VISUALIZE CUMULATIVE DATA

Help students visualize how cumulative data narrows the margin of error and changes the p-value—potentially crossing the significance threshold.

Key Columns:

- $\text{Cumulative Proportion } (\hat{p})$ = Cumulative Orange / Cumulative Total
- $p-value$ from 1-proportion Z-test (explained below)
- $\text{Margin of Error (ME)}$ for 1-prop CI:

$$ME = z^* \sqrt{\frac{\hat{p}(1-\hat{p})}{n}}$$

$(\text{Use } z^* = 1.645 \text{ for } 90\%,\ 1.96 \text{ for } 95\%)$

- Confidence Interval =
    - Lower Bound: = Cumulative Proportion - ME
    - Upper Bound: = Cumulative Proportion + ME

Create Two Graphs:

Excel	Ti-Calculator
1. **Graph 1: Cumulative Sample Proportion vs. Target (0.20)** o **X-axis**: Total M&Ms (or Bag #) o **Y-axis**: Cumulative Proportion o Add a horizontal line at 0.20 (claimed value) o Add confidence bands if desired (CI bounds) 2. **Graph 2: p-value vs. Total Sample Size**	1. **Graph 1: Cumulative Sum vs. Cumulative Proportion** o **X-axis**: Total M&Ms (or Bag #) o **Y-axis**: Cumulative Proportion o Add a horizontal line at 0.20 (claimed value) o Add confidence bands if desired (CI bounds) 2. **Graph 2: ME vs. n functions**

o **X-axis**: Cumulative Total M&Ms o **Y-axis**: p-value o Add a horizontal line at $\alpha = 0.05$ or $\alpha = 0.10$ (depending on your z^*)	o **X-axis**: ME o **Y-axis**: n function o Add a horizontal line at $\alpha = 0.05$ or $\alpha = 0.10$ (depending on your z^*)

As students keep adding data and updating the spreadsheet:

- Watch the p-value column. The moment the p-value drops below α, point out:

"We now have enough evidence to reject the null hypothesis."

- In the graph, you'll see the p-value line dip below 0.05, and the sample proportion diverge significantly enough from 0.20.

Also, look at the confidence interval bounds:

- If 0.20 is no longer inside the interval, it means the observed proportion is statistically different from the claimed 20%.