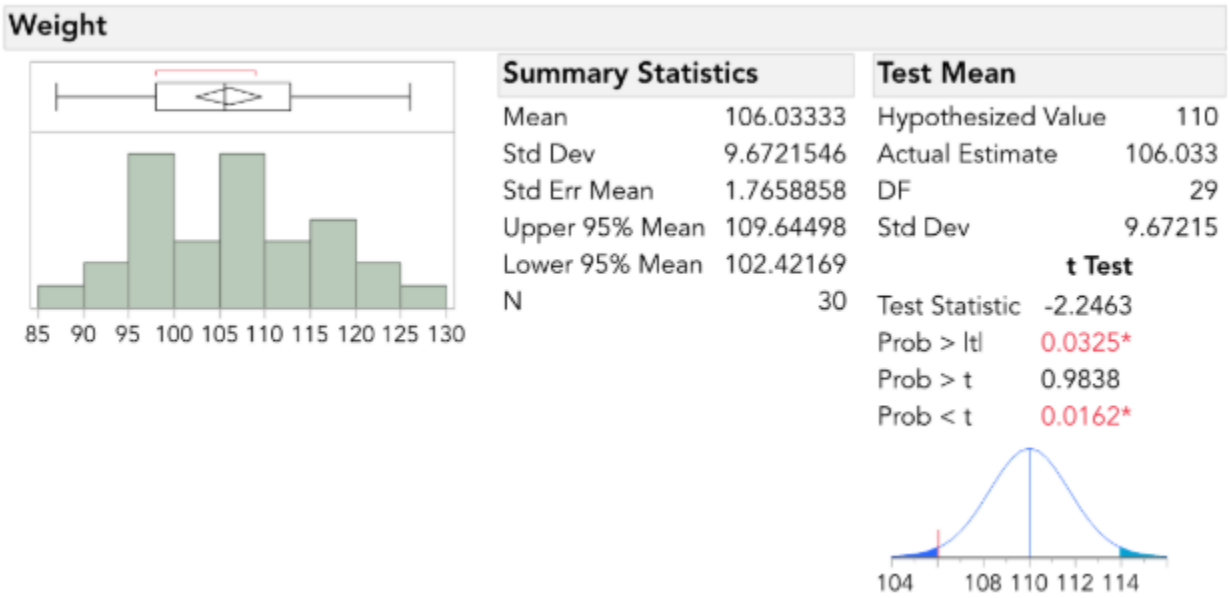
Questions Module 4.2

The target weight for a component is 110 grams. A colleague has collected a random sample of 30 parts from a stable process to test the hypothesis that the component weight is on target. Your colleague is concerned that the process might be off target. Based on this output, what can you conclude about the target weight?



- *a.* Based on the 95% confidence interval for the mean, you can conclude that the true mean is 110 and the process is on target.
- *b.* Based on both the 95% CI and the p-value, you can conclude that the process is on target.
- *c.* Based on both the 95% CI and the p-value, you can conclude that the process is off target.
- *d.* There is not enough information to determine whether the process is off target.

Incorrect.
The correct answer is **c**. The 95% CI for the mean is 102.4 to 109.6. The target, 110, is just outside this interval. The p-value is 0.0325, which is below the cutoff of 0.05. A sample mean of 106, based on 30 measurements, is highly unlikely if the process is on target. Note that the language used in some of the questions, "the process is on target," would be frowned upon by statisticians. You cannot prove that the null hypothesis is true. You simply fail to find evidence against the null hypothesis. You learn more about this in the next video.

A sawmill uses a large spinning circular blade to cut through logs. Ideally, the blade spins in a perfect vertical plane, but after use, the blade's path might wobble. This deviation from the vertical is called runout. When runout is pronounced, the mill operator needs to stop production and make time-consuming adjustments. A sample of measurements is taken to measure runout for a blade. When the blade is running true, runout = 0.

Which statement represents the null hypothesis?

- *a.* Mean runout = 0.
- *b.* Mean runout $\neq$ 0.

Incorrect.
The correct answer is **a**. Mean runout = 0. Operators won't stop the process unless there is evidence that runout is significantly different from zero.

