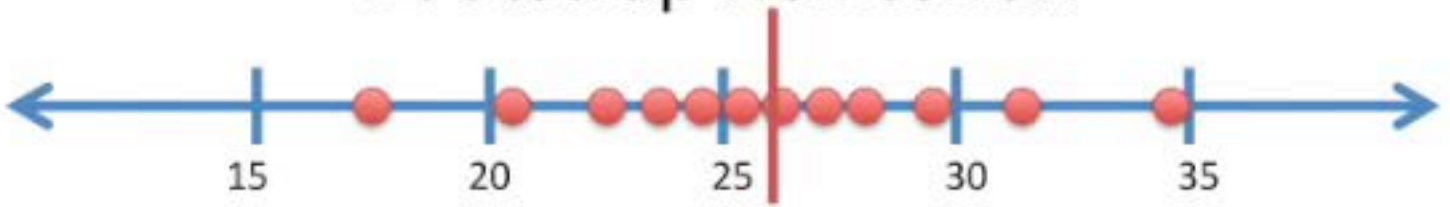

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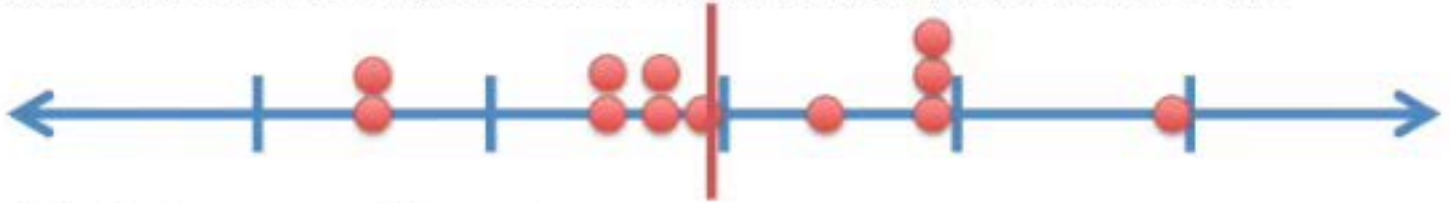

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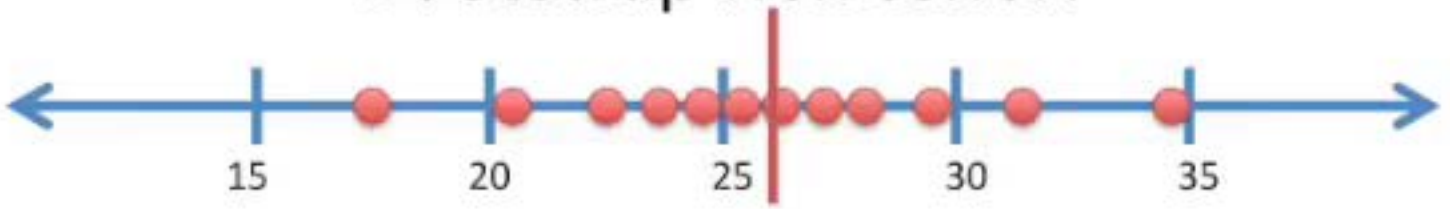

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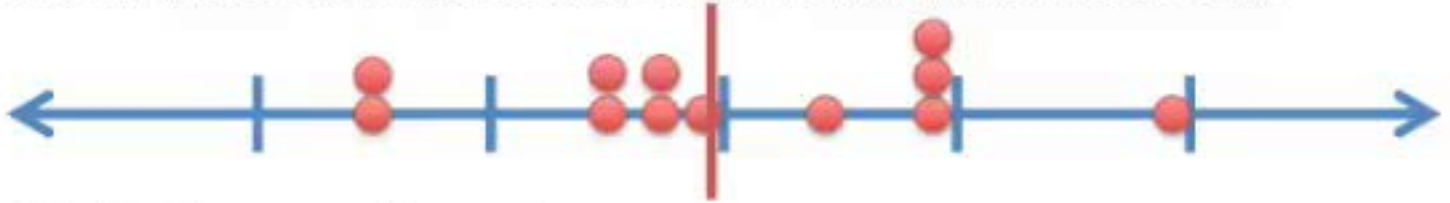

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3) Repeat steps 1 and 2 until you have calculated a lot of means (>10,000)

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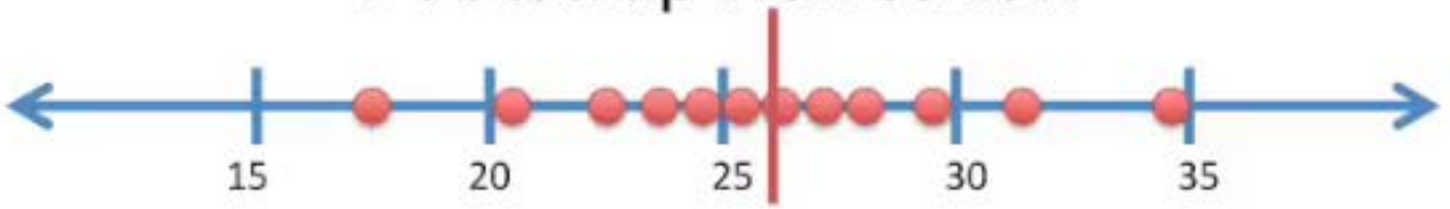

