Successive Differences

ID: 10124

Time required
45 minutes

Topic: Exponential & Radical Functions

- *Calculate successive differences for data on a spreadsheet to determine whether the function that best models the data is linear, quadratic or exponential.*
- *Find the regression equation (linear, quadratic or exponential) that best models a given set of data.*

Activity Overview

Students explore the relationships between the side length and perimeter of a square and the edge length and surface area of a cube by manipulating geometric models. They use the models to generate a dataset, calculate successive differences, and use them to determine which type of function best models the relationship. Finally, they graph the data set as a scatter plot and use the handheld's regression tools to evaluate their conclusion.

Teacher Preparation

- *This activity is appropriate for an Algebra 1 classroom. Students should have experience with sequences, linear and polynomial equations, and fitting a regression line to a set of data.*
- *One way to complete the activity is to demonstrate Problem 1 to the whole class and then allow students to work individually or in small pairs to complete Problem 2, which is very similar.*
- ***To download the SQUARE and CUBE Cabri Jr. files and student worksheet, go to education.ti.com/exchange and enter "10124" in the quick search box.***

Classroom Management

- *This activity is intended to be **student-centered** with periods for **teacher-led class discussion**. You should seat your students in pairs so they can work cooperatively on their handhelds. You may use the following pages to present the material to the class and encourage discussion. Students will follow along using their calculators.*
- *The student worksheet provides detailed instructions for the completion of the activity and a place for students to record their work. You may wish to have the class record their answers on separate sheets of paper, or just use the questions posed to engage a class discussion.*

TI–84 Plus Applications

Cabri Jr.

Successive Differences

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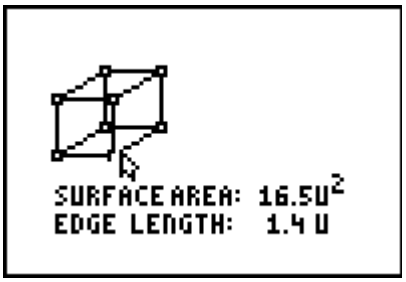
In this activity, you will explore:

- *successive differences*
- *choosing a function type to model data*

Use this document as a reference. Record your answers on the worksheet.



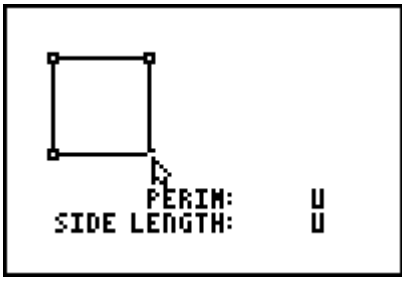
Problem 1 – Perimeter and Side Length

How does changing the side length of a square change its perimeter?

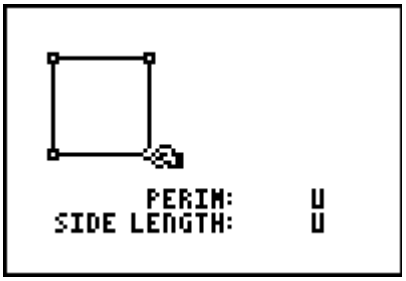
What is the relationship between side length and perimeter: linear, quadratic, or cubic?

Start the Cabri Jr. App. Press [Y=] and choose Open…. Select the file **SQUARE** and press [ENTER].

The model shows a square with an adjustable side length. To resize the square, move your cursor over the **lower right** corner of the square. The arrow will turn white.

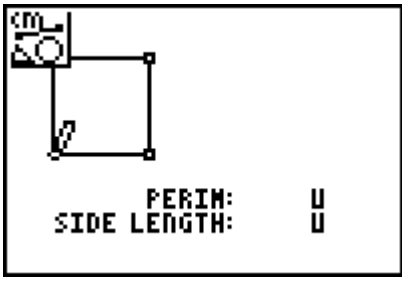


Press [ALPHA] to "grab" the point. The cursor will look like a closed fist. Use the right and left arrows to move the point and adjust the side length of the square. Press [CLEAR] to let go of the point.

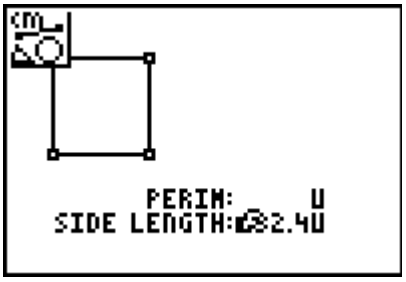


Measure the side length of the square. Press [GRAPH] to open the F5: Appearance menu. Choose **Measure > D. & Length**.

Choose two adjacent corners of the square to measure the length of the side between them.

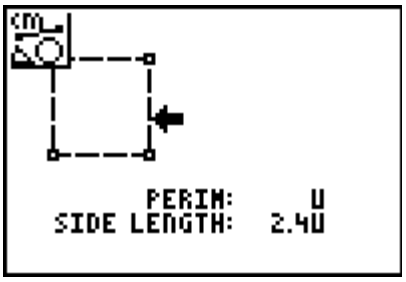


Move the measurement next to the words SIDE LENGTH: and press [ENTER].



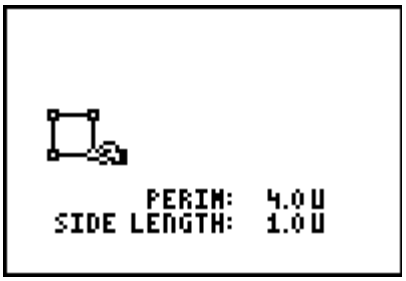
Next, measure the perimeter of the square. While still in the **D. & Length** tool, move your cursor over a side of the square (not a corner) so that the whole square is flashing. Press ENTER.