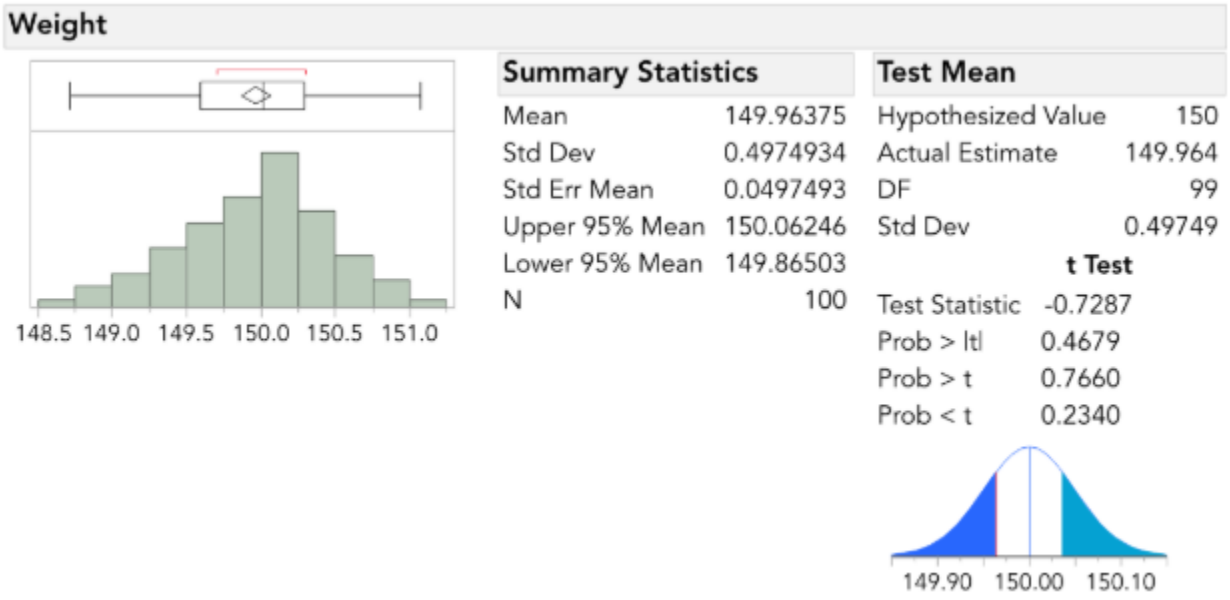
A factory dispenses nasal spray into plastic bottles. The mean volume of fluid per bottle is supposed to be 30 mL. You are concerned that the bottles are being overfilled.

Which statement represents the null hypothesis?

- *a.* Mean volume >= 30 mL.
- *b.* Mean volume = 30 mL.

Incorrect.
The correct answer is **b**. The initial assumption is that the process is working normally. You test this against the alternative hypothesis that the process is overfilling the bottles.

A pharmaceutical company produces tablets. The target weight for the tablets is 150 mg. You randomly select 100 tablets and test the hypothesis that the mean tablet weight is 150. Based on this output, what can you conclude about the mean tablet weight?

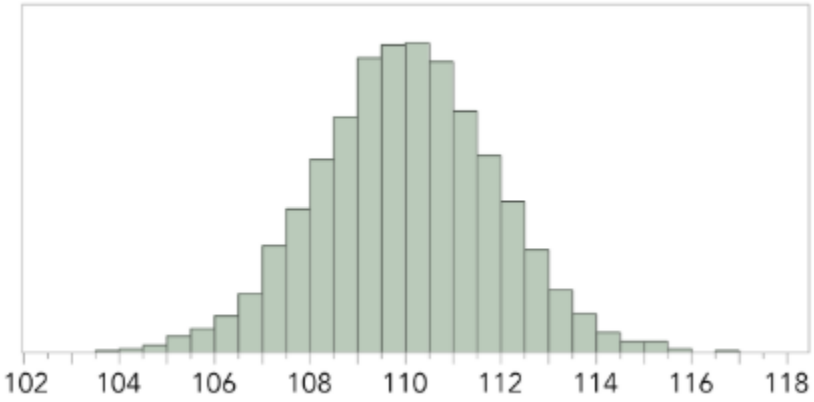


- *a.* Based on the 95% CI for the mean, you can conclude that the mean tablet weight is greater than 150.
- *b.* Based on the *p*-value, you can conclude that the process is off target.
- *c.* Based on the 95% CI for the mean, you can conclude that the mean tablet weight is below the target of 150.
- *d.* Based on both the 95% CI and the *p*-value, you can conclude that the data are consistent with the hypothesis that the mean target weight is 150.

Incorrect.
The correct answer is **d**. The hypothesized value falls in the 95% CI, so 150 is a likely value for the true mean tablet weight. The *p*-value is 0.4679. This is larger than a cutoff of 0.05, so you don't have

evidence that the null hypothesis is not true. The data are consistent with your null hypothesis that the mean is 150.

This distribution of sample means is based on 10000 simulated samples, with a true mean of 110, a standard deviation of 10, and a sample size of 30. Based on this distribution of sample means, which of the following statements is true?