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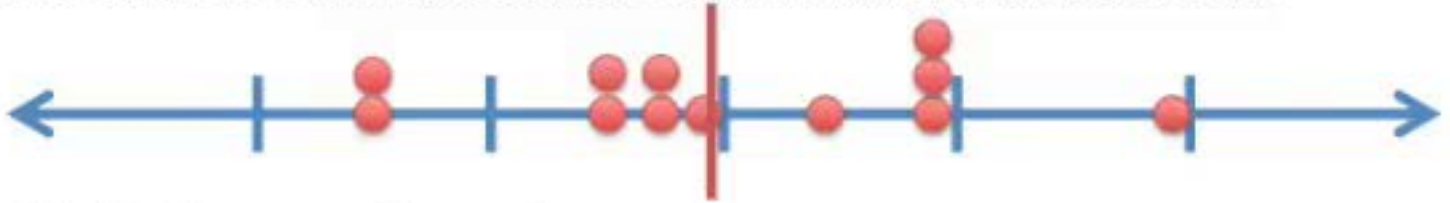

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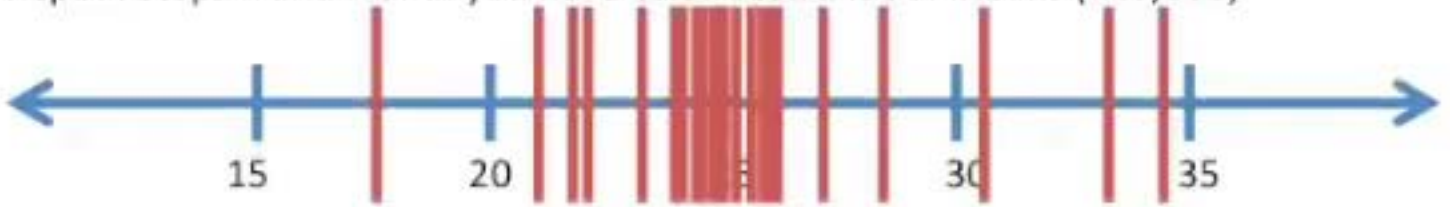

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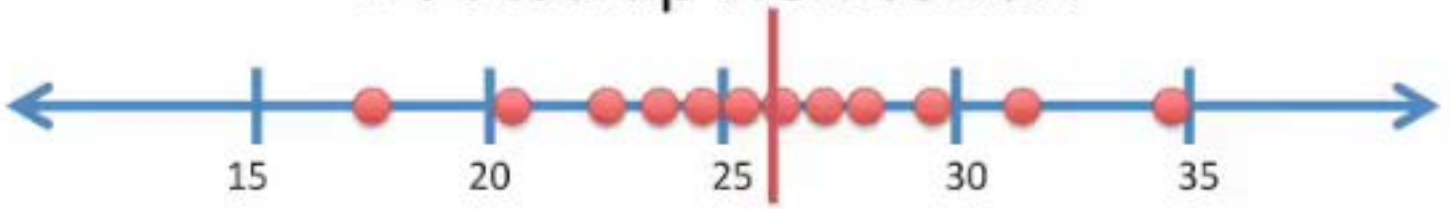

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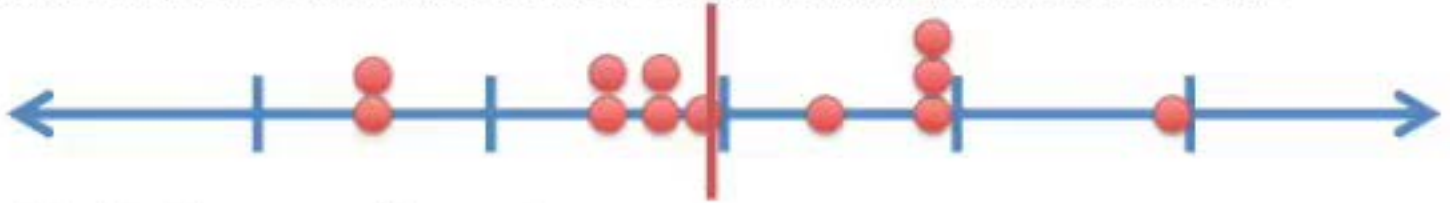

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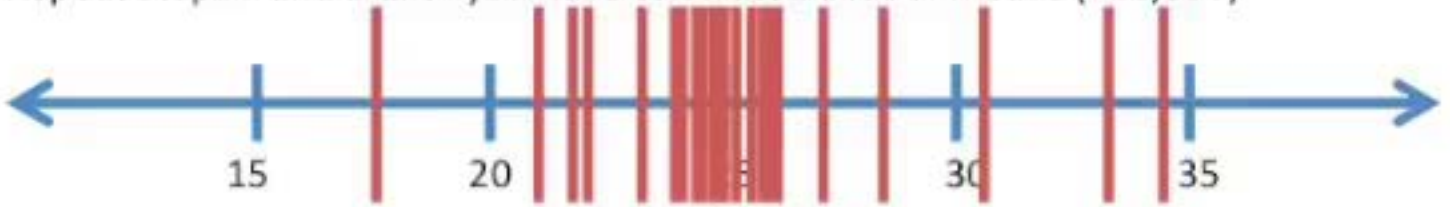
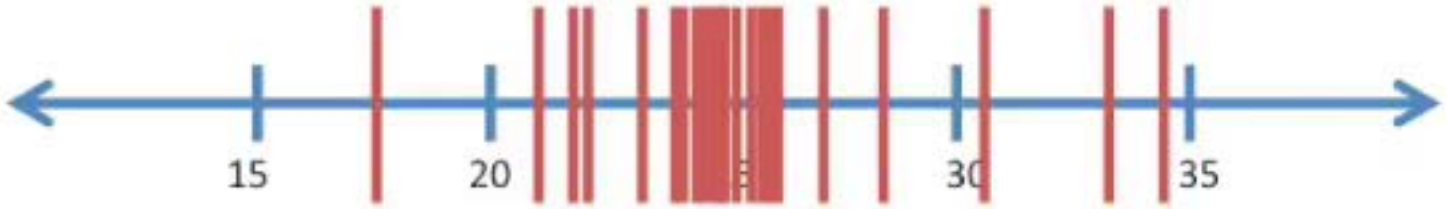


