Hw2 Review

CS100

Deflategate

Pressure Drops of: P1 P2 P3 P4 P5 P6 P7 P8 P9 P10 P11 and C1 C2 C3 C4

PATRIOTS' mean drop: 1.202 psi

COLTS' mean drop: 0.469 psi

Difference: 0.734 psi

The average pressure drops of the balls are different.
But is this difference statistically significant?

Deflategate

NULL HYPOTHESIS:
The Patriots' mean drop is larger than the Colts' due to chance variation alone.

ALTERNATIVE HYPOTHESIS:
The difference between the Patriots' mean drop and the Colts' mean drop is too large to be attributed to chance variation alone.

Deflategate

Pressure Drops of: C1 P2 P3 C4 P5 P6 P7 P8 P9 P10 P11 and P1 C2 P3 C4

Mean drop of FIRST 11: 0.9 psi

Mean drop of LAST 4: 0.85 psi

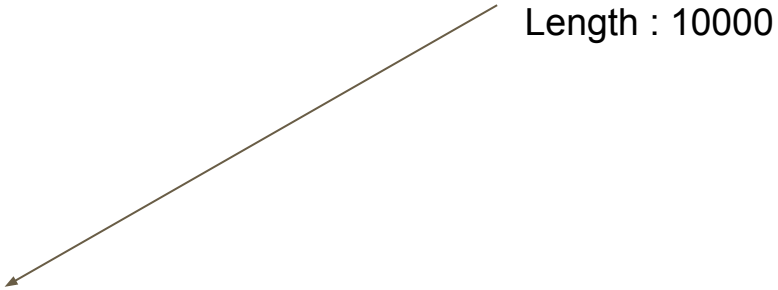
Difference: 0.05 psi (< 0.734 psi) ---> 0

