Statistics for Experimentalists

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Problem. From Page 320 number 6. If we take the 95% upper, $n = 60$, $s^2 = 12.5$, and $\overline{x} = 18.6$ the formula we are going to be using is $\overline{x} + Z_\alpha \cdot \frac{s}{\sqrt{n}}$.

$$18.6 + 1.645\frac{\sqrt{12.5}}{\sqrt{60}} \approx 19.55 \tag{1}$$

Because our result was 19.55, our interval is $(-\infty, 19.55)$.

If we were to take $\overline{x_1} - \overline{x_2}$, we would need to do

$$\overline{x_1} - \overline{x_2} + Z_\alpha \cdot \sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}. \tag{2}$$

So if we were to have the $\hat{p_1} - \hat{p_2}$ lower,

$$\hat{p_1} - \hat{p_2} - Z_\alpha\sqrt{\frac{\hat{p_1}\hat{q_2}}{n_1} + \frac{\hat{p_2}\hat{q_2}}{n_2}}. \tag{3}$$

Problem. Let's take a look at a problem, where 55% of 2000 American adults surveyed said they have watched digitally streamed TV programming on some type of device. $\hat{W}$ sample size would be required for the width of a 99% CI to be at most 0.5 irrespective of the value of $\hat{p}$. We know that the value of $\hat{p}$ is 55%. and we need to find the $[a, b]$ interval.

$$\begin{aligned}
\left(\hat{p} + 2.576\sqrt{\frac{\hat{p}\hat{q}}{n}}\right) - \left(\hat{p} - 2.576\sqrt{\frac{\hat{p}\hat{q}}{n}}\right) \\
&= 2 \cdot 2.576\sqrt{\frac{\hat{p}\hat{q}}{n}} \\
&= \text{size of the CI} \\
0.5 &> 2 \cdot 2.576\sqrt{\frac{\hat{p}\hat{q}}{n}}
\end{aligned}$$

Consider the worst scenario:

$$
\begin{aligned}
2 \cdot 2.576\sqrt{\frac{\frac{1}{2}\frac{1}{2}}{n}} &< 0.05 \\
\sqrt{\frac{\frac{1}{4}}{\sqrt{n}}} &< \frac{0.5}{2 \cdot 2.576} \\
\frac{\frac{1}{2}}{\sqrt{n}} &< \frac{.05}{2 * 2.576} \\
\frac{2.576}{0.5} &< \sqrt{n} \\
n &> \left(\frac{2.576}{.05}\right)^2 \\
n &= 2655
\end{aligned}
$$