That's all there is to it!

95% Confidence Intervals



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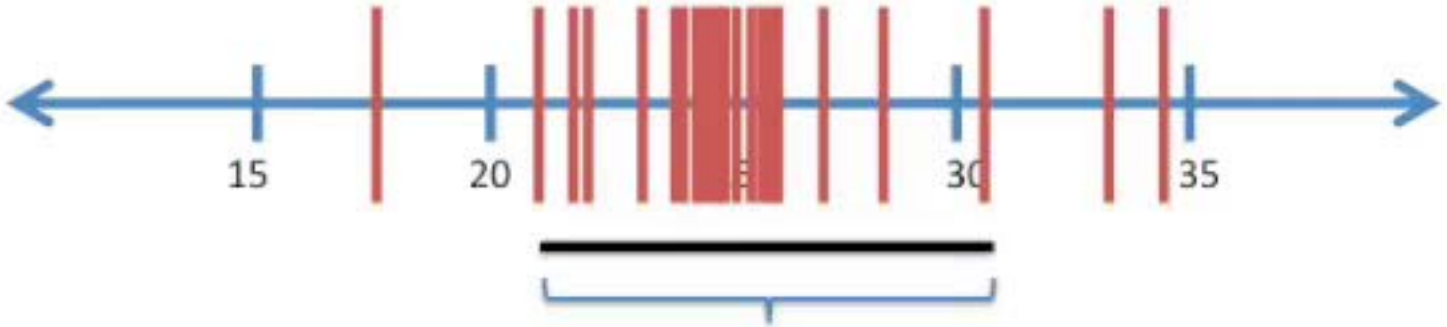
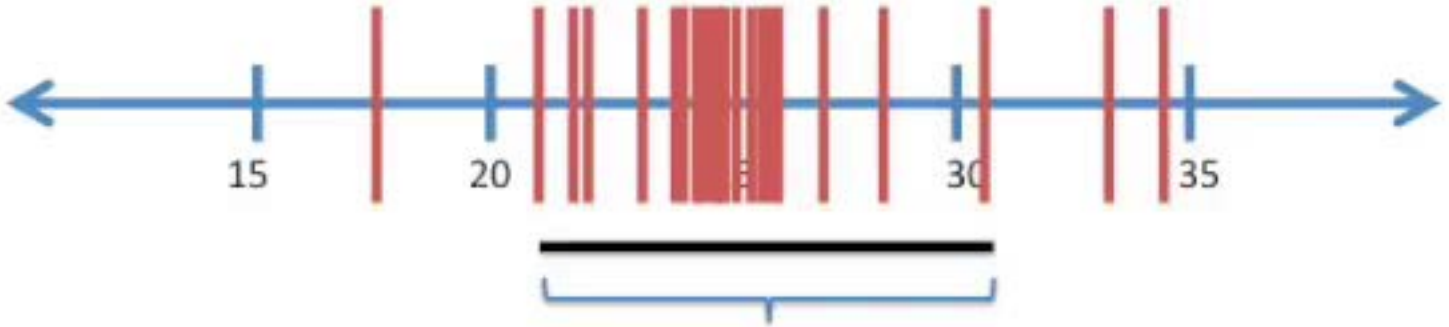


A 95% confidence interval is just an interval that covers 95% of the means.

95% Confidence Intervals



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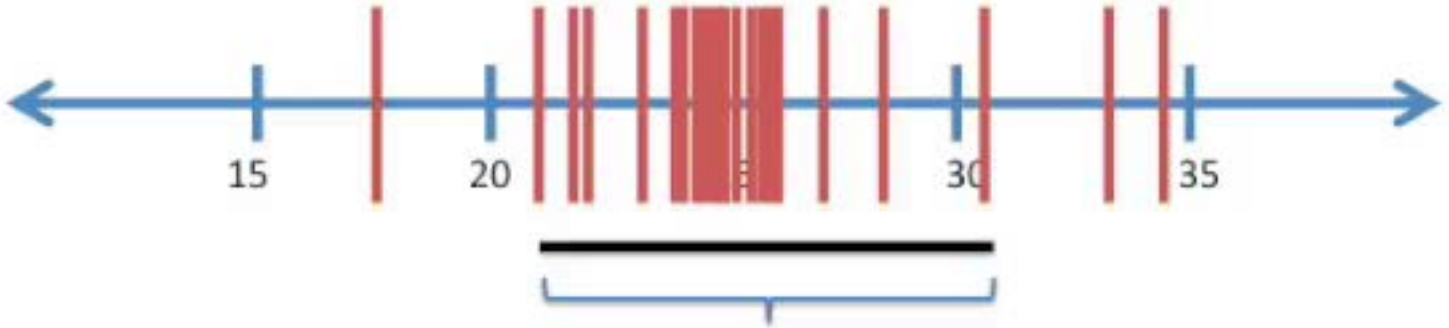

