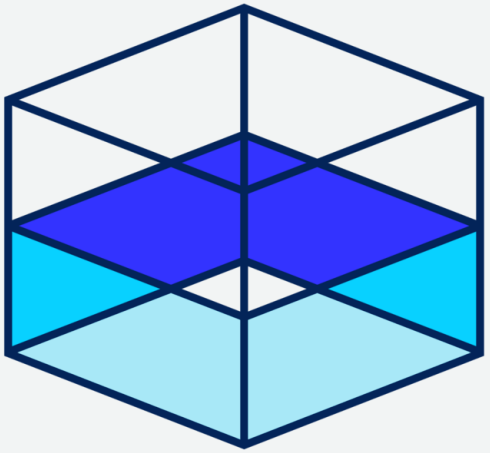


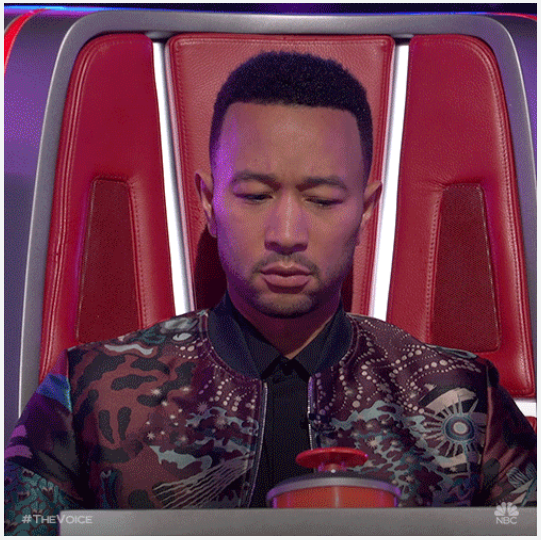
TECH
TALENT
SOUTH

Hypothesis Testing

Hypothesis Testing

Much of data science involves forming and testing a hypothesis.

A hypothesis is a guess about something that can be tested through observations or experiments.



TECH TALENT SOUTH

Hypothesis Testing

"If I…(do this to an independent variable)….then (this will happen to the dependent variable)."

- If I give this medicine to someone who is sick, then their symptoms will improve.
- If a group gets more sleep, then they will have better test scores.
- If I run three times a week, then my blood pressure will decrease.

TECH TALENT SOUTH

Hypothesis Testing

To properly test a hypothesis, you need to determine the null hypothesis.

The null hypothesis is what is the accepted fact. To prove your hypothesis is correct, you need to reject the null hypothesis.

