Congress loves M&M's!

M&M's and Confidence Intervals!

Please DO NOT eat your M&M's until we are done with the entire activity 😀

Part I: Use Confidence Intervals to estimate the true proportion of each color.

You should have a medium (~10-16 oz.) bag of M&M's and a container to hold your M&M's. You will use random samples of M&M's from your bag to calculate 90% confidence intervals to estimate the true proportion of each color produced.

1. **Just for fun!** Before your open your package:

(M&M's come in six colors: red, orange, yellow, green, blue, brown)

Guess which color occurs most often: _____

Guess which color occurs least often: _____

2. Now open your package. Take out a random sample of **40** M&M's. Record the number and proportion for each color in the space provided below. Then use your chart of 90% boxplots for samples of size **40** to generate a 90% confidence interval for the true proportion of each color in the bag. Put those **40** back and shuffle. Repeat this process with another SRS of **40**.

Trial #1 ($n_1 = 40$)	Number	Proportion $\hat{p}$	90% CI	**Trial #2 ($n_2 = 40$)**	Number	Proportion $\hat{p}$	90% CI
Red				**Red**			
Orange	8	0.2	[0.15, 0.30]	**Orange**			
Yellow				**Yellow**			
Green				**Green**			
Blue				**Blue**			
Brown				**Brown**			

3. The actual proportions (for your type of M&M's) according to the Mars Company are:

Red: _____ Orange: 0.20 Yellow: _____ Green: _____ Blue: _____ Brown: _____

0.20 is within [0.15, 0.30]

4. Based on the factory proportions given in #3, write Y(yes, captured) or N (no, not captured) for each color if the true proportions were captured by the calculated interval. Do this for both trials.

Trial 1: Red _____ Orange Y Yellow _____ Green _____ Blue _____ Brown _____

Trial 2: Red _____ Orange _____ Yellow _____ Green _____ Blue _____ Brown _____

How many times out of 12 did you capture the true proportion? _____/12 **Let's compare results with the entire class. What success rate is this? Why?**

5. Choose a Confidence Interval from the table above. Interpret that CI in the context of this situation. I am 90% confident that the true proportion of orange M and M's produced was captured within 0.15 and 0.30.

6. Write a statement explaining what a Confidence Interval tells us about the population.

We are using a random sample to calculate an interval at a certain success rate of capture to estimate the parameter.

Part II: Use Confidence Intervals to estimate the number of M&M's in the entire bag.

1. Let's say you "tagged" a group of M&M's. Devise a system for "tagging" them so that when they are put back into the population you can tell they were originally "tagged." (Hint: M&M's are already different colors!) **We choose:** red!

2. How many of the chosen "tagged" color are in the entire bag? T = 88 red

3. Write how many of the chosen "tagged" color you got in your two samples of **40**.

Trial #1 there were 3 and Trial #2 there were 7

4. Set up a proportion with the number of "tagged" color T and $\hat{p}$ from **Trial #1** to find an estimate for the number of M&M's in your entire bag.

$$\frac{3}{40} = \frac{88}{N_1}$$

N_1 = 1,173.33

5. Repeat the process in #4 with **Trial #2**.

$$\frac{7}{40} = \frac{88}{N_2}$$

N_2 = 502.86

6. Write the CI you found from **Trial #1** for the "tagged" color: [0.05, 0.15]

Use T = 88 to solve for a CI to estimate the true number of M&M's in the bag. You will have to solve two proportions, one for each endpoint of the CI.

$0.05 = \frac{88}{x}$ $0.15 = \frac{88}{x}$

CI_1 = [587, 1760]

7. Repeat the process in #6 with **Trial #2**.

Write the CI you found from **Trial #2** for the "tagged" color: [0.10, 0.30]

Use T = 88 to solve for a CI to estimate the true number of M&M's in the bag. You will have to solve two proportions, one for each endpoint of the CI.

$0.10 = \frac{88}{x}$ $0.30 = \frac{88}{x}$

CI_2 = [293, 880]

8. Now **COUNT** all of the M&M's in your bag! N_{bag} = 847

9. Does the total number of M&M's in your bag (N_{bag}) fall within your CIs from #6 and #7? How many times out of two did you capture the true amount in your bag? 2 /2
Let's compare results with the entire class. What success rate is this? Why?

847 is within both CIs

10. NOW YOU CAN EAT YOUR M&M's!!!!!! 😀