Half-Life – ID: 9288

By Pat Flynn

Time required
45 minutes

Activity Overview

Students will explore exponential decay through an experiment and use the gathered data to generate an exponential regression equation. Students will then repeat the process with a data set and forecast future results.

Concepts

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

Teacher Preparation

This investigation offers students an experimental way to generate data with pennies to produce an exponential regression graph and equation.

- *Students should have already studied linear regression and discussed what the correlation coefficient, r, represents.*
- *The screenshots on pages 2 and 3 demonstrate expected student results. Refer to the screenshots on page 4 for a preview of the student TI-Nspire document (.tns file).*
- ***To download the student and solution .tns files and student worksheet, go to education.ti.com/exchange and enter "9288" in the quick search box.***

Classroom Management

- *This activity is intended to be **teacher-led**. You may use the following pages to present the material to the class and encourage discussion. Students will follow along using their handhelds. Be sure to cover all the material necessary for students' total comprehension.*
- *The student worksheet PreCalcAct09_HalfLife_worksheet_EN is intended to guide students through the main ideas of the activity, while providing more detailed instruction on how they are to perform specific actions using the TI-Nspire handhelds. It also serves as a place for students to record their answers. Alternatively, 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.*
- *The TI-Nspire solution document PreCalcAct09_HalfLife_Soln_EN.tns shows the expected results of working through the activity.*

