Confidence Intervals
by Statquest

understanding CIs through bootstrapping

bootstrap refresher
take a sample and find a mean (for example n=12)
for simplicity sake say the sample was 1 to 12
then randomly take a sample from the sample
here we will use sampling with replacement
this means that if the 12 components of the sample were in a bag
we shake up the bag and blindly pull a number (for our example we'll say that we
pick 2)
2 would be the first component of our sample
we then would put the 2 back in the bag
this means that when we go to pull our 2nd component of the sample
2 has equal chance of being pulled as all the other components in the bag
example our first bootstrap sample may look like this
2,8,6,6,7,12,1,1,3,6,9,11
we would then calculate the mean of this sample
we would then repeat this process as much as planned within the problem

CIs are most commonly defined as 95%
what does this mean?
a 95% confidence interval is just an interval that covers 95% of the means
example
so if we had 100 bootstrap samples with 100 means
the CI bar would cover 95 of these 100 means
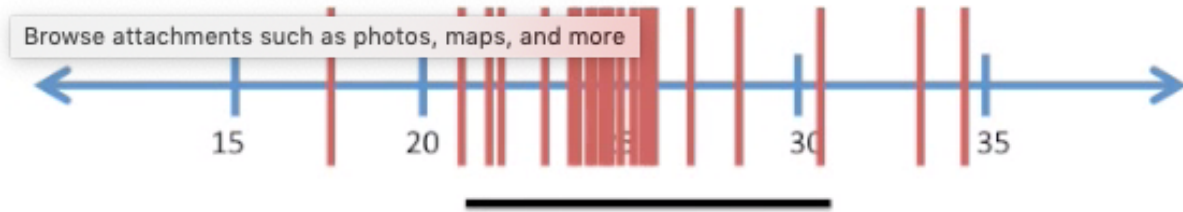so just transpose this mind set onto 90% CI or 99% CI
90 of 100 means
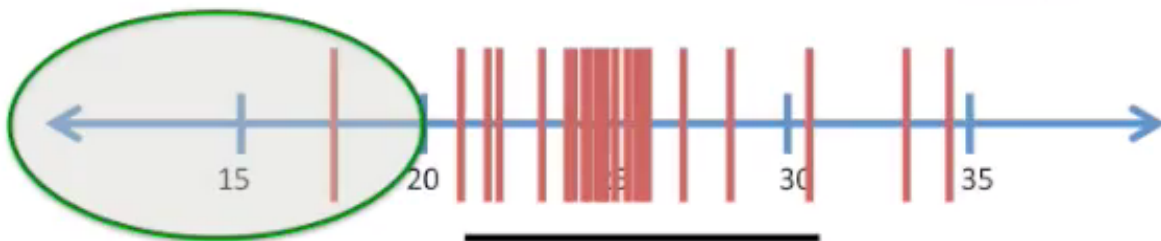or 99 of 100 means respectively

Why are CIs useful?
statistical tests performed visually
we know that everything outside of the bar is less than 5% of the sample
visual

the p-value is anything outside of the confidence interval
**ie significantly different

further understanding
here we are asking if the 'true' mean (ie the mean of the population) not just our sample is <20?
because the highlighted region is outside of the 95% CI, which contains 95% of the means, we know that the probability that the 'true' mean in this area has to be <0.05
for this example this is saying that the p-value is <0.05
or it is saying that the chance that the true mean is less than 20 is unlikely
**we are saying there is a statistically significant difference

How this can be powerful?
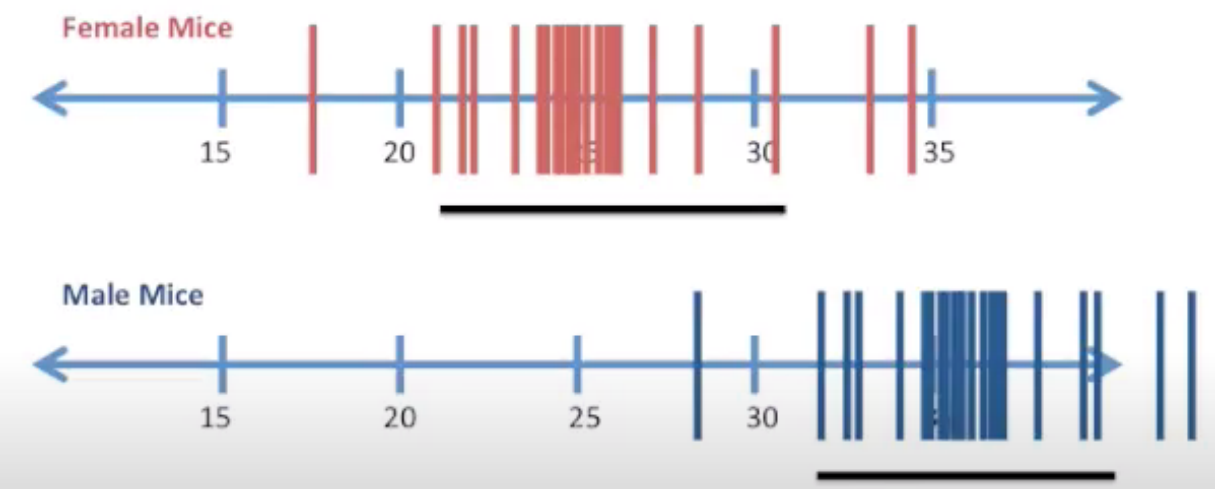
here both sample means were calculated using bootstrapping

remember bootstrapping is not the only way to confidence intervals
here is this visualization we note that both CIs do not overlap
so just by the visual we know that there is a statistically significant difference in the weights of female to male mice
*if CIs overlap the difference can still be statistically significant but you need to do a t-test to confirm
if there is no overlap you can be confident that the difference is statistically significant