Half-Life

ID: 9288

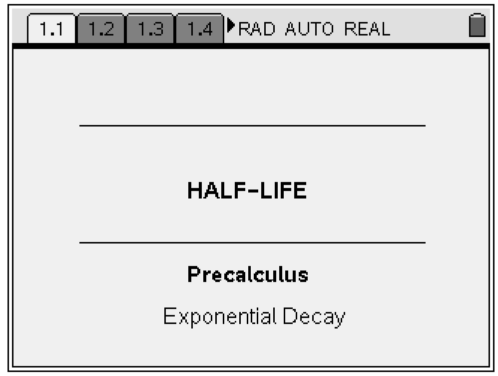
Name ______________________

Class ______________________

In this activity, you will explore:

- *Exponential decay*
- *Forecasting results based upon mathematical models*

Open the file *PreCalcAct09_HalfLife_EN.tns* on your handheld and follow along with your teacher to work through the activity. Use this document as a reference and to record your answers.



Problem 1 – Dropping Pennies

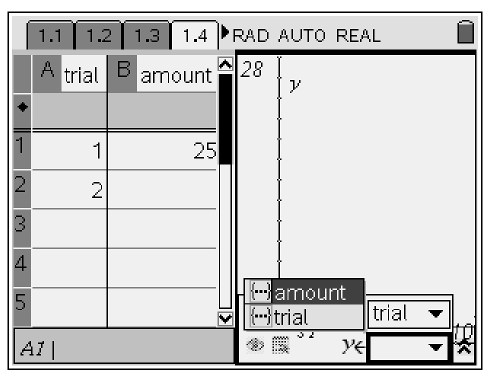
On page 1.4, the initial settings of the experiment have been entered in the first row of the table. A trial is when you drop the pennies and the amount is the number of pennies that landed heads up.

To begin the experiment, pick up the pennies and drop them on your desk. Remove any pennies showing tails and record the results (under the amount column, enter the number of remaining pennies.)

Continue this procedure until there are no more pennies remaining. Do <u>*not*</u> record the last trial when 0 pennies remain.

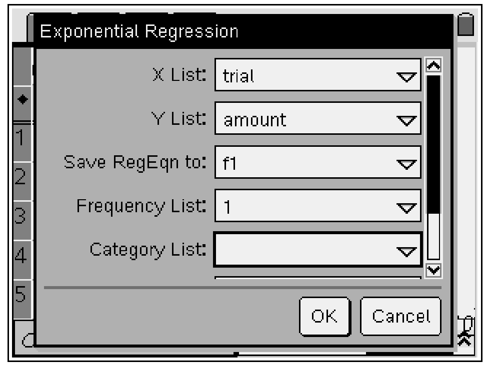
Trial	Amount
1	25
2	

To view the scatter plot of this data, move to the *Graphs & Geometry* application (press ctrl + tab) and select **Scatter Plot** from the Graph Type menu. Choose **trial** for the *x*-value and **amount** for the *y*-value.



To find the exponential regression equation for the data, return to the *Lists & Spreadsheet* application and move the cursor to cell C1. Select **Exponential Regression** from the Statistics menu.

Select **trial** for the X list and **amount** for the Y list, and set the RegEqn to save to **f1**. Then select **OK**.



To view the graph of the exponential regression equation, move to the *Graphs & Geometry* application and change the graph type to **Function** (**MENU > Graph Type > Function**). Press up on the **NavPad** until **f1** appears and press enter to graph it.

This is an exponential decay graph of rate $\frac{1}{2}$, which means that about half of the pennies are “lost” each trial.

Compare your data and equation to those around you.

- Are they similar or different?
- Explain why this occurs.

Problem 2 – Radioactive Decay

Often, predictions must be made without a complete data set. To explore this, suppose there are 35 grams of radioactive material and the amount of it remaining over time (days, amount) has been recorded as follows:
(0, 35), (2.2, 25), (4, 22.1), (5, 17.9), (6, 16.8)

Enter this data into the spreadsheet on page 2.2, and produce the scatter plot and exponential regression equation as you did in Problem 1.

The true power of regression is to forecast future results. To predict how much will be left after 15 days, go to page 2.4 and enter **f1**(15).

- Try other values and determine how many days it will take for there to be less than 1 gram of the material remaining.
- Will there ever be 0 grams remaining?

Exercises

1. **a.** Return to page 1.4. Clear out **f1**(*x*) from the *Graphs & Geometry* application, remove the last three data points from the spreadsheet, and re-compute the exponential regression equation. How does this equation compare to the one you initially obtained?

b. Insert a *Calculator* page. Forecast the values of the decayed data points that you deleted above. How well did this new regression equation predict the deleted data?

2. **a.** While this activity focused on exponential *decay*, it could also be used to explore exponential *growth*. Insert a new problem and a *Lists & Spreadsheet* page. Then enter the following world populations (in millions) into the data table.

(1995, 5691), (1996, 5769), (1999, 6003), (2001, 6157), (2003, 6311).

Compute the regression equation.

b. Insert a *Calculator* page, and use the regression equation to predict the population of the world for the year 2008.

c. Predict when the world's population reaches 100,000 million. (It may be helpful to create a scatter plot of the data.) Is this possible? Explain.