Difference: 0.735 psi (>= 0.734 psi) ---> 1

X 10000 trials

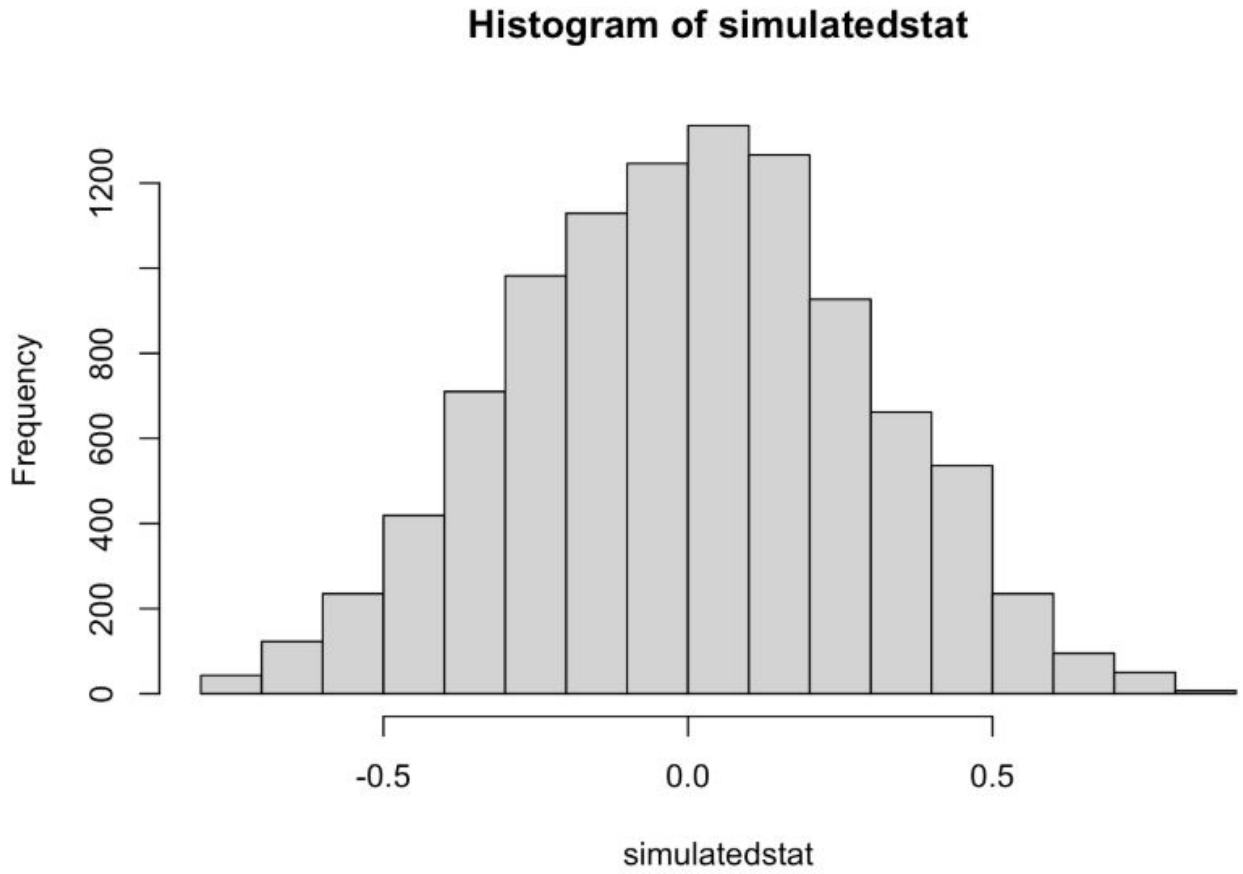
Deflategate

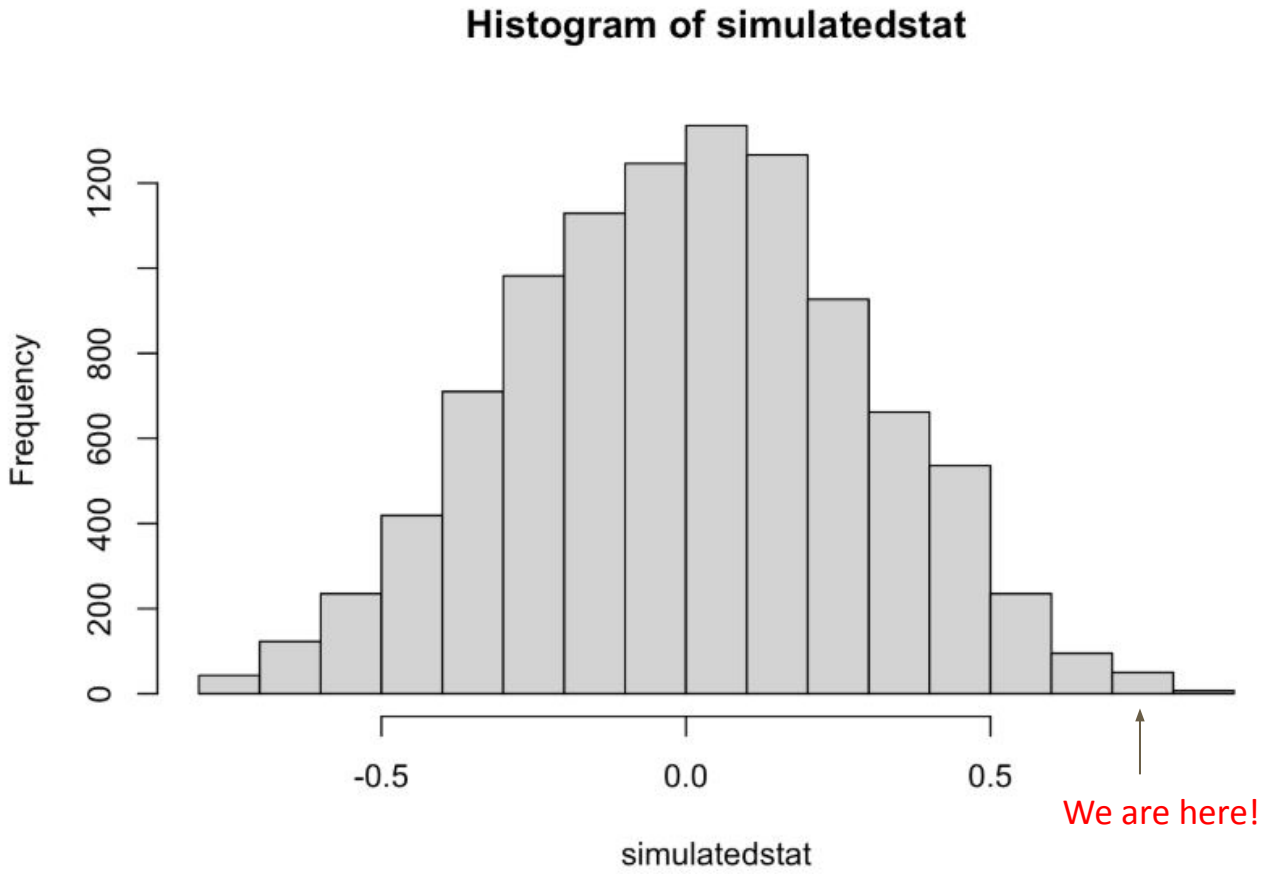
0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 0 1 1 1 1 1 .... 0 0 0 0 0 0 0 0 0 0 0 0 1 1 1



