

Circulation System: River of Life-Teacher

Concepts

- Analyzing and interpreting data
- Performing regressions

Materials

- TI-Nspire™ Math and Science Learning Handheld
- *PTE-Alg-RiverLife_Soln_EN.tns*

Overview

In this activity, students will utilize the Lists & Spreadsheet application to investigate the relationship between the mass of a person and that person's volume of blood. They will enter data into a spreadsheet, plot the data, determine the regression equation, and use the regression equation to answer questions.

Teacher Preparation

This investigation offers opportunities for review and consolidation of key concepts related to data analysis and linear regression. As such, care should be taken to provide ample time for ALL students to engage actively with the requirements of the task, allowing some who may have missed aspects of earlier work the opportunity to build a new and deeper understanding.

Students will begin by creating a new TI-Nspire™ document. Therefore, they should have some familiarity with the TI-Nspire™ handheld (using the Lists & Spreadsheet application to enter data and perform regressions, using the Graphs & Geometry application to create scatter plots and graph lines) and also some experience with lines of best fit.

The following pages provide step-by-step instructions as to how to perform tasks using the TI-Nspire™ technology. It may be shared with students, as needed, to guide them through the activity.

- Load the teacher .tns document
PTE-Alg-RiverLife_Soln_EN.tns.

Classroom Management

This activity is designed to be student-centered—the teacher may act as a facilitator while students work cooperatively, particularly to aid students in performing the specific actions using the tools of the TI-Nspire™ handhelds.

The student worksheet is intended to guide students through the main ideas of the activity and presents questions that ask them to use their handhelds to analyze and interpret the data. It also serves as a place for students to record their answers.

The .tns document entitled *PTE-Alg-RiverLife_Soln_EN.tns* shows the expected results of working through the activity (lists populated, regression performed, and data plotted).

There is no student .tns document—students begin with a blank document.

Circulation System – The River of Life

Scenario:

Blood is a body part that is often overlooked because it is made up, in large part, of liquid. This liquid portion of the blood is plasma, while the solid portion is the various blood cells. What relationship exists between the body mass and blood volume of a human?

The table below shows how body mass (in kilograms) and blood volume (in liters) are related.

Mass (kg)	Blood Volume (L)
30	2.5
40	3.4
50	4.3
60	5.2
70	6.1
80	7.0
90	7.9
100	8.8
110	9.7
120	10.6

It should be clear from the above data, and our own understanding, that the volume of blood increases with body mass. More mass means more veins, arteries, and capillaries to move the nutrients and waste to and from the cells.



(Adapted from Jeff Lukens and Bob Tower
2001: Activity 11 The River of Life in
Explorations: Biology with the TI-83 Plus
Texas Instruments p. 97–105.)

Procedure



1. Create a new document on your TI-Nspire™ handheld, and add a Lists & Spreadsheet application (Figures 1 and 2).

Data Entry in Lists




2. In Column A, type in the **Mass** readings from the table on page 2 of this activity.
3. In Column B, type in the **Volume** readings.

Tip: Pressing   returns you to the top of a list.

Column Headings

4. Move the cursor into the heading space of Column A, and type **mass** as the List name.
5. Press .
6. Type **volume** as the List name for Column B.
7. Press  (See Figure 3).

