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Question: In your calculations please use at most three decimal points. F...

In your calculations please use at most three decimal points. For brief explanations, two or three sentences is enough.

A new COVID-19 vaccine is developed and the developer company claims that the vaccine’s protection lasts longer than their competitors. In an experiment with 55 subjects, the company showed that their vaccine protects for 6.2 months with a standard deviation of 1.5 months. Note that, when tested on an independent set of 55 patients, the old vaccine developed by their competitors protect for 5.8 months with a standard deviation of 1.1 months. With 5% level of significance, can we state that the new vaccine really protects for a longer duration? (Please state H_0 and H_A)

Expert Answer ⓘ

Sidessh Bandekar answered this
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Sample Mean 1 (\bar{X}_1) =	6.2
Sample Standard Deviation 1 (s_1) =	1.5
Sample Size (n_1) =	55
Sample Mean 2 (\bar{X}_2) =	5.8
Sample Standard Deviation 1 (s_2) =	1.1
Sample Size (n_2) =	55
Significance Level (α) =	0.05

(1) Null and Alternative Hypotheses

The following null and alternative hypotheses need to be tested:

$$H_0 : \mu_1 = \mu_2$$

$$H_a : \mu_1 > \mu_2$$

This corresponds to a right-tailed test, for which a t-test for two population means, with two independent samples, with unknown population standard deviations will be used.

(2) Rejection Region

Based on the information provided, the significance level is $\alpha = 0.05$, and the degrees of freedom are $df = 108$. In fact, the degrees of freedom are computed as follows, assuming that the population variances are equal:

$$df_{Total} = df_1 + df_2 = 54 + 54 = 108$$

Hence, it is found that the critical value for this right-tailed test is $t_c = 1.659$, for $\alpha = 0.05$ and $df = 108$.

The rejection region for this right-tailed test is $R = \{t : t > 1.659\}$.


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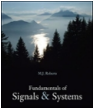
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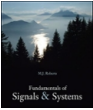
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computed as follows:

$$t = \frac{\bar{X}_1 - \bar{X}_2}{\sqrt{\frac{(n_1-1)s_1^2 + (n_2-1)s_2^2}{n_1+n_2-2} \left(\frac{1}{n_1} + \frac{1}{n_2} \right)}}$$
$$= \frac{6.2 - 5.8}{\sqrt{\frac{(55-1)1.5^2 + (55-1)1.1^2}{55+55-2} \left(\frac{1}{55} + \frac{1}{55} \right)}} = 1.595$$

(4) Decision about the null hypothesis

Since it is observed that $t = 1.595 \leq t_c = 1.659$, it is then concluded that *the null hypothesis is not rejected*.

Using the P-value approach: The p-value is $p = 0.0568$, and since $p = 0.0568 \geq 0.05$, it is concluded that the null hypothes is not rejected.

(5) Conclusion

It is concluded that the null hypothesis H_0 *is not rejected*. Therefore, there is not enough evidence to claim that the population mean μ_1 is greater than μ_2 , at the $\alpha = 0.05$ significance level.

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