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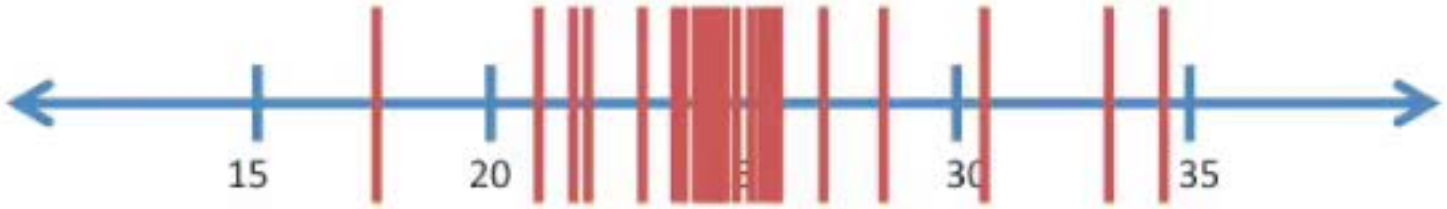
Can you guess what a 99% confidence interval is?

95% Confidence Intervals



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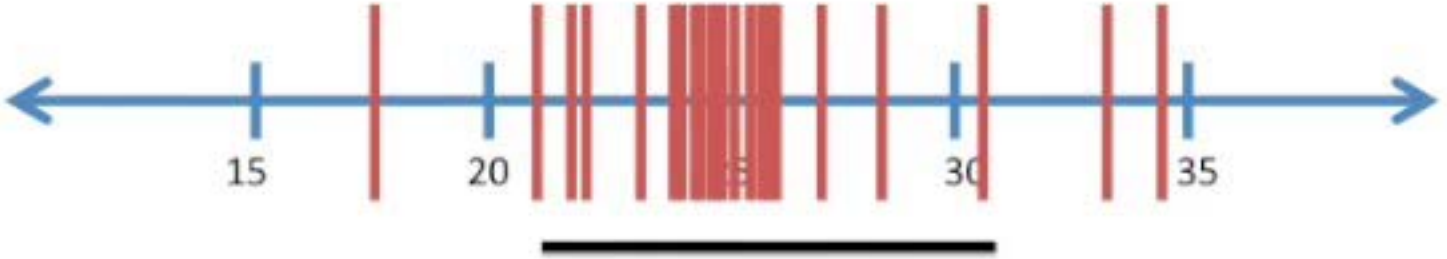
Can you guess what a 99% confidence interval is?

(hint)

Why are confidence intervals useful?

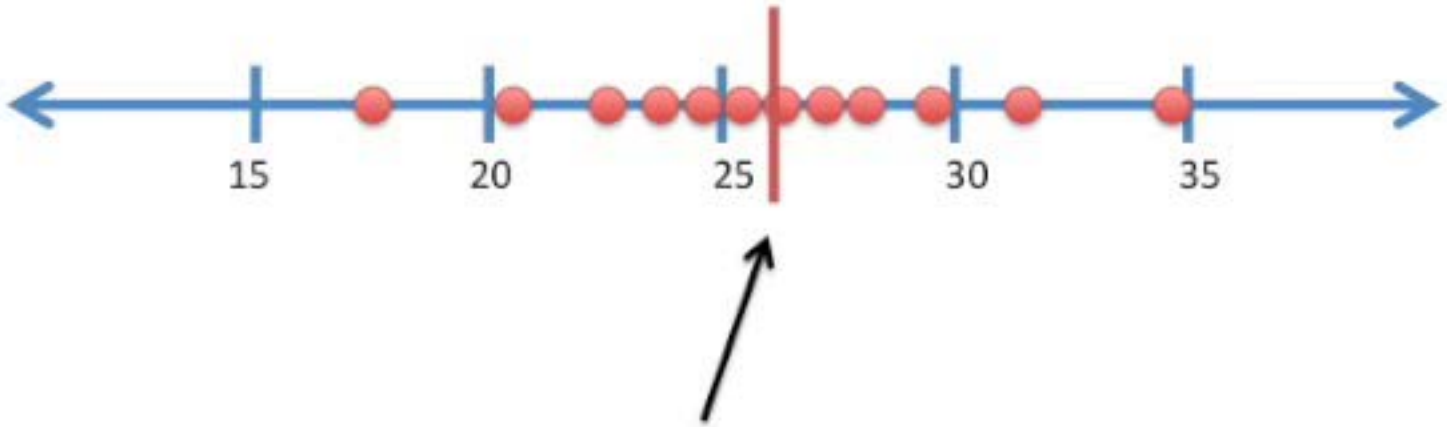
Confidence intervals are statistical tests performed visually.



Because the interval covers 95% of the means, we know that anything outside of it occurs less than 5% of the time.

That is to say, the p-value of anything outside of the confidence interval is < 0.05 (and thus, significantly different).

