1. Question — Your company has implemented a new process to increase manufacturing speed. Previously it took 2 seconds on average. To verify that the new method is faster, time was measured 25 times resulting in an average of 1.9 seconds with a standard deviation of 0.2. Perform a t-test to check if the process got faster ($\alpha = 0.05$)

Answer :

1. Null hypothesis: The new process did not change the speed
2. Alternative hypothesis: The new process is faster.
3. $t = \frac{\overline{x}-\mu}{\frac{std}{\sqrt{n}}} = \frac{1.9-2}{\frac{0.2}{\sqrt{25}}} = \frac{-0.1}{0.04} = -2.5$
4. Using $\alpha = 0.05$, the test statistic of -2.5 and 24 degrees of freedom results in a t-value of 1.711. $2.5 > 1.711$ thus we can reject the Null hypothesis and conclude that new method might be faster

2. Question — You implemented a new trading algorithm that needs to outperform the annual bond interest yield of 5% Over the last 4 years your algorithm yielded 5.9% with a std of 1.1%. Perform a t-test if your algorithm is better using an $\alpha = 0.01$

Answer :

1. Null hypothesis: Your algorithm is not better
2. Alternative hypothesis: Your algorithm is better
3. $t = \frac{\overline{x}-\mu}{\frac{std}{\sqrt{n}}} = \frac{5.9-5}{\frac{1.1}{\sqrt{4}}} = \frac{-0.9}{0.55} = 1.6$
4. Using $\alpha = 0.01$, the test statistic of 1.6 and 3 degrees of freedom results in a t-value of 4.541. $1.6 < 4.541$ thus we cannot reject the Null hypothesis.

3. Question — You need to check if your new warehouse has a different (lower or higher) delivery time compared to your old ones. Your old warehouses have an avg. delivery time of 46 minutes. Tracking the delivery times for 20 times returned an average of 44 with a standard deviation of 1.8. Perform a t-test to check if delivery times differ using an α of 0.05

Answer :

1. Null hypothesis: There is no difference in delivery times
2. Alternative hypothesis: Delivery times differ
3. $t = \frac{\overline{x}-\mu}{\frac{std}{\sqrt{n}}} = \frac{44-46}{\frac{1.8}{\sqrt{20}}} = \frac{-2}{0.4} = -5$
4. Using $\alpha = 0.05$, the test statistic of -5 and 19 degrees of freedom results in a t-value of 2.093. $5 > 2.093$ thus we can reject the Null hypothesis and state that the delivery times are different.