Place the measurement next to the word **PERIM:**.

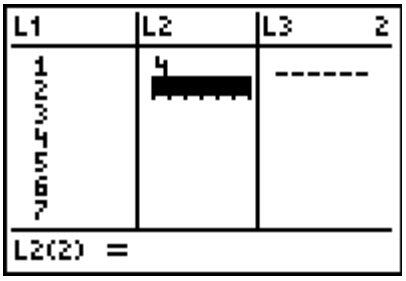


Press CLEAR to exit the D. & Length tool. Grab and drag the lower right corner of the square. What happens to the side length and perimeter?

Use the model to complete the table on your worksheet.



Press 2nd + MODE to exit Cabri Jr. Then press STAT then ENTER to open the List Editor. Copy the data from the table into **L1** and **L2**.



Successive differences measure how data is changing.

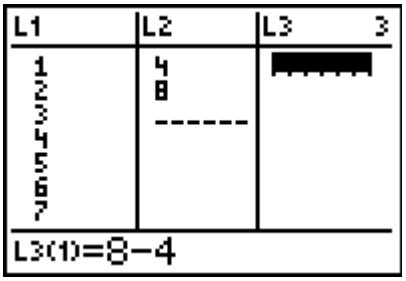
As you move down the table, the side length increases one unit at a time. But how does a one unit increase in side length affect the perimeter?

For example, how does increasing side length from 1 to 2 change the perimeter? You can calculate 8 – 4 to find the change.

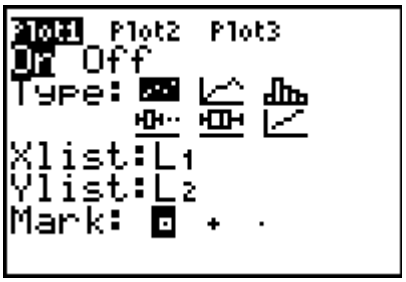
If all the successive differences are the same, it means that a 1-unit change in the *x*-values always yields the same size change in the *y*-values. In other words, **if the successive differences are constant, the data is linear!**

Calculate the successive differences in **L3**. Subtract the first perimeter from the second, the second from the third, and so on.

Then answer the questions on your worksheet.

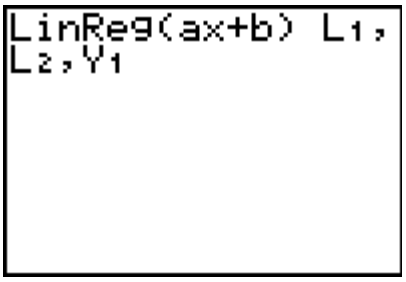


Verify your answers by graphing the data as a scatter plot. Go to **Zoom > ZoomStat** to view the data in an appropriately sized window.



Add a regression line. Go to **Stat > Calc** and choose the appropriate regression from the list and graph it.

The command shown calculates the linear regression of **L1** and **L2** and stores the result in **Y1**. (To enter Y1, go to Vars > Y-Vars > Function.)

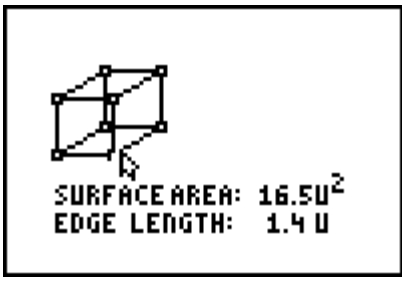


Problem 2 – Surface Area and Edge Length

How does changing the edge length of a cube change its surface area?

What is the relationship between edge length and surface area: linear, quadratic, or cubic?

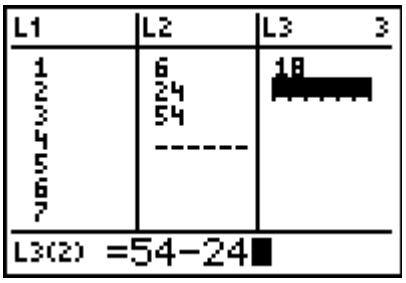
In Cabri Jr, open the file **CUBE**. This file contains a model of a cube that can be adjusted by dragging the **lower right** corner of the front face of the cube. The edge length and surface area have already been measured for you.



Use the model to answer the question and complete the table on your worksheet. Use the instructions for Problem 1 as a guide if necessary.

Copy the data from the table into **L1** and **L2**. Calculate the successive differences in **L3**.

To clear data from a list, move the cursor to the title of the list and then press [CLEAR] [ENTER].



This time the differences are not all the same, so the data is not linear!

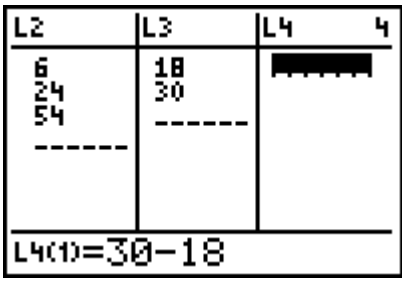
The differences you calculated in L3 are called **first differences**. They are the differences between the function values or *y*-values. If the first differences are not all the same we can calculate the **second differences**, the differences between the first differences.

If the second differences are constant, the data is quadratic.

Calculate the second differences in **L3**. Subtract the first differences in L3 from the second difference, the second from the third, and so on.

Then answer the questions on your worksheet.

Verify your answers by graphing the data as a scatter plot. Add a regression equation and answer the questions on your worksheet.



Problem 3 - Exercises

Complete the exercises on your worksheet.

Solutions

1. quadratic $y = 2.4x^2 - 3$
2. cubic $y = 0.5x^3 - 25$
3. none
4. linear $y = 2x - 7$