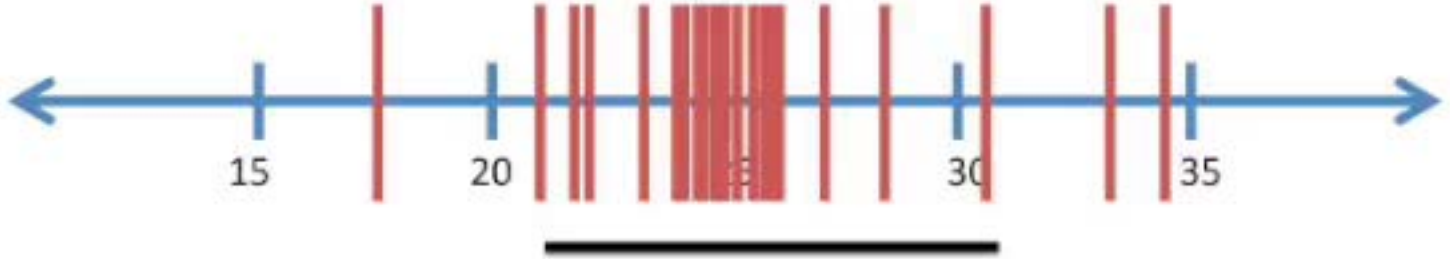
Visual Statistical Tests



This is the sample mean, it is an estimate of the "true" mean for all female mice.

Visual Statistical Tests

What is the p-value that the "true" mean of all female mice, not just our sample, is < 20?



The 95% confidence interval tells us which values the "true" mean are likely and which values are unlikely.

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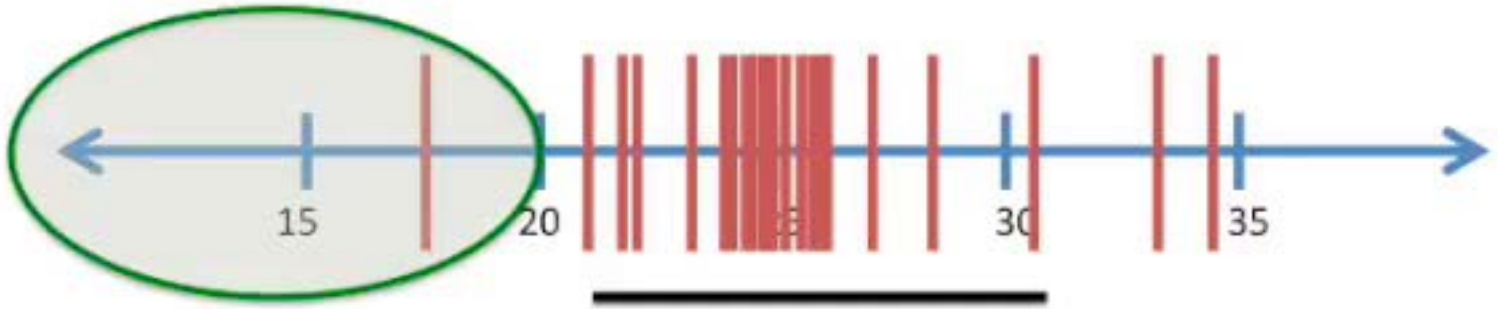

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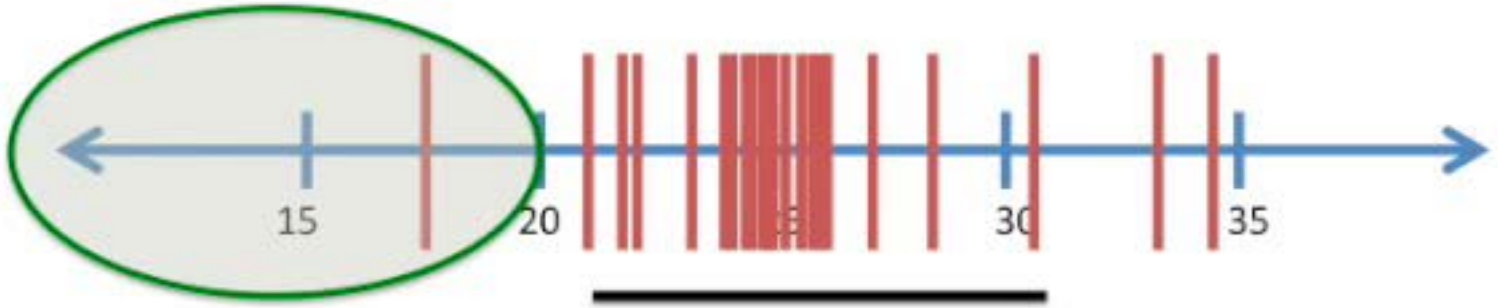

Because the highlighted region is outside of the 95% confidence interval, which contains 95% of the means, we know that the probability that the "true" mean is in this area has to be < 0.05. Thus…