- *a.* If the true mean is 110, it would be impossible to get a sample mean of around 112.
- *b.* If the true mean is 110, you would expect to get a sample mean greater than 116.
- *c.* If the true mean is 110, it would be highly unlikely to get a sample mean of around 109.
- *d.* If the true mean is 110, it would be reasonable to get a sample mean of around 108.

Incorrect.
The correct answer is **d**. With 30 observations and a standard deviation of 10, you might observe a sample mean of 108 if the true mean is 110. It would be possible to get a sample mean of 112 or 109, but it would be highly unlikely to get a sample mean greater than 116.

Note: These data were simulated using the Sampling Distribution of Sample Means teaching module, which is available in the **Help** menu, **Sample Data**, **Teaching Scripts**, and then **Interactive Teaching Modules**.

An athlete is tested for the use of a banned drug. The null hypothesis is that the athlete does not use the drug. Which of the following is an example of a Type I error, or a false positive?

- *a.* The test is positive for the banned drug, but the athlete has never used the drug.
- *b.* The test is positive for the banned drug, and the athlete uses the drug.
- *c.* The test is negative for the banned drug, and the athlete has never used the drug.
- *d.* The test is negative for the banned drug, but the athlete uses the drug.

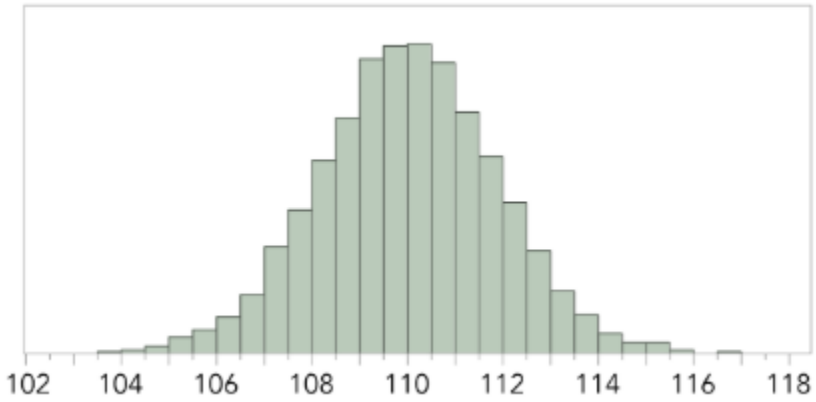
Incorrect.
The correct answer is **a**. A Type I error is when a correct null hypothesis is rejected. In this example, the null hypothesis is true (the athlete doesn't use the drug), but the test results would lead you to conclude that the athlete uses the drug.

The effectiveness of a diet on weight loss is studied. The null hypothesis is that the diet doesn't result in significant weight loss. Which of the following is an example of a Type II error?

- *a.* You conclude that the diet is effective, and it actually is.
- *b.* You conclude that the diet is effective, and it actually isn't.
- *c.* You conclude that the diet is not effective, and it actually is.
- *d.* You conclude that the diet is not effective, and it actually isn't.

Incorrect.
The correct answer is **c**. A Type II error is when the null hypothesis is false and you fail to reject it. In this example, the null hypothesis is false (the diet actually is effective), but the test results would lead you to conclude that the diet doesn't lead to significant weight loss.

The target weight for a component is 110 grams, and the standard deviation is 10. If the process is on target, and you repeatedly select random samples of size 30 from this process, the distribution of sample means might look like this:



In practice, you select only one sample, and you use a probability value (a p-value) to help you make decisions about the null hypothesis. If you were to select only one sample from this process and conduct a hypothesis test that the true mean is 110, which of the following statements is true? Assume that the null hypothesis is true.

- *a.* The probability of observing a sample mean as extreme as 116 is large (p-value > 0.05).
- *b.* The probability of observing a sample mean as extreme as 104 is small (p-value < 0.05).
- *c.* The probability of observing a sample mean of 111 is 1 (p-value = 1.0).
- *d.* The probability of observing a sample mean as extreme as 108 is small (p-value < 0.05).

Incorrect.
The correct answer is **b**. 104 is extreme relative to 110, so the p-value will be very small. If you observe a sample mean as extreme as 104, you have evidence that the null hypothesis is not true.

In hypothesis testing, you either reject the null hypothesis, or you fail to reject the null hypothesis. Why do statisticians warn that you can never "accept the null?"

You can never prove the null to be true. You can simply fail to find evidence against it. Consider a person being charged with a crime. The court system, at least in the United States, uses the language "innocent unless proven guilty." The person either committed the crime or didn't, and you don't know the truth. You can find evidence that the person committed the crime. But if you find the person not guilty, you have not proven that person's innocence. You have simply failed to find evidence of his or her guilt.