Count the Differences Name ___________________
Student Activity Class ___________________

Problem 1 – Review Linear Functions

When studying linear functions, you were able to find the slope by finding the difference between the *x*- and *y*-values and writing them as a ratio.

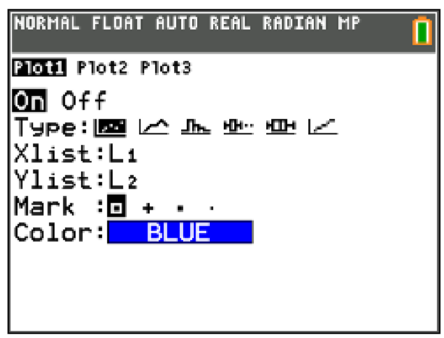
For the data in **L1** and **L2**, press [stat] [enter] and find the difference between consecutive *y*-values and write an equation that fits the data.

1. Use the table to help you record the differences.

x **(L1)**	***y*** **(L2)**	**1st difference**

To observe the graphs of the data as well as your equation:

- Press [2nd] [stat plot] and press [enter] to select **1:Plot 1**. Change the settings to match the screen to the right.
- Press [y=] and key-in your equation in **Y1**.
- Press [zoom] and select **9:ZoomStat** to observe the graph.



2. What is the relationship between the degree of a linear function and the number of times you had to subtract the *y*-values to find the same difference?

Problem 2 – Finding Finite Differences, Part 1

For the data in **L3** and **L4** again find the difference of consecutive *y*-values (i.e. $f(2) - f(1)$). Keep repeating until the differences are the same.

3. Use the table to help you record the differences.

***x* (L3)**	***y* (L4)**	**1st difference**	**2nd difference**	**3rd difference**

Next, follow the procedure in Problem 1 to examine the graph of the data points (be sure to change **L1** and **L2** to **L3** and **L4**) and find an equation that models the data. Note the relationship between the degree of the equation and the number of times you took the difference.

4. How many times did you have to find the difference between the *y*-values until they were all the same?

5. What is the function that models the data?

6. What type of function models the data?

Problem 3 – Finding Finite Differences, Part 2

For the data in **L5** and **L6**, find the difference of consecutive *y*-values. Keep repeating until the differences are the same.

7. Use the table to help you record the differences.

x	*y*	1st difference	2nd difference	3rd difference

Next, follow the procedure from Problem 1 to examine the graph of the data points (be sure to change **L3** and **L4** to **L5** and **L6**) and find an equation that models the data. Note the relationship between the degree of the equation and the number of times you took the difference.

8. How many times did you have to find the difference between the *y*-values until they were all the same?

9. What is a function that models the data?

10. What type of function models the data?

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Extension – Using Matrices to Find Equations

For Problem 1, the data is modeled by the polynomial $y = ax + b$. We can use matrices to find the values of a and b.

11. Write the general form of a linear equation two times. In one of them, substitute the x- and y-values of third point. In the other, substitute the x- and y-values of the fourth point. You will now have a system of equations.

12. Now write the equation as a matrix equation. (Part of it is done for you.)

$$\begin{bmatrix} \square & \square \\ \square & \square \end{bmatrix}\begin{bmatrix} a \\ b \end{bmatrix} = \begin{bmatrix} 5 \\ 2 \end{bmatrix}$$

13. Use the inverse of a matrix to solve the matrix equation. You should find the same values for a and b as in Problem 1.

14. You can use the same process for Problems 2 and 3 by using the general equations for a quadratic and cubic polynomial and substituting in the correct number of points to get the equation. Write the system of equations and the matrix equation below before solving the matrix equation on your calculator.