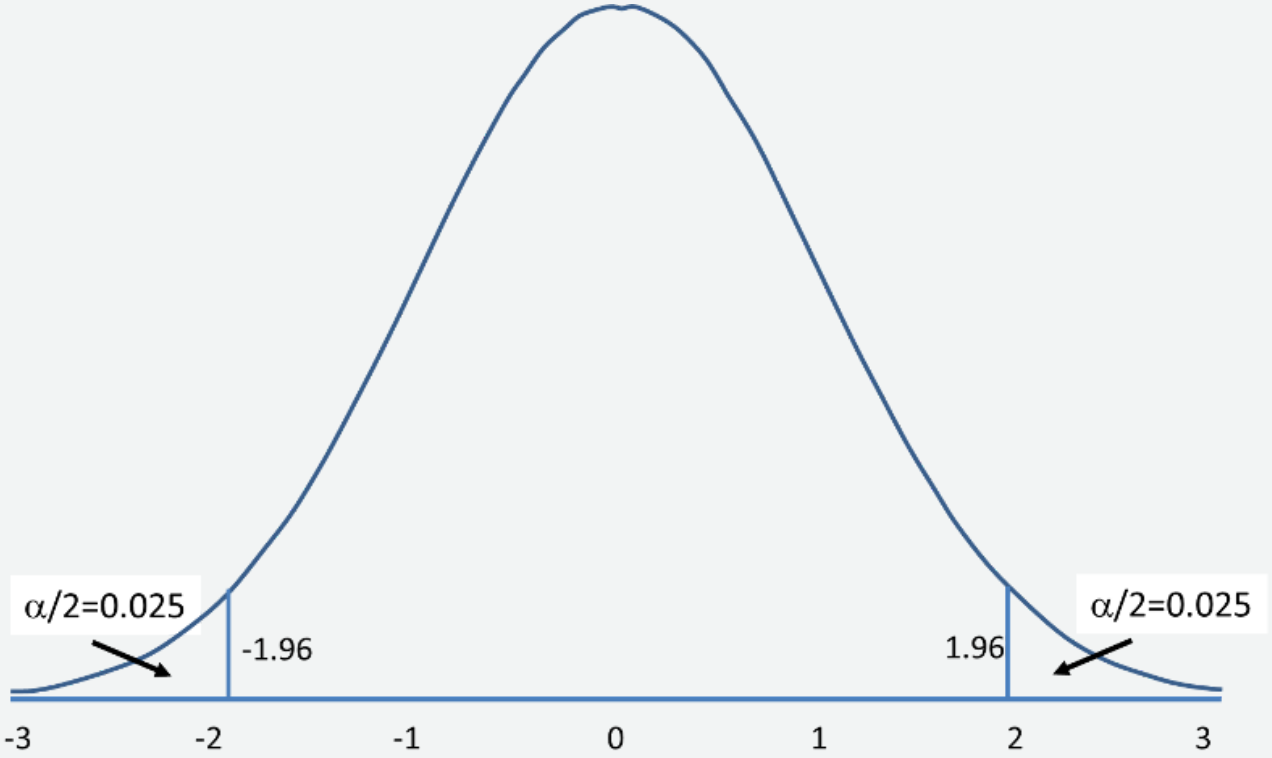
For example, say a company has a web development company has an average development time of 6 weeks. You hypothesize a new management method will reduce development time to 5 or fewer weeks.

The null hypothesis would say that with the new management style the development time would be greater than 5 weeks.

TECH
TALENT
SOUTH

Two-Tailed Hypothesis Tests

In a two-tailed hypothesis test, the region of rejection lies on both sides of the distribution.



TECH TALENT SOUTH

Two-Tailed Hypothesis Tests

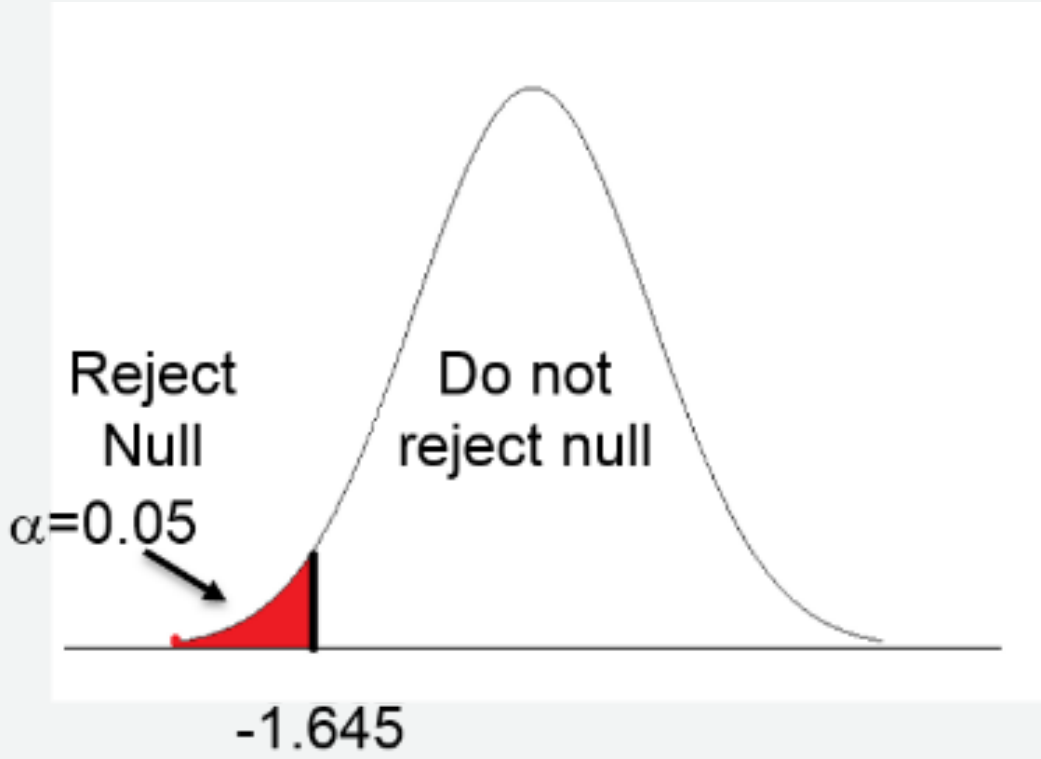
For example, if the null hypothesis states the mean weight of an apple is 5 ounces, the alternate hypothesis would state that the mean is less than 5 ounces or greater than five ounces.

