Understanding Error Bars in Experimental Science

Standard Deviation (SD) (Descriptive)

Q’s w/n a population: Is this “normal”?

\[ SD = \sqrt{\frac{\sum (y - \overline{y})^2}{(n - 1)}} \]

Standard Error (SE) (Inferential)

Q’s between populations: Are they “different”?

\[ SE = \frac{SD}{\sqrt{n}} \]

- Drug

+ Drug

Standard Error (SE) vs 95% Confidence Interval (CI) vs p-value

\( n = 3 \) (4×SE = CI)

4SE gap: \( p = 1\% \)

2SE gap: \( p = 5\% \)

50% overlap: \( p = 1\% \)

(100% overlap: \( p = 5\% \))

\( n > 9 \) (2×SE = CI)

2SE gap: \( p = 1\% \)

0% overlap: \( p < 1\% \)

(50% overlap: \( p = 5\% \))