Activity Sheet

Estimating Population Parameters with M&M’S®

Background:
A population parameter is a number that describes some characteristic of a given population, which, in statistics, is the entire group of individuals about which we want information. The population parameter is a constant value that does not change. Many times it is impractical or even impossible to calculate the population parameter of interest, the most common reason being that populations are often composed of very large numbers of individuals. When we cannot calculate the population parameter directly, we use a sample, which is a part of the population from which we actually collect information. From the sample we calculate a statistic, which is a number that describes some characteristic of the sample. A statistic will vary depending on the sample from which it was calculated.

How are a sample and the population related? We use information from a sample (a statistic) to draw conclusions about a population parameter. We will use this relationship while performing the following investigation.

Problem:
Mars, Incorporated claims that when producing milk chocolate M&M’S®, 16% of the total number produced are green in color.

Question of Interest:
Is the claim that 16% of milk chocolate M&M’S® produced by Mars, Inc. are green a valid claim?

Instructions: Your class will be divided into pairs or small groups to perform the following investigation in order to answer the question above.

STEP 1: Preliminary questions.

1. What is the specific question that needs to be addressed in your investigation?

2. How does this question relate to the background information at the beginning of the activity? Be sure to use some of the bold-faced terms in your answer.

3. What is the population of interest in the investigation?

4. What is the population parameter of interest in the investigation?
5. Why can we not realistically calculate the population parameter of interest directly?

6. How could the concept of random sampling be used to investigate the population parameter of interest?

Your group will now be given two bags of milk chocolate M&M’S® whose contents will be places in a large bucket at the front of the class. Teachers should ensure there are at least 300 M&Ms in the bucket. Groups will then come up to the bucket one-by-one and grab without looking 30 M&Ms. The group will make note of the number of M&Ms of each color, place the sampled M&Ms back in the bucket, and repeat the process again. Once two samples are recorded, the group will return to their seats to answer the questions in Steps 2 through 4.

STEP 2: Answer the following questions before using the samples of M&M’S® in your investigation.

1. What are we interested in finding out about each of the samples of M&M’S®?

2. What information do we need in order to answer our question or investigate the claim that 16% of milk chocolate M&M’S® produced by Mars, Inc. are green? How can we use the samples of M&M’S® to obtain this information?

3. If the proportion of green M&Ms® is really 16% and we have approximately 300 M&Ms® in the bucket, how many green M&Ms would we expect?

STEP 3: Each pair or group of students will perform the following investigation using one sample of M&M’S®.

1. Count the number of M&M’S® in one of the samples you drew.

   Total number of M&M’S® in one sample ____________________________

2. Calculate the proportion of green M&M’S® in the sample.

   Proportion of green M&M’S® ____________________________
3. Give an estimate for the proportion of green M&Ms that Mars, Incorporate makes based on your sample.

4. Write the proportion you have found in (2) on the post-it note you were given and place it in the appropriate position on the dot plot your teacher has drawn on the board. Did every package have the same proportion of green M&M’S®?

5. What value is at the center of the dot plot constructed by using one sample per group? Is it a coincidence that the value is close/far to the 16% claimed by Mars, Incorporated?

6. Mars, Inc. claimed that 16% of milk chocolate M&M’S® produced are green. Does the information on the dot plot seem to support this claim? Why or why not?

7. Define each of the following in the context of the investigation you are performing with one package of M&M’S®.

   Population of interest
   _______________________________________________________________________

   Population parameter of interest
   _______________________________________________________________________

   Sample (drawn from population of interest)
   _______________________________________________________________________

   Statistic (used to estimate population parameter of interest)
   _______________________________________________________________________

   _______________________________________________________________________

STEP 4: Each pair or group of students will perform the following investigation using two samples of M&M’S®.

1. Use the second sample of M&M’S® taken from the bucket and combine it with the first in order to count the total number of M&M’S® in the samples.

   Total number of M&M’S® in two samples __________________________

2. Calculate the proportion of green M&M’S® in the overall sample.

   Proportion of green M&M’S® in two samples __________________________


3. Write the proportion you have just found on the post-it note you were given and place it in the appropriate position on the dot plot your teacher has drawn on the board. Did every group have the same proportion of green M&M’S® in two packages?

4. Give an estimate for the proportion of green M&Ms that Mars, Incorporate makes based on your overall sample.

5. What value is at the center of the dot plot constructed by using the overall samples of each group? Is it a coincidence that the value is close/far to the 16% claimed by Mars, Incorporated?

6. Mars, Inc. claimed that 16% of milk chocolate M&M’S® produced are green. Does the information on the dot plot for two packages seem to support this claim more or less than the information obtained from one package? Why or why not?

7. Define each of the following in the context of the investigation with two samples of M&M’S®.

   Population of interest ________________________________

   Population parameter of interest ________________________

   Sample (drawn from population of interest) ___________________

   Statistic (used to estimate population parameter of interest) __________________

8. What type of changes occurred in the dot plot when you used two samples of M&M’S® instead of one?

9. If you only had one sample to base your estimate on, how far off might your estimate be? What would be the worse case scenario with one sample shown on the dot plot? What would the worse case scenario be if you had two samples?