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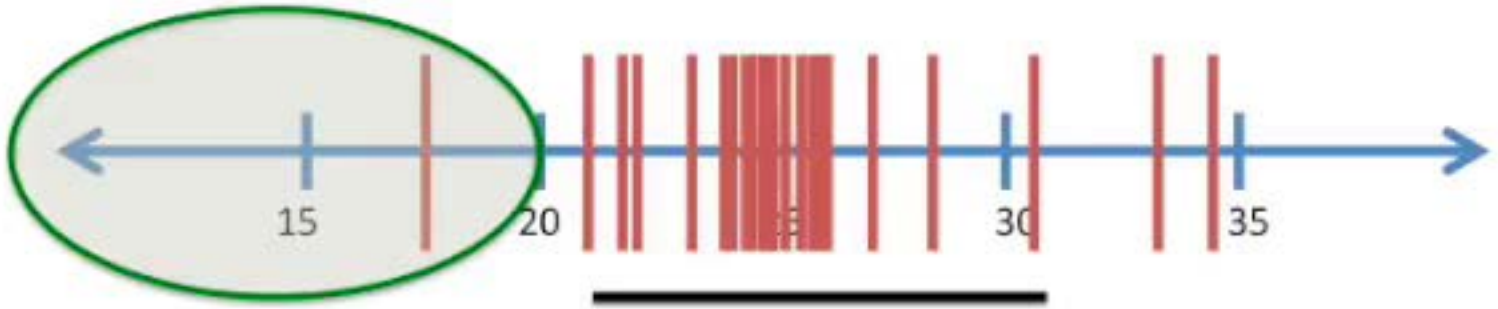

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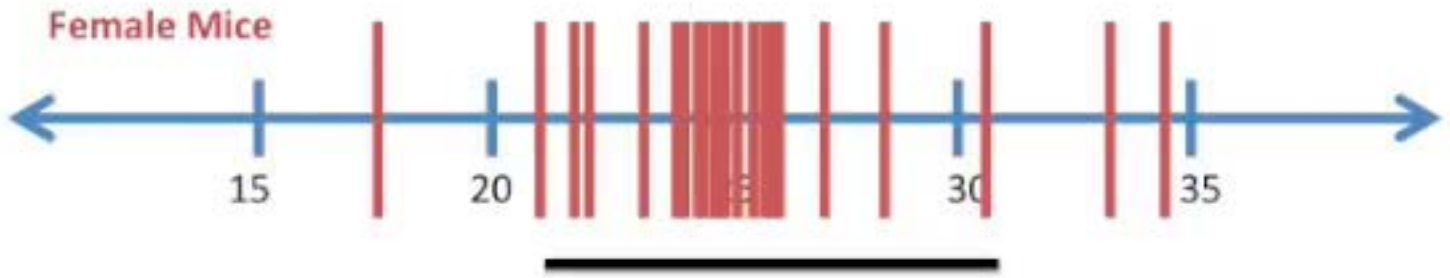
The p-value < 0.05 - This is unlikely and we say there is a statistically significant difference.

Visual Statistical Tests – compare two samples



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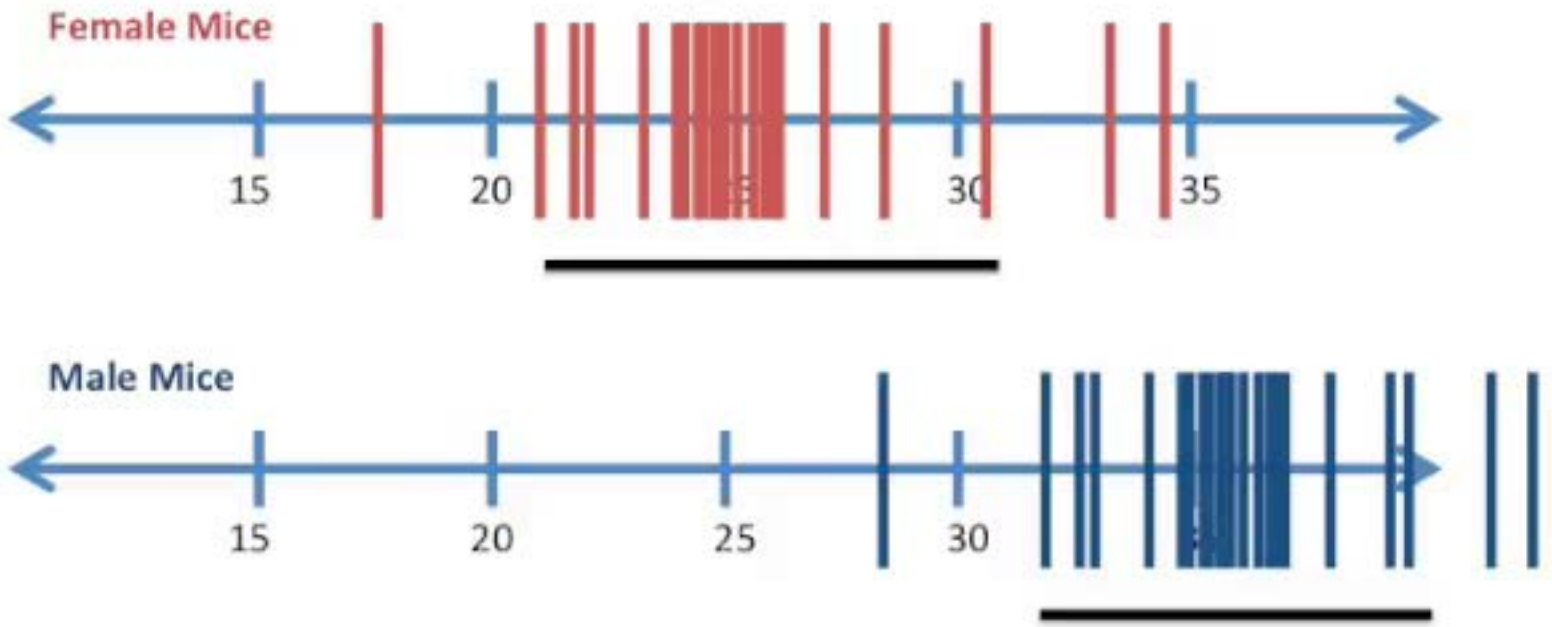

