

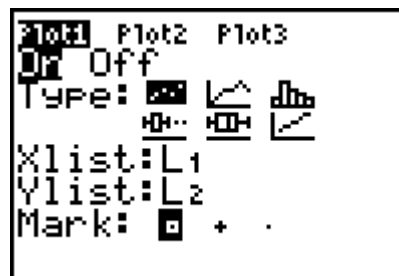
Problem 1 – Creating a model

Residents of a town near an airport are concerned that the noise levels in their community are not safe. They have hired you to perform an impact study to address their concerns. You will develop a model of the intensity of the noise in different areas surrounding the airport and use it to map safe and unsafe zones.

The table shows sound readings collected at various distances from the center airport (the source of the noise). Open the **List Editor** and enter the data into **L₁** and **L₂**.

Distance (m)	Sound Intensity (W/m ²)
76.808	0.001695
278.12	0.000129
337.975	0.000088
518.453	0.000037
321.854	0.000097
162.523	0.000379
229.805	0.000189
168.971	0.00035
302.731	0.000109

To begin your examination of the data, make a scatter plot. Press **2nd** **Y=** select **Plot 1** and change the settings as shown. Use the **ZoomStat** command to view the plot in an appropriate window.



It's hard to tell from the graph what type of model would be best for this data. Fortunately, we know that the laws of physics state that the intensity of a sound varies inversely with the square of its distance from the source.

Two variables *vary inversely* if, for a constant k ,

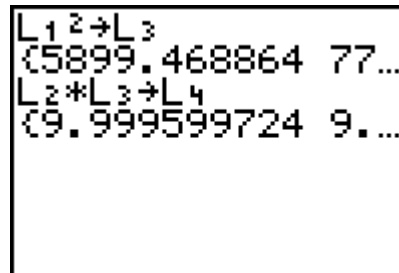
$$yx = k.$$

We say that one variable y varies inversely with the square of another variable x if, for a constant k ,

$$yx^2 = k.$$

Test to see if this relationship holds for the data collected. Calculate the squares of all the distances and store them in **L₃**. Then calculate the product of the intensity and the square of the distances and store it as **L₄**.

Go to the **List Editor** and examine the result.



1. What do you notice about L_4 ?
2. What is the constant of variation, k ? How do you know?

You have shown that

$$\text{intensity} \cdot \text{distance}^2 = k.$$

3. Use this relationship to write a function $I(d)$ that gives the intensity of the sound, I , at a distance d from the source.

Enter your function in Y_1 . You will know your model is correct if it passes through all the data points.

Problem 2 – Applying the model

The community association has defined of 3 noise-level zones.

Zone 1: Intensity < 0.000001 W/m².

Zone 2: $0.000001 < \text{Intensity} < 0.0001$ W/m².

Zone 3: Intensity > 0.0001 W/m².

4. One zone is unsafe for houses; another is an impact zone, where people will be allowed to live if they aware of the risks, and another is safe for houses. Which is which?

Unsafe zone:

Impact Zone:

Safe Zone:

5. Describe the shape of each zone.

