15) Suppose the happiness of angry grad students has a population that is normally distributed with a standard deviation of 4. I go and sample 21 angry grad students from this population and obtain a mean happiness of 80.97 and a standard deviation of 4.3132. Using an alpha value of \( \alpha = 0.05 \), is this observed mean significantly different than an expected happiness of 82?

\[ H_0: \mu_{hyp} = 82, \alpha = 0.05, \text{ two tailed} \]

\[ \sigma_x = 4, \ s_x = 4.3132, \ \bar{x} = 80.97, \ n = 21 \]

If given both \( \sigma_x \) and \( s_x \), use \( s_x \): \[ \sigma_x^2 = \frac{\sigma_x}{\sqrt{n}} = \frac{4}{\sqrt{21}} = 0.8728 \]

\[ Z = \frac{\bar{x} - \mu_{hyp}}{\sigma_x} = \frac{80.97 - 82}{0.8728} = -1.18 \]

\[ Z_{crit} = \pm 1.96 \]

\( Z < -1.96 \) we fail to reject \( H_0 \)

\( p\text{-value: } p = 2 \cdot \Pr (Z < -1.18) = 2 \cdot 0.1190 = 0.2380 \)

"The happiness of angry grad students (\( \bar{m} = 80.97 \)) is not significantly different than 82 (\( Z = -1.18 \), \( p = .2380 \))."