Method 2: *p*-Values

The *p*-value given by the calculator is approximately 0.1912 as shown in the previous screenshot. Since $0.1912 > 0.01$, we have *p*-value $> \alpha$. Thus, the conclusion is to fail to reject the null hypothesis.

Interpretation: We interpret failing to reject the null hypothesis to mean that the evidence collected is not strong enough at the 0.01 level of significance to say that the machine is working improperly.

10.3 Section Exercises

Rejection Regions for Hypothesis Tests for Population Means (σ Unknown)

Determine the rejection region for a hypothesis test for the population mean using the given information. Assume that the population standard deviation is unknown and the population distribution is approximately normal.

1. $\alpha = 0.05, \quad df = 14, \quad$ left-tailed test

2. $\alpha = 0.01, \quad df = 23, \quad$ right-tailed test

3. $c = 0.90, \quad df = 18, \quad H_a: \mu \neq 18$

4. $c = 0.95, \quad df = 26, \quad H_a: \mu < 0.18$

5. $\alpha = 0.10, \quad n = 10, \quad H_a: \mu \neq 102$

6. $\alpha = 0.025, \quad n = 6, \quad H_a: \mu > 203$

Draw the rejection region for the hypothesis test for the population mean and give the appropriate conclusion for the hypothesis test using the given information. Assume that the population distribution is approximately normal.

7. $H_0: \mu = 195$ and $H_a: \mu \neq 195, \quad t = -3.11, \quad n = 20, \quad \alpha = 0.05$

8. $H_0: \mu = 17$ and $H_a: \mu < 17, \quad t = -2.05, \quad n = 6, \quad \alpha = 0.05$

9. $H_0: \mu = 28$ and $H_a: \mu > 28, \quad t = 1.99, \quad n = 29, \quad \alpha = 0.01$

10. $H_0: \mu = 98$ and $H_a: \mu < 98, \quad t = -2.73, \quad n = 10, \quad \alpha = 0.01$

11. $H_0: \mu = 7$ and $H_a: \mu \neq 7, \quad t = -3, \quad n = 15, \quad \alpha = 0.01$

12. $H_0: \mu = 39$ and $H_a: \mu > 39, \quad t = 2.01, \quad n = 8, \quad \alpha = 0.05$

Hypothesis Tests for Population Means (σ Unknown)

Perform each hypothesis test. For each exercise, complete the following steps. Assume that each population distribution is approximately normal.

a. State the null and alternative hypotheses.
b. Determine which distribution to use for the test statistic, and state the level of significance.
c. Calculate the test statistic.
d. Draw a conclusion and interpret the decision.

13. One cable company claims that it has excellent customer service. In fact, the company advertises that a technician will arrive in approximately 30 minutes after a service call is placed. One frustrated customer believes this is not accurate, claiming that it takes over 30 minutes for the cable technician to arrive. The customer asks a simple random sample of 9 other cable customers how long it has taken for the cable technician to arrive when they have called for one. The sample mean for this group is 33.2 minutes with a standard deviation of 3.4 minutes. Test the customer's claim at the 0.025 level of significance.

14. A parenting magazine reports that the average amount of wireless data used by teenagers each month is 10 Gb. For her science fair project, Ella sets out to prove the magazine wrong. She claims that the mean among teenagers in her area is less than reported. Ella collects information from a simple random sample of 25 teenagers at her high school and calculates a mean of 9.8 Gb per month with a standard deviation of 2.7 Gb per month. Test Ella's claim at the 0.01 level of significance.

15. A children's clothing company manufactures hand-smocked dresses for girls. The length of one particular size of dress is designed to be 26 inches. The company regularly tests the lengths of the garments to ensure quality control, and if the mean length is found to be significantly longer or shorter than 26 inches, the machines must be adjusted. The most recent simple random sample of 28 dresses had a mean length of 26.30 inches with a standard deviation of 0.77 inches. Perform a hypothesis test on the accuracy of the machines at the 0.01 level of significance.

16. A pizza delivery chain advertises that it will deliver your pizza in 20 minutes from when the order is placed. Being a skeptic, you decide to test and see if the mean delivery time is actually more than 20 minutes. For the simple random sample of 7 customers who record the amount of time it takes for each of their pizzas to be delivered, the mean is 22.7 minutes with a standard deviation of 4.3 minutes. Perform a hypothesis test using a 0.05 level of significance.

17. Community college instructors' salaries in one state are very low, so low that educators in that state regularly complain about their compensation. The national mean is $51,878, but instructors from Mississippi claim that the mean in their state is significantly lower. They survey a simple random sample of 23 colleges in the state and calculate a mean salary of $46,005 with a standard deviation of $8833. Test the instructors' claim at the 0.01 level of significance.

Source: Based on 2017-18 NCES data for average 9-month salary for full-time instructional staff nationwide and in Mississippi for colleges where the highest degree is an Associate's degree.

18. It currently takes users a mean of 5 minutes to install the most popular computer program made by RodeTech, a software design company. After changes have been made to the program, the company executives want to know if the new mean is now different from 5 minutes so that they can change their advertising accordingly. A simple random sample of 20 new customers are asked to time how long it takes for them to install the software. The sample mean is 4.1 minutes with a standard deviation of 1.9 minutes. Perform a hypothesis test at the 0.05 level of significance to see if the mean installation time has changed.