

Table Number: _____

Group Name: _____

Group Members: _____

M&M Simulations

Scenario: Suppose you are throwing an Ohio NFL themed party and need to get orange M&Ms to show your support for your team. We are going to do some simulations using an applet to try to determine the proportion of orange M&Ms in the population of ALL M&Ms available.

You will now simulate taking samples of M&Ms by using an online app available at <http://www.rossmanchance.com/applets/OneProp/OneProp.htm?candy=2>

WHAT YOU SEE ON THE APPLET:

A big container of colored candies represents the POPULATION of M&M candies. Be sure you check the “Animate” box and also the “Proportion of Orange” button at the bottom.

M&M Candies

Probability of orange

Number of candies


Number of samples

Animate

Total = 0

Number of orange

Proportion of orange



1. What is the proportion (p) of orange candies in the given population? _____ (Note: Normally, we didn't know the parameter value but one catch in running a computer simulation is that we have to assume a value for the simulation to work.)

Be sure the probability of obtaining an orange candy is set to be 0.20. This is the **population proportion, or parameter, p** . (People who have counted lots of M&Ms, like we did the past couple days, came up with this number.)

Simulation

- Click on the “*Draw Samples*” button in the applet. One sample of 25 candies will be taken and the proportion of orange candies for this sample is plotted on the graph.
 - What is the sample proportion (\hat{p}) of orange candies? _____
(Note: Note the difference in the symbols used for the sample proportion and the population proportion.)
 - Repeat this again. (Draw a second sample.)
 - What is the sample proportion (\hat{p}) of orange candies in this sample? _____
(Note: Note again the difference in the symbols used for the sample proportion, \hat{p} , and the population proportion, p .)
2. Do you get the same or different values for each sample proportion (\hat{p})? Why do you think that is?
3. How close is each **sample statistic** (\hat{p}) (sample proportion) to the **population parameter** (p)?

Further Simulation

- Uncheck the “*Animate*” box.
 - Check the “*Summary Stats*” box.
 - Change the “Number of samples” to 500.
 - Click on the “*Draw Samples*” button, and see the distribution of sample statistics (in this case proportions) build.
4. Describe the shape, center and spread of the distribution of sample proportions. These sample proportions are called **statistics**.
- Shape:**
- Center:**
- Spread:**
5. How does this distribution compare to the one our class constructed on the board in terms of shape? Center? Spread?

6. Use the sampling distribution to answer the following. If we ran the simulation and obtained a sample of 0.4 (40% of our candies were orange), would that result be unusual based on the distribution? Interpret what that means for our distribution.

a) List the mean and standard deviation of the sampling distribution:

Mean (μ):

Standard deviation (σ):

b) Approximate the probability that the proportion of orange candies in a random sample of 25 Reese's pieces will be less than 0.2. Explain your reasoning and reference the sampling distribution.

When we generate sample statistics and graph them, we are generating an estimated **sampling distribution**, or a distribution of the sample statistics. It looks like other distributions we have seen of raw data.

Make a Conjecture

7. What do you think will happen to the distribution of sample proportions if we change the sample size to 50? Explain.

8. What do you think will happen if we change the sample size to 500? Explain.

Test your conjecture. Set the **number of samples (*num samples*)** in the applet to 50. Complete the table below

Sample Size	Mean of the Sampling Distribution	Standard Deviation of the Sampling Distribution
$n = 25$		
$n = 50$		
$n = 500$		
$n = 5$		

9. As the **sample size** increases, what happens to the spread of the distribution?

10. Now, describe the effect of sample size on the distribution of sample statistics in terms of shape, center and spread.