**Tossing M&M’s**

Gather the following materials: M&Ms (Don't eat them!)

Paper cup for M&Ms

Paper plate or other surface for "tossing" M&Ms

Directions: In your groups, start with 2 M&Ms in your cup.

Toss the M&Ms on your plate.

Count the number of M&Ms that landed with the “*m*” logo facing up.

Take that number of M&Ms from the bag and add to your cup along with all the M&Ms tossed on the plate. Now you are ready for the next roll.

Repeat this process for 10 trials or until you get past 90 M&Ms.

Fill out the table as you go.

Example. Trial 0: Start with 2 M&Ms, toss, 1 M&M facing up, add 1 M&M

Trial 1: Now there are 3 M&Ms to toss 2 M&Ms facing up, add 2 M&Ms

Trial 2 Now there are 5 M&Ms to toss 5 M&Ms facing up, add 5 M&Ms

Trial 3 Now there are 10 M&Ms to toss

1. Now perform your group experiment and record your data in the table as you go. One student will toss, one will count, and one will record. When you are done, graph your results.



|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| |  |  | | --- | --- | | **Trial #** | **# M&Ms**  **Tossed** | | 0 | 2 | | 1 |  | | 2 |  | | 3 |  | | 4 |  | | 5 |  | | 6 |  | | 7 |  | | 8 |  | | 9 |  | | 10 |  | |  |

1. Are the data from the trials linear? Explain why or why not.

1. Is there a constant rate of change in the table? Explain why or why not.
2. Fill out the table below to see if we can find any pattern in the data.

* Find the difference between the outputs (#M&Ms) of the trials: (new – previous).
* Find the ratio between the outputs (#M&Ms) of the trials: (new)/(previous).

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Trials**  **(new to previous)** | 4 to 3 | 5 to 4 | 6 to 5 | 7 to 6 | 8 to 7 | 9 to 8 | 10 to 9 |
| **Difference** |  |  |  |  |  |  |  |
| **Ratio** |  |  |  |  |  |  |  |

1. What pattern do you see in the differences on successive trials? Do the differences increase, decrease, or stay the about the same?
2. What pattern do you see in the ratios on successive trials? Do the ratios increase, decrease, or stay about the same?

**Exponential Functions**

Your data may be modeled with an exponential function, which we can call the “M&M function.” Recall that an exponential function has the form , where *a* is the initial value and *b* is the growth factor.

1. In your data, where do you find the initial value?
2. What is the initial value for the M&M function?
3. Estimate the growth factor for the M&M function.
4. Look at the table in question 4. Where do you think the growth factor should appear?
5. Does the exact growth factor appear in the table?
6. Why do you think the ratios in the table do not exactly match the growth factor every single time?
7. Write an equation for the M&M function.
8. Fill out the following table using the M&M function. (Round the number of M&Ms to the nearest integer.)

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Trial #** | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 |
| **# M&Ms** |  |  |  |  |  |  |  |  |
|  |  |  |  |  |  |  |  |  |
| **Trial #** | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 |
| **# M&Ms** |  |  |  |  |  |  |  |  |

1. According to the table, how many new M&Ms are added between:

Trials 0 and 1: \_\_\_\_\_\_\_\_ Trials 1 and 2: \_\_\_\_\_\_\_\_ Trials 2 and 3: \_\_\_\_\_\_\_\_

Trials 12 and 13:\_\_\_\_\_\_\_\_ Trials 13 and 14:\_\_\_\_\_\_\_\_ Trials 14 and 15:\_\_\_\_\_\_\_\_

1. What do you notice about the change in the earlier trials compared to the change later on?

1. Summarize the differences between a linear function and an exponential function.

**Extending the M&M Function**

1. A 7-ounce bag of M&Ms has about 210 pieces of candy. How many trials would it take to use an entire bag of M&Ms? Estimate an answer.
2. A 10-pound bag of M&Ms holds about 5,000 pieces of candy. How many trials would it take to use the whole bag? Estimate an answer.
3. Suppose we wanted to continue our experiment for 50 trials. How many M&Ms do you think we would need? Estimate an answer.

**Using Technology to Explore the M&M Function**

Enter the data from your group’s initial experiment into L1 and L2 on your graphing calculator. Find an exponential regression equation to model the data. (Press STAT 🡪 CALC, and scroll down to “0 ExpReg.”)

1. Use your calculator to find the exponential equation that models your data. Write the equation below.
2. Is this equation exactly the same as the equation from question 13? Is the equation similar to the equation from question 13? Why do you think this is the case?
3. Use your calculator to answer question 18. Write the answer below. How close was your estimate?
4. Use your calculator to answer question 19. Write the answer below. How close was your estimate?
5. Use your calculator to answer question 20. Write the answer below. Is this surprising? Explain why or why not.