Sum of all the numbers above:

50 ⟶ pval = 0.005


Histogram of simulatedstat
Frequency
0
200
400
600
800
1200
-0.5
0.0
0.5
simulatedstat


Histogram of simulatedstat
Frequency
0
200
400
600
800
1200
-0.5
0.0
0.5
simulatedstat
We are here!

Another Example of a Permutation Test

Black Friday Prices

23.99 449.99 322.87 13.50 12.99 ..... /..... 76.89 129.99 49.99

Non-Black Friday Price

Black Friday Price

Approval Ratings

President	Approve	Disapprove	Sample Size
Trump	615	810	1500
Obama	600	795	1500
Bush Jr	900	555	1500
Clinton	690	660	1500
Bush Sr	1065	285	1500

Sampling Error: The error due to the unrepresentativeness of the taken sample.
Statistical Significance: Quantification of whether a result is due to mere luck.

Binomial Random Variable, *X*

X denotes the number of successes.

p is the success probability.

n is the number of Bernoulli trials.

The mean of *X*: *np*

The variance of *X*: *np(1-p)*

Sample Proportion Random Variable, X/n

X/n denotes the sample proportion.

p is the success probability.

n is the number of Bernoulli trials.

The mean of X/n: $np/n = p$

The variance of X/n: $1/n^2 \text{ Var}(X) = p(1-p)/n$

It's All About the Confidence!

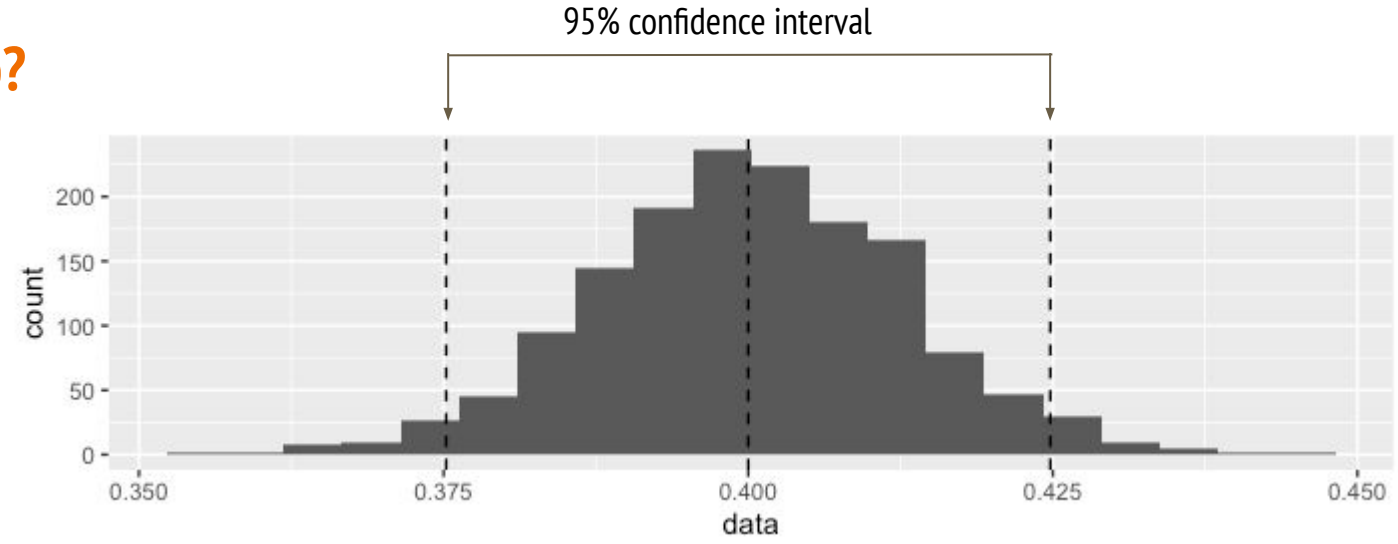
95 % Confidence Interval: Range of values one can be 95% confident contain the true mean of the population.