Changing the Column Width

8. Go to the    for Menu 1:Actions, 2:Resize (Figure 4).

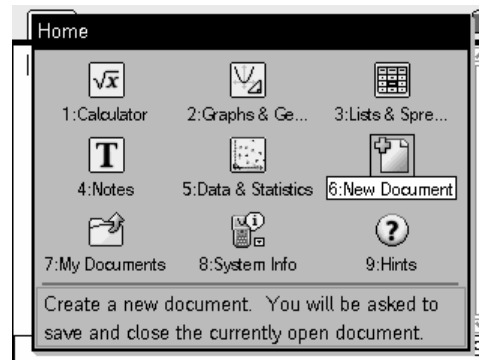


Figure 1

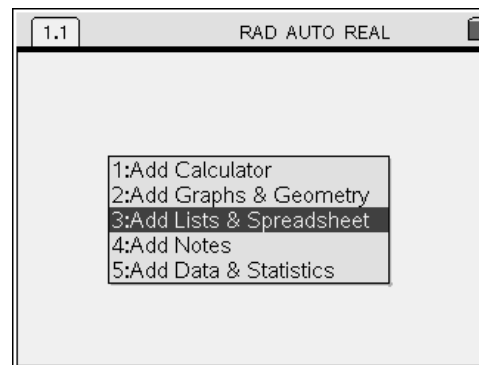


Figure 2

The image shows the TI-Nspire Lists & Spreadsheet application with a table of data. The table has columns A through G and rows 1 through 5. The data is as follows:

	A	B	C	D	E	F	G
1	30	2.5					
2	40	3.4					
3	50	4.3					
4	60	5.2					
5	70	6.1					

The status bar at the bottom shows 'B1 | 2.5'.

Figure 3

The image shows the TI-Nspire Lists & Spreadsheet application with the menu open. The menu path is: 1: Actions, 2: Insert, 3: Data, 4: Statistics, 5: Function Table, 6: Sort. The '2: Resize' option is highlighted.

	A	B	C	D	E	F	G
1	30	2.5					
2	40	3.4					
3	50	4.3					
4	60	5.2					
5	70	6.1					

The status bar at the bottom shows 'A mass'.

Figure 4

9. Press \blacktriangleright (a few times) to incrementally change the width of the column (See Figure 5).
10. When the column is the desired width, press enter and then esc .

Using Formulas in a Column

In Column C, we will create a finite difference calculation for the first difference of the volume.

11. Move to cell C1.
 - The cell name appears in the status bar.
12. Create a formula for the difference in the volume by using $= B2 - B1$ (Figure 6).
13. Press enter .
14. Return to cell C1, and press ctrl ↓ to select the cell.
15. Press \blacktriangledown to drag down the formula to fill the column to C9 (Figure 7).
16. Press enter .
 - Do the first-difference values support the idea that a linear regression model is an appropriate regression model?

	A mass	B volume	C	D	E	F
1	30	2.5				
2	40	3.4				
3	50	4.3				
4	60	5.2				
5	70	6.1				

Figure 5

	A mass	B volume	C	D	E	F
1	30	2.5	=B2-B1			
2	40	3.4				
3	50	4.3				
4	60	5.2				
5	70	6.1				

Figure 6

	A mass	B volume	C	D	E	F
1	30	2.5	.9			
2	40	3.4				
3	50	4.3				
4	60	5.2				
5	70	6.1				

Figure 7

Alternate Method

17. Move to the formula cell (in gray and marked with a diamond symbol).
18. Type = .
19. View the catalog by pressing $\text{2nd} \text{ } \left[\frac{\square}{\square} \right]$.
20. Select the math functions tab (denoted by 2: $\int \Sigma$).
21. On the catalog math functions tab, use the NavPad cursor controls to move \blacktriangledown to the item named List.
22. Press enter or $\text{2nd} \text{ } \left[\frac{\square}{\square} \right]$ to open this item.
23. Move to the Operations item, and press enter or $\text{2nd} \text{ } \left[\frac{\square}{\square} \right]$ again (See Figure 8).
24. Move to Difference List, and press enter or $\text{2nd} \text{ } \left[\frac{\square}{\square} \right]$ to select it (Figure 9).

25. Type in the list name (in this case, `volume`), and press enter (See the results in Figure 10).

Tip: Pressing $\text{ctrl} + \text{Z}$ undoes the last action.