Either side would allow us to reject the null hypothesis.

TECH TALENT SOUTH

One-Tailed Test

In a one-tailed hypothesis test, we test for effects in only one direction.



TECH TALENT SOUTH

One-Tailed Test

There are two options for one-tailed tests:

Null: The effect is less than or equal to zero

Alternative: The effect is greater than zero

or

Null: The effect is greater than or equal to zero

Alternative: The effect is less than zero

TECH TALENT SOUTH

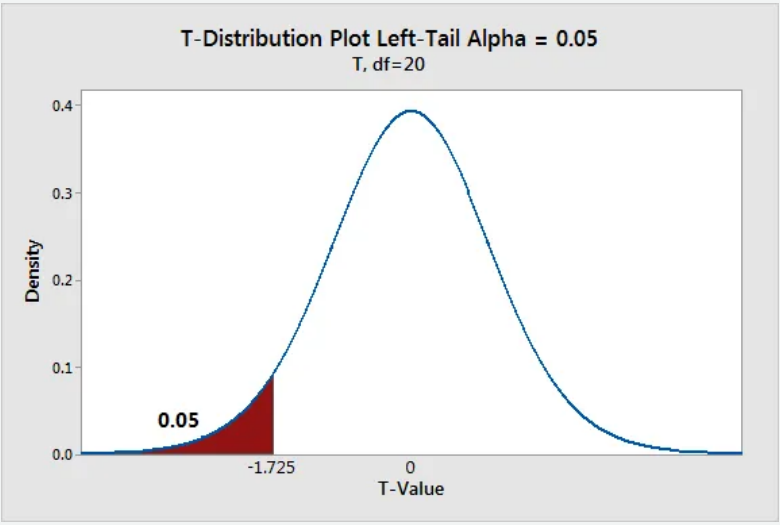
One-Tailed Test

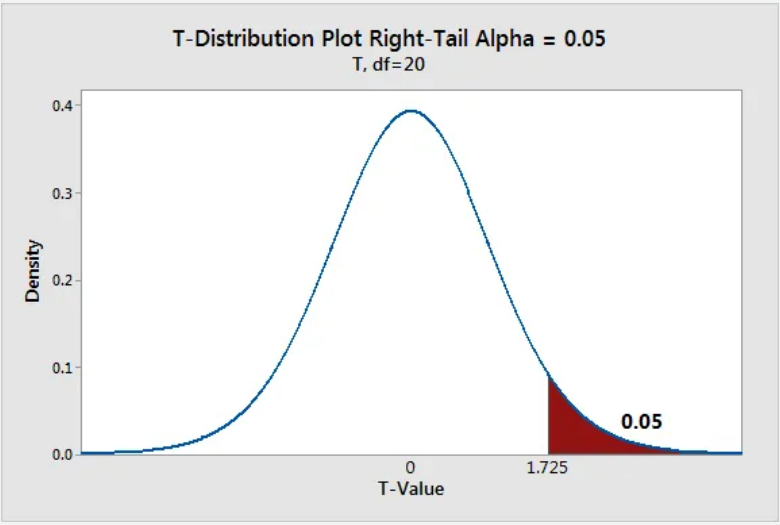
Which graph matches the following hypothesis test:

We want to see if a new medicine lowers blood pressure.

