BOUNCING BASKETBALL
INSTRUCTOR INFORMATION

Principal Author Jo Eary

Prerequisite Section 4.3, Modeling nearly exponential data

Comments

You need at least five or six bounces to get a good data set.

Hold the ball at least 18 inches from the motion detector when the ball is dropped. If the ball is closer, just throw out the first data point in your analysis.

Unless you are using a program that records the height of the ball with respect to time, your graph of the distance of the ball from the motion detector with respect to time will appear upside down to most students. To avoid extra confusion for students, after dropping the ball and collecting the distance data you can flip the graph to get the graph of the height of the ball before showing the data to the students. A quick and easy way to flip the graph of distance versus time is to use the max( ) statistics function on your calculator. Suppose the distance measurements are recorded in L4 . To get the graph of the height of the ball you can create a new list in L2 by storing [max (L4) − L4] in L2 . Now, with the time measurements in L1, you can graph L1 versus L2 and so view the height of the ball versus time.

After collecting the data, you can either trace the graph of height versus time to find the rebound heights together as a class or you can download the data into one calculator from each group and let each group trace to find the rebound heights.

Sample Data

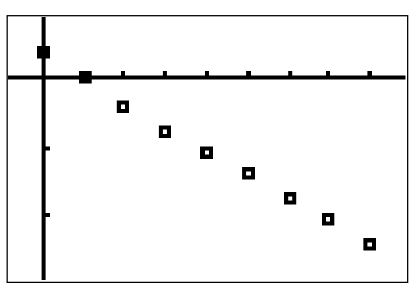
Rebound Height versus Number of Bounces

Number of bounces	0	1	2	3	4	5	6	7	8
Rebound height (meters)	1.49	1.00	0.67	0.476	0.34	0.25	0.18	0.13	0.09

Answers to Questions

Let H represent the rebound height (in meters) and b the number of bounces.

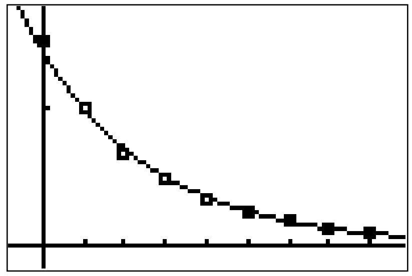
1. Here is the graph.



The rebound height data does appear exponential since the graph of $\ln H$ versus b is approximately linear.

2. The equation of the regression line is $\ln H = -0.344b + 0.333$.
3. Since $e^{-0.344} = 0.71$ and $e^{0.333} = 1.40$, we have $H = 1.4 \times 0.71^b$.

4. Here is the graph.



5. Just by observing the graph you can see that the rebound height decreases quickly at first but decreases less with each bounce. Since the decay factor in our formula is 0.71, the percentage decay rate for H is $1 - 0.71 = 0.29$, or 29%. Thus the rebound height decreases by 29% with each bounce.

6. We have a formula for H, and we want to use this to solve the equation $H(b) = 0.01$ for b. We can do so by using the crossing graphs method or simply by scrolling down a table of values for H. The result is that $H(14)$ is greater than 0.01, but $H(15)$ is less than 0.01. Thus we find that the ball stops bouncing after 14 bounces.