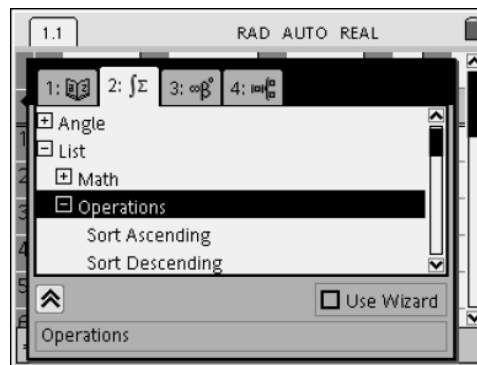


Figure 8

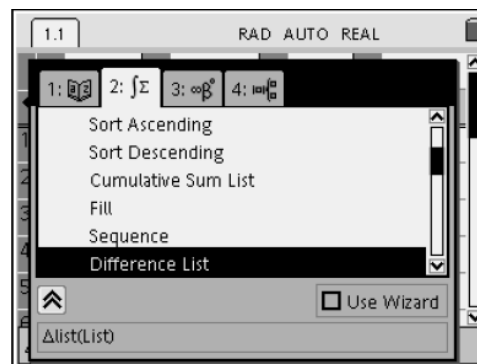


Figure 9

	A	B	C	D
	mass	volume		
1	30	2.5	.9	.9
2	40	3.4	.9	.9
3	50	4.3	.9	.9
4	60	5.2	.9	.9
5	70	6.1	.9	.9
DI =.9				

Figure 10

The Regression Line

Since we can assume a linear regression model is appropriate for this relationship, we now need to find the regression equation.

26. Press **(menu)** **(4)** **(1)** **(3)** for Menu 4:Statistics, 1:Stat Calculations, 3:Linear Regression (mx+b) (Figures 11 and 12).
27. To select the independent variable for the X-List from the lists named in the drop-down, press **▼** on the NavPad to reveal the available list names.
28. Select **mass**, and press **(enter)**.
29. Press **(tab)** to move to the Y-List, and repeat the above to select the dependent variable, **volume** (Figure 13).
30. Press **(tab)** again to define a name for the regression equation.
31. Save the regression equation as **f1** (Figure 14).
32. Continue pressing **(tab)** until you get to the 1st Results Column option.
33. Enter a column name from the spreadsheet where you want the regression information to be placed.

