Problem.

Engineers for a cell phone producer think that using Bluetooth decreases battery life. Average battery life is expected to be 23 hours. A sample of 20 phones was tested for battery life with Bluetooth enabled. The average for the sample was 22.5 hours with a standard deviation of 0.9 hours.

What is the null hypothesis?

What is the alternative hypothesis?

What is the test statistic t ?

What is the t value for a .05 one tailed critical (rejection) region?

Draw the rejection region.

Do you reject or fail to reject the null hypothesis? Show why you made your choice.

What is the approximate p value for the test?

Solution.

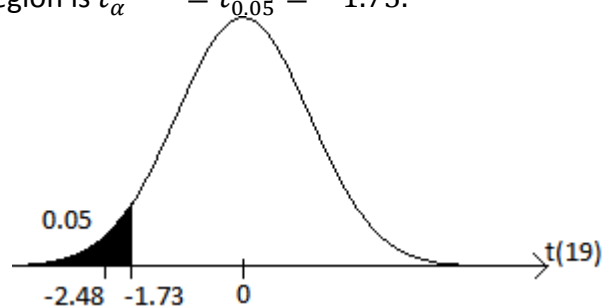Suppose that, $\mu_0 = 23$ hours, $n = 20$, $\bar{x} = 22.5$ hours, $s = 0.9$ hours, $\alpha = 0.05$.

The null hypothesis is $H_0: \mu = \mu_0$.

The alternative hypothesis is $H_1: \mu < \mu_0$ (since producer think that using Bluetooth decreases battery life).

The test statistic

$$t = \frac{\bar{x} - \mu_0}{s/\sqrt{n}} = \frac{22.5 - 23}{0.9/\sqrt{20}} \approx -2.48.$$

There are degrees of freedom $n - 1 = 20 - 1 = 19$. Hence a critical t value for a 0.05 one tailed critical (rejection) region is $t_\alpha^{(n-1)} = t_{0.05}^{19} = -1.73$.

H_0 is rejected at $\alpha = 0.05$, because the test statistics value (-2.48) falls into the rejection region $(t \le -1.73)$.

The approximate p-value for the test is
$p = T_{n-1}(|t|) = T_{19}(2.48) = TDIST(2,48; 19; 1) = 0.0113$ (via Excel function TDIST).