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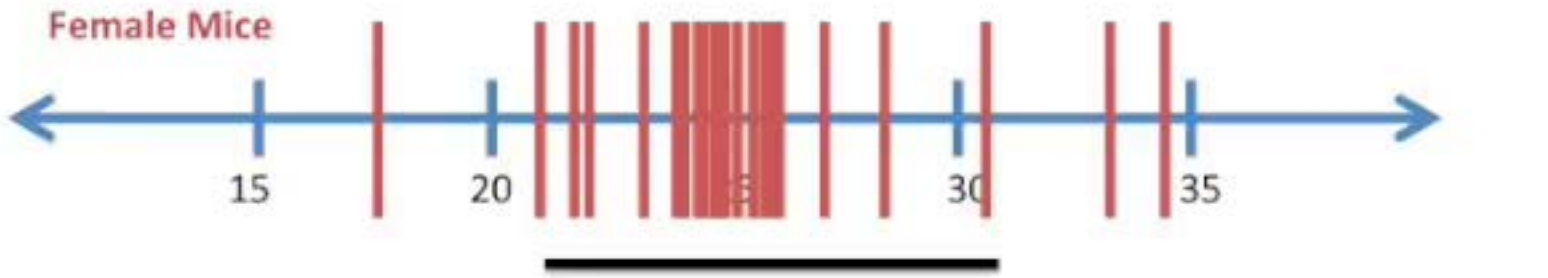
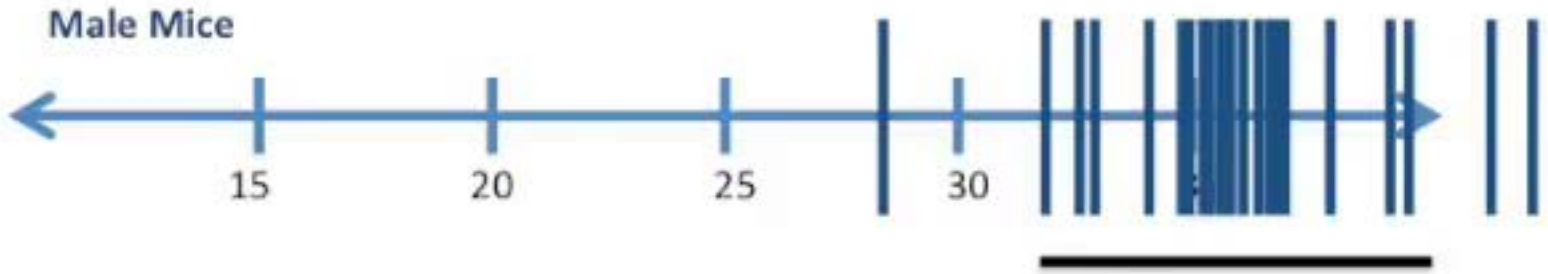
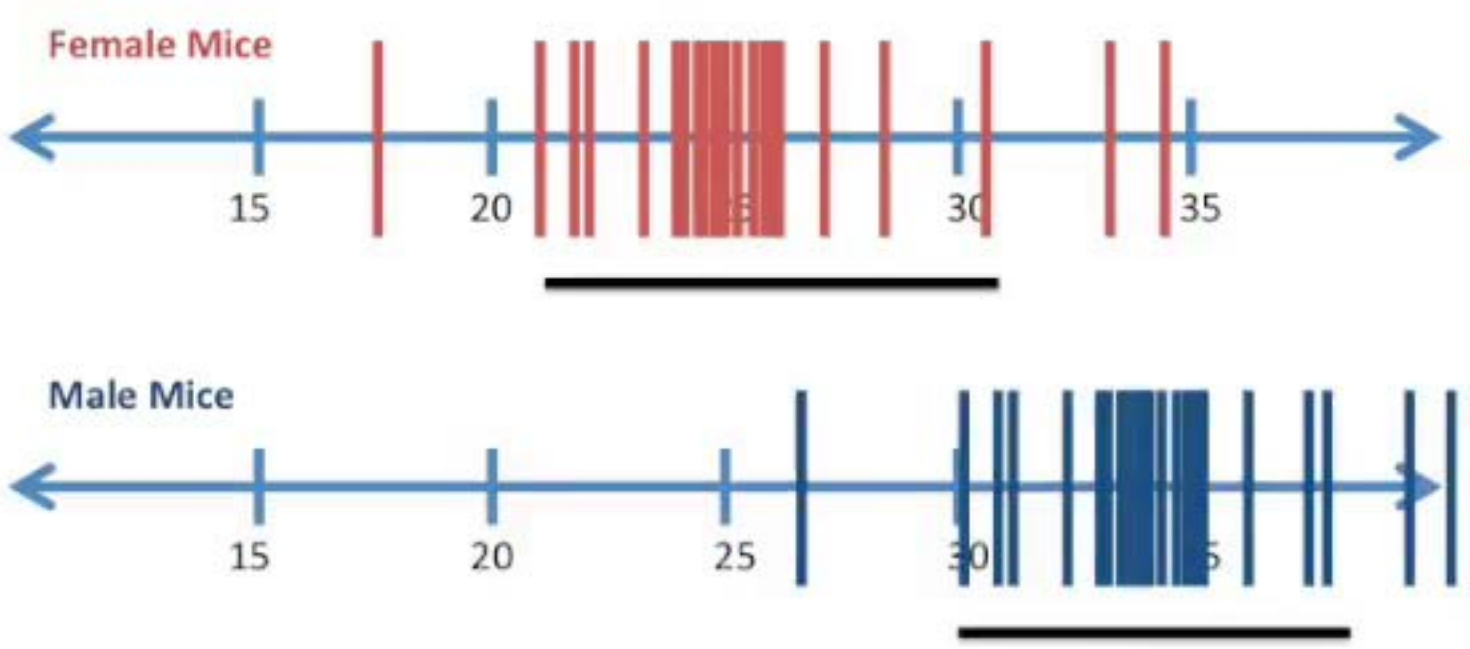