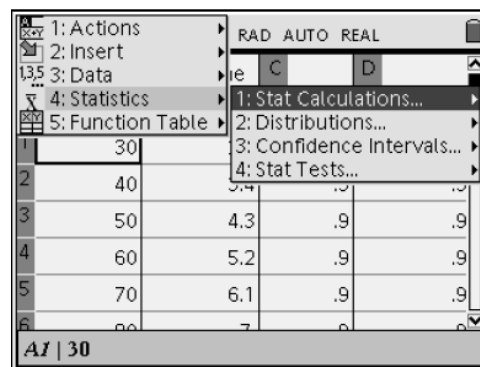


Figure 11

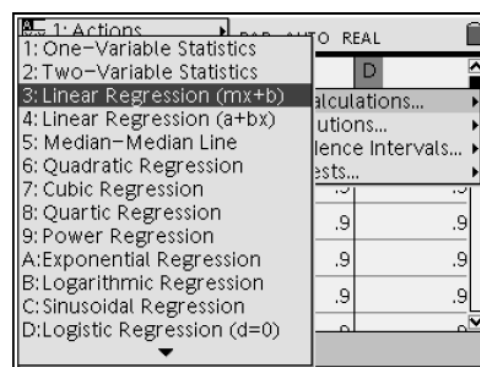


Figure 12

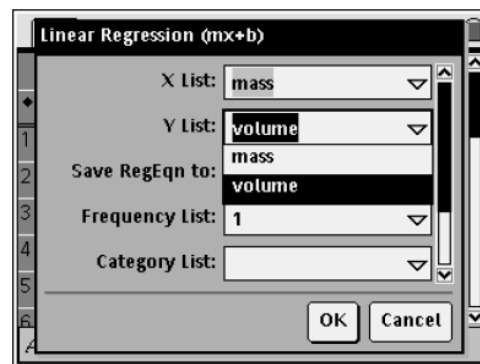


Figure 13

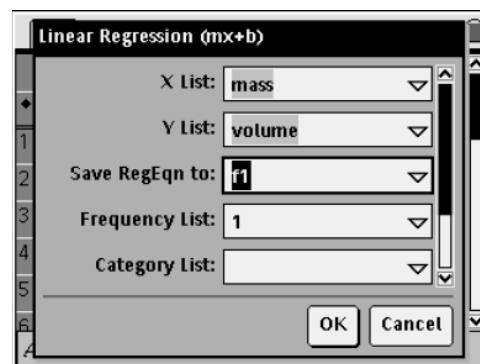


Figure 14

- The column name is entered as a letter followed by brackets, such as $g []$ (Figure 15).

34. Press **tab** to OK, and press **enter**.

35. Expand the columns where the data was placed to clearly see the values (Figure 16).

The Function Table

Now that a function has been defined, a table of values can be established.

36. Press **menu** **5** **1** for Menu 5:Function Table, 1:Switch to Function Table.

37. Select the function required.

- The function we are interested in is **f1** (Figure 17).

38. Once in the function table, you can access the function table menu and alter the settings (Table Start, Table Step, and Auto/Ask for Independent/Dependent variable) (See Figure 18).

39. Press **menu** **1** **3** for Menu, 1:Function Table, 3:Edit Function Table Settings.

Tip: **ctrl** + **T** toggles between the Function Table and the Lists & Spreadsheet application.

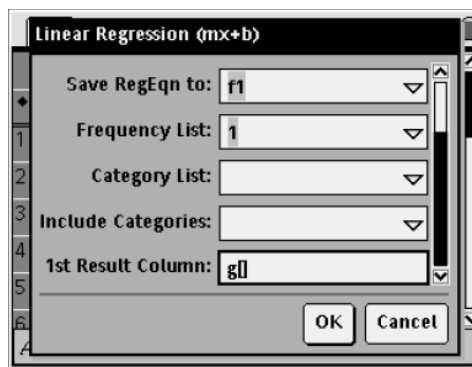


Figure 15

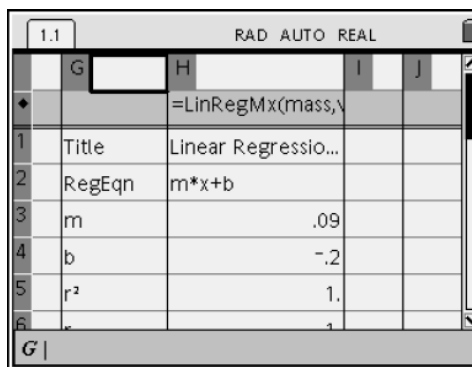


Figure 16

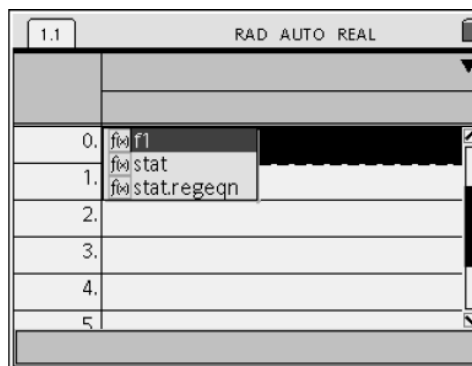


Figure 17

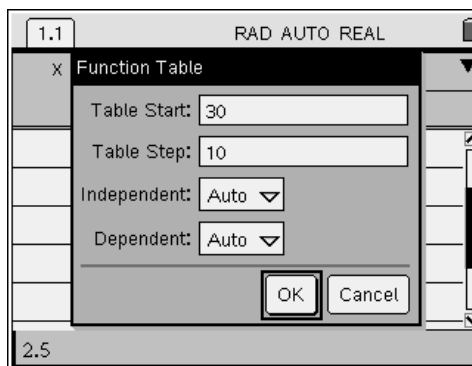


Figure 18

The Scatter Plot

A scatter plot of this data can also be established, and since the function **f1** is defined, a line of best fit can be overlaid on the scatter plot.

