Question 25

Pizzas

Population

We are studying the amount of time, in minutes, between order and delivery of a pizza to college dormitories.

μ = true mean time between order and delivery of a pizza to college dormitories.

Goal: Test to see if there is support for saying that μ has decreased from 25 minutes.

Method

$$\begin{aligned} H_0 &: \mu = 25 \\ H_a &: \mu < 25 \\ \alpha &= 0.05 \\ T - curve\ with\ df &= 30 \end{aligned} \tag{1}$$

Sample

Interpretation for a 1-Sample t-Test

Decision Rule Based on p-value
Reject H_0 : p-value $\leq \alpha$
Fail to Reject H_0 : p-value $> \alpha$

The p-value for this test is 0.0121
$\alpha = 0.050$

For the p-value approach:

Since 0.0121$<$ 0.05, we reject the null hypothesis in favor of the alternative hypothesis. There is enough evidence to support the claim of the alternative hypothesis.

$$\begin{aligned} &n > 30 \\ &\therefore \\ &The\ sample\ can\ be \\ &considered\ normal \end{aligned} \tag{2}$$

Results

$$\begin{aligned} t &= \frac{\overline{x} - u_0}{s \div \sqrt{n}}\ with\ df = n - 1 \\ t &= \frac{22.4 - 25}{\frac{6.1}{\sqrt{31}}}\ with\ df = 31 - 1 \\ t &= \frac{-2.6}{\frac{10}{\sqrt{31}}}\ with\ df = 30 \\ t &= -2.373\ with\ df = 30 \end{aligned} \tag{3}$$

My sample mean is 2.373 standard errors below 25.

My p-value is 0.0121.

Assuming that the true mean equals 25, there is a 1.21% probability of getting a sample mean ($\overline{x}$) at least as extreme as the one we got from sampling.

Conclusion

At the 5% level of significance, the sample data does provide sufficient evidence to say that the true mean has decreased from 25 minutes between the order and the delivery of a pizza to college dormitories.

Question 26

Lactose

Population

We are studying the percentage of Americans who have trouble digesting milk.

p= the true proportion of Americans that have trouble digesting milk.

Goal: Test to see if there is support for saying that p has increased from 35% of the American population.

Method

$$\begin{gathered} H_0 : p = 0.35 \\ H_a : p < 0.35 \\ \alpha = 0.05 \end{gathered} \tag{4}$$

Sample

> Interpretation for a 1-Sample Z-test
>
> Decision Rule Based on p-value
> Reject H_0 : p-value $\leq \alpha$
> Fail to Reject H_0 : p-value $> \alpha$
>
> p-value=0.3228
> $\alpha = 0.050$
>
> For the p-value approach:
>
> Since 0.3228> 0.05, we fail to reject the null hypothesis.
> There is not enough evidence to support the claim of the alternative hypothesis.

$$
\begin{gathered}
n(p_0)(1-p_0) \geq 10 \\
250(0.35)(0.65) \geq 10 \\
56.875 \not\geq 10 \\
\therefore \\
\textit{The sample can be} \\
\textit{considered normal}
\end{gathered} \tag{5}
$$

Results

$$
\begin{gathered}
Z = \frac{\hat{p} - p_0}{\sqrt{\frac{(p_0)(1-p_0)}{n}}} \\
Z = \frac{0.364 - 0.35}{\sqrt{\frac{(0.35)(1-0.35)}{250}}} \\
Z = \frac{0.014}{\sqrt{\frac{(0.35)(0.65)}{250}}} \\
Z = \frac{0.014}{\sqrt{\frac{0.2275}{250}}} \\
Z = 0.46
\end{gathered} \tag{6}
$$

My sample mean is 0.46 standard errors below 35%.

My p-value is 0.3228.

Assuming that the true proportion equals 35%, there is a 32.28% probability of getting a sample population ($\hat{p}$) at least as extreme as the one we got from sampling.

Conclusion

At the 5% level of significance, the sample data does not provide sufficient evidence to say that the true proportion has increased from 35% of Americans having trouble digesting regular milk.