Because the 95% confidence intervals do not overlap, we know that there is a statistically significant difference in the weights of female and male mice.

You know the p-value is < 0.05 just by looking at this picture!

Visual Statistical Tests – One Caveat



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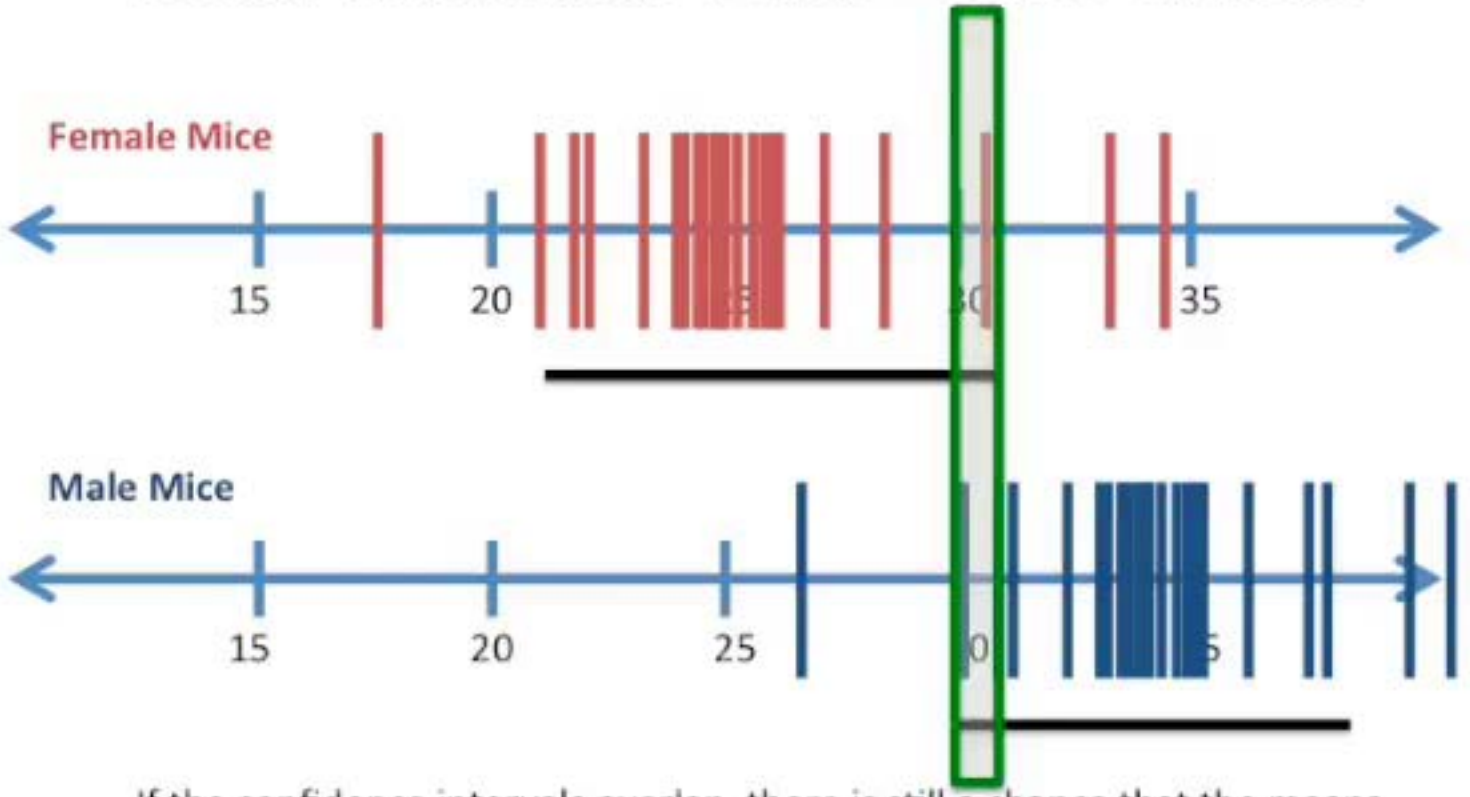

If the confidence intervals overlap, there is still a chance that the means are significantly different from each other, so, in this case, you still have to do your t-test...