40. Add a new page (press **ctrl** **I**) with the Graphs & Geometry application.
 41. Press **menu** **3** **4** for Menu 3:Graph Type, 4:Scatter Plot (Figure 19).
 42. Press **enter** to open the drop-down menu for the independent variable, and select **mass**.
 43. Press **tab** or **▶** on the NavPad, and repeat the above to select the dependent variable **volume** (Figure 20).
 44. Press **menu** **4** **9** for Menu 4:Window, 9:Zoom-Data (Figure 21).
 - The points of the scatter plot will appear.
 45. To display the regression equation, go to the Graph Type menu, and select Function.
 - The Function Entry Line should appear at the bottom of the screen.
 46. Press **▲** to access the defined regression equation **f1**, and press **enter** (Figure 22).
- Tip: Pressing **ctrl** + **G** toggles hiding and showing the Entry Line.

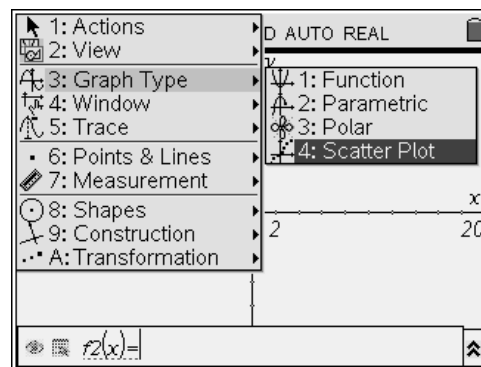


Figure 19

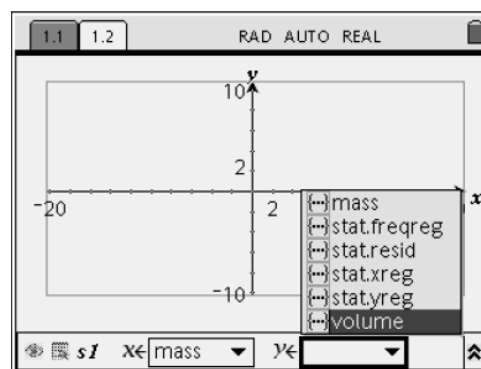


Figure 20

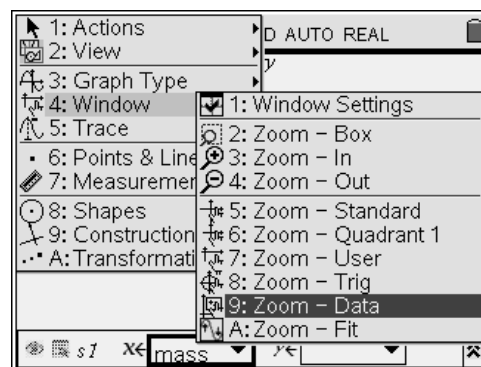


Figure 21

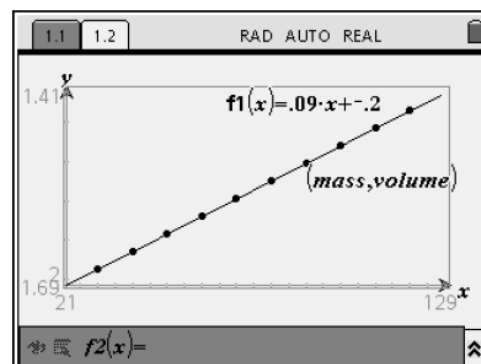


Figure 22

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