Null: The medicine has no effect or raises blood pressure.

Alternative: The medicine lowers blood pressure.

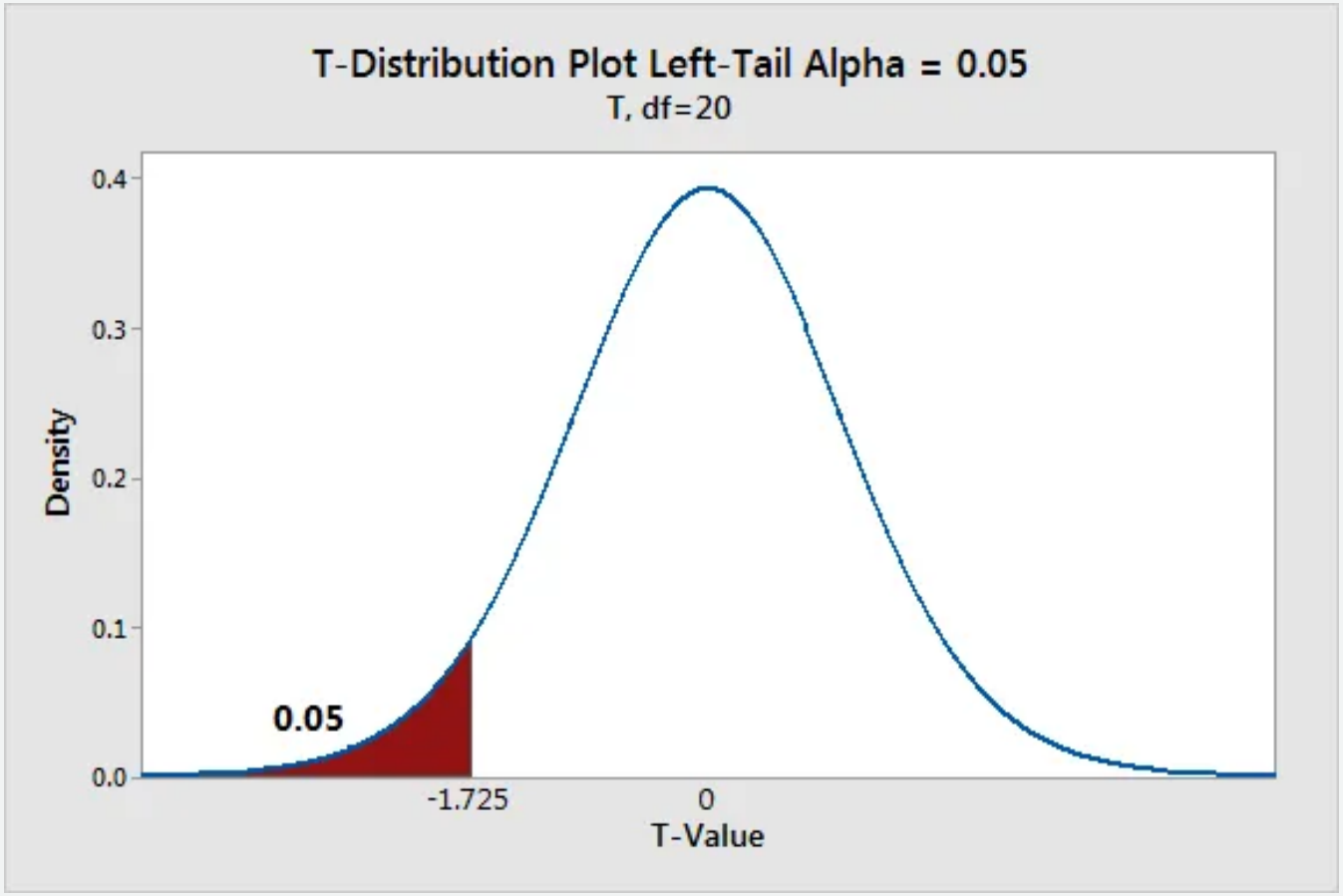




TECH TALENT SOUTH

One-Tailed Test

Answer



TECH TALENT SOUTH

Disadvantages of One-Tailed Tests

In a one-tailed tests, effects can exist in both directions, but researchers are only concerned with one direction.

There is no statistical power to detect an effect in the other direction.

Sometimes, this may prove disadvantageous.

TECH TALENT SOUTH

Tailed Tests Practice

Determine if each of the following is a two-tailed or one-tailed test. If it's a one-tailed test, determine which side it is.

Eating greasy foods everyday will raise your cholesterol.

The average person reads five books per year.

Working out three times a week will lower your blood pressure.

Drinking coffee before an exam will raise your test score.

The average person in Florida goes out to eat twice a week.

TECH TALENT SOUTH

One-Sample Z Test

To practice, we'll do a one-sample z test. This means we have one sample that we use to prove or disprove our hypothesis.

Obviously, this is not the best-case scenario. We would want *many* more examples, and since we have access to various computer tools we could analyze them extremely quickly.

Still, this is a good way to begin to understand hypothesis testing.

TECH
TALENT
SOUTH

One-Sample Z Test

A community believes that its men have a higher-than-average weight.

A random sample of 50 men found an average weight of 230 pounds.

The general population has an average weight of 172 with a standard deviation of 29 pounds.

Is the claim that the community's men's weights above average valid?

TECH TALENT SOUTH

One-Sample Z Test

First, we need a null hypothesis.