0.05 Significance Level: There is a 5% risk of rejecting the null hypothesis when it is true. In other words, concluding a difference exists, when it doesn't.

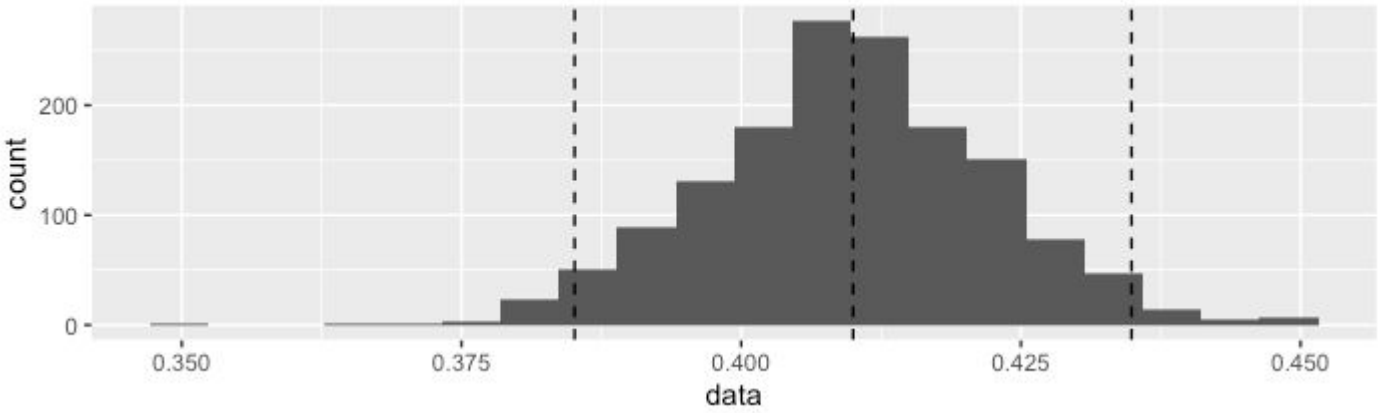
Trump and Obama

Do they overlap?

Obama:

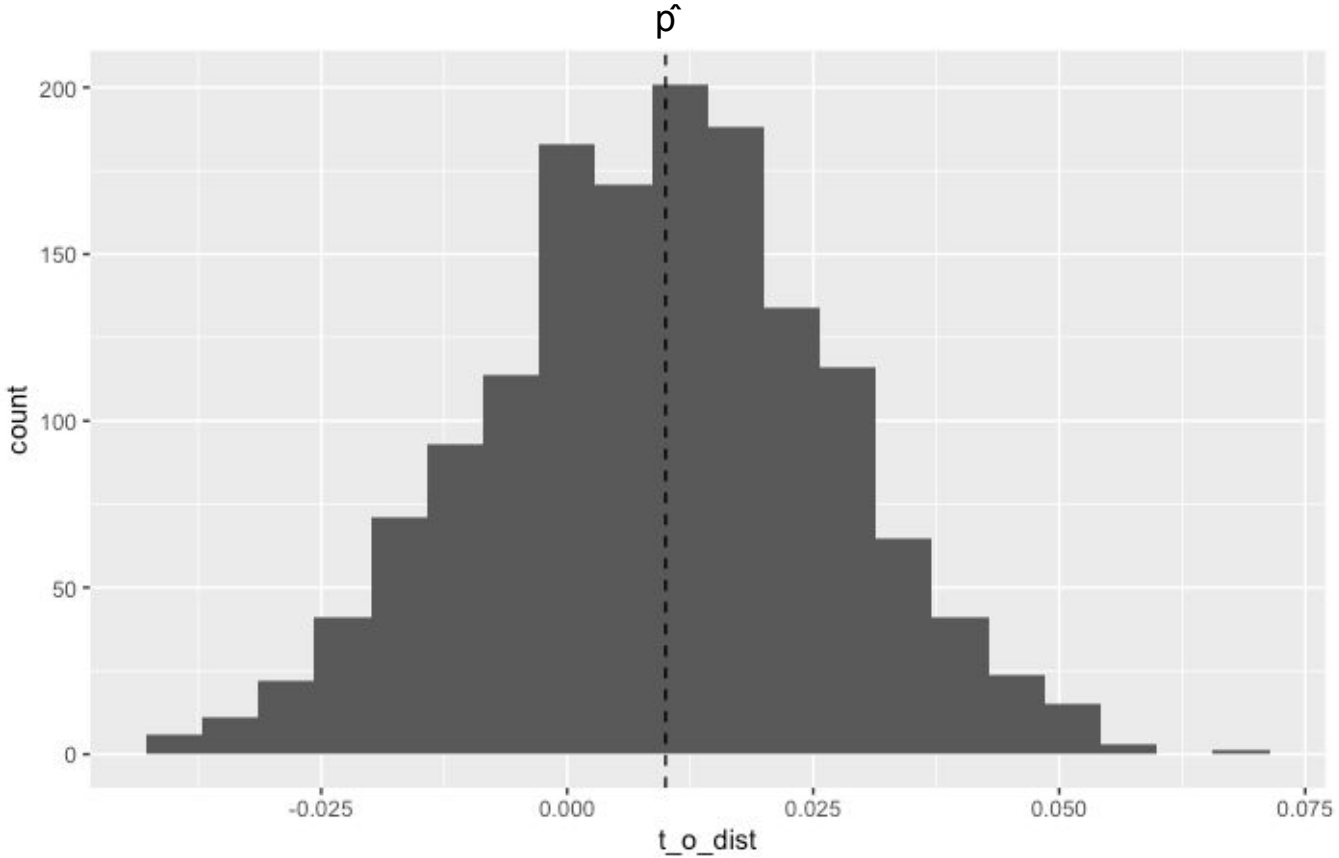


Trump:



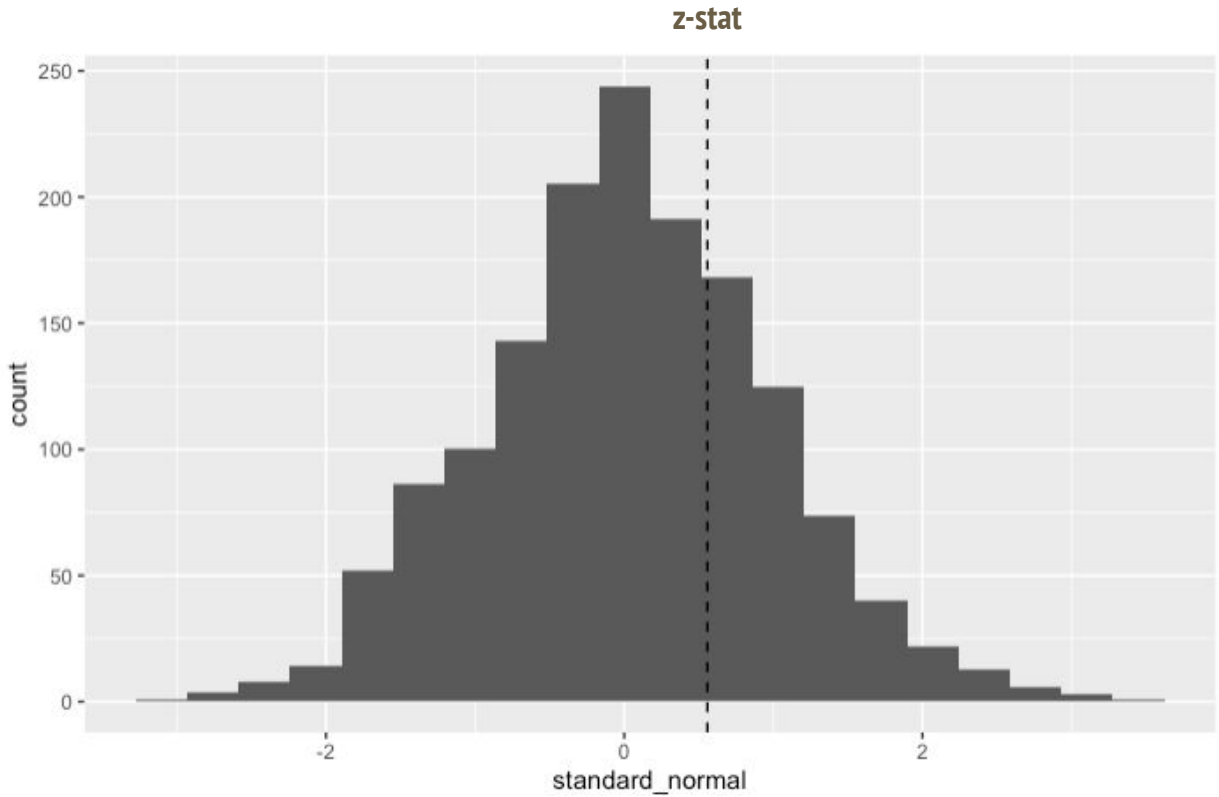
An Alternative: The difference between Two Sample Proportions

Does it contain 0?



Normal Distribution, Mean: 0, SE: 1

z-statistic: number of standard deviations from the mean a given value lies



How About Problem 8?

dist_t_o = rnorm(50000, sd=se_t_o)

dist_t_o =

```
-8.409863e-03
2.025476e-02
1.369391e-02
    ...
    ...
    ...
3.976248e-02
1.746751e-02
-1.332317e-02
```

> p_hat_t_o

"Count how many of these are greater than p_hat_t_o"

"Use this count and the number of samples to calculate the p value by: count/#samples."

"Finally multiply the result by two to reflect the two-sided nature."

p_val_wo_pnorm = (count / n_samples) * 2 = 0.58068

"Which is quite similar to p_val = 0.5769032"

Two-Sided Hypothesis Testing

One-tailed test: Alternative hypothesis is articulated directionally to test the null hypothesis.

Two-tailed Test: Non-directional. The critical region is on both tails.

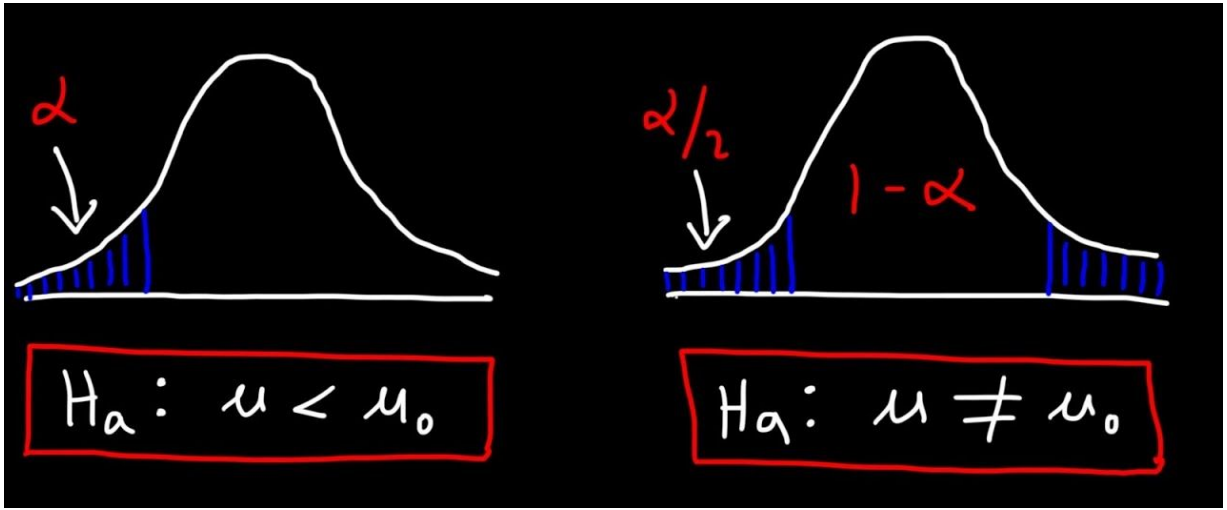


Image Source

One Line of Code :(

*p_val = pnorm(z_stat, lower.tail=FALSE) * 2*

p_val = 0.577, which is > 0.05.

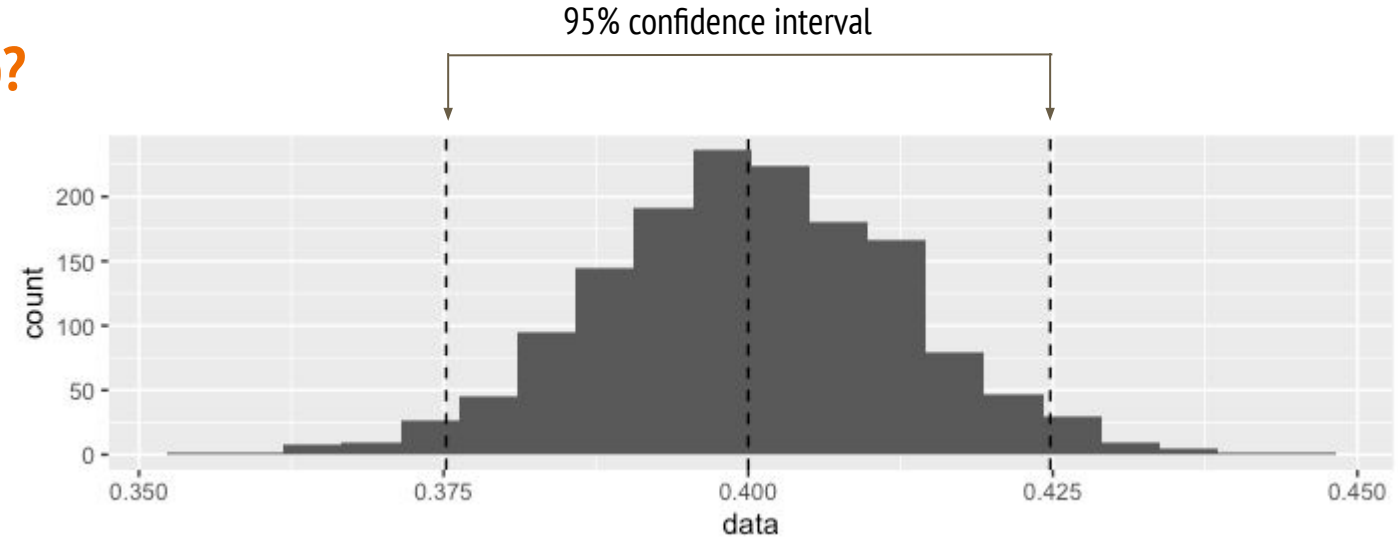
Thus, we accept the null hypothesis, at a 95% confidence level.

Meaning, the difference between Obama's and Trump's approval ratings is negligible.

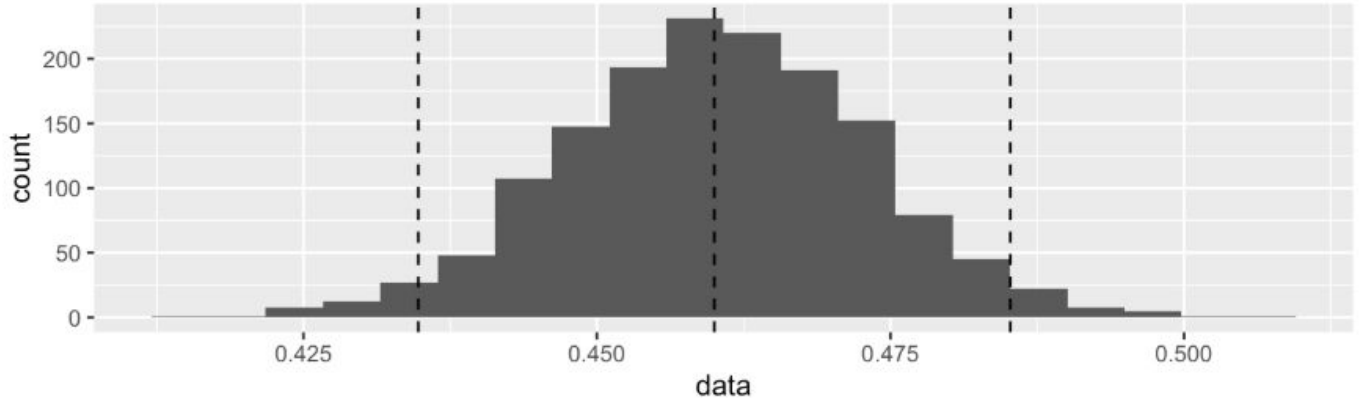
What about Clinton and Obama?

Do they overlap?

Obama:



Clinton:



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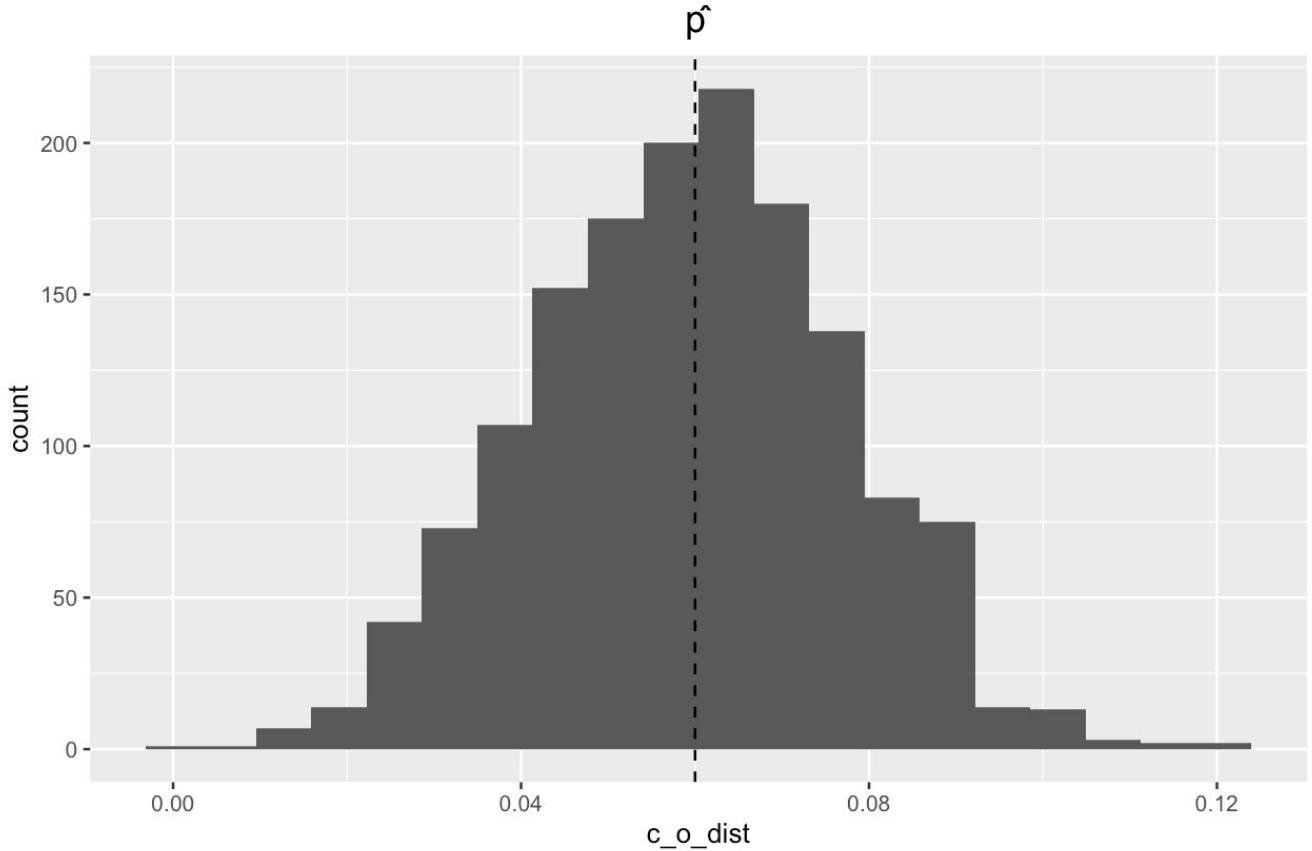

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