The null hypothesis is that the average weight of the general population is 172 pounds.

The alternate hypothesis is that our population has an average weight >172 pounds.

One-Sample Z Test

Next, we need our alternate hypothesis.

The alternate hypothesis is that community's average weight is >172 pounds.

One-Sample Z Test

Next, we'll pick an alpha level. For our case let's use 0.05.

We can now pick a rejection region. Remember that for 0.05 we will have a z-score of 1.645.

Next, we'll find our test statistic. Our hypothesis is that the average weight is higher than normal, so if our test statistic is greater than 1.645, we can reject the null hypothesis.

TECH TALENT SOUTH

One-Sample Z Test

Next, we'll pick an alpha level. For our case let's use 0.05.

We can now pick a rejection region. Remember that for 0.05 we will have a z-score of 1.645.

Next, we'll find our test statistic. Our hypothesis is that the average weight is higher than normal, so if our test statistic is greater than 1.645, we can reject the null hypothesis.

TECH TALENT SOUTH

One-Sample Z Test

To calculate the test statistic, we use the following z score formula:

z = (sample mean - population mean)/(standard deviation of the population / sqrt(sample size)

$$Z = \frac{\overline{x} - \mu_0}{\sigma / \sqrt{n}}$$

TECH TALENT SOUTH

One-Sample Z Test

Let's calculate our test statistic:

$$z = (230 - 172)/(29/\sqrt{50})$$

$$z = 58/4.1$$

$$z = 14.15$$

$$14.15 > 1.645$$

We can reject the null hypothesis!

TECH TALENT SOUTH

P-Values

A p-value let's you know how useful your results are.

If you have a low p-value, less than 0.05, then you can claim that your results are repeatable. A higher p-value may indicate that your results were an anomaly, and you will need to do further testing to ensure you get an accurate result.

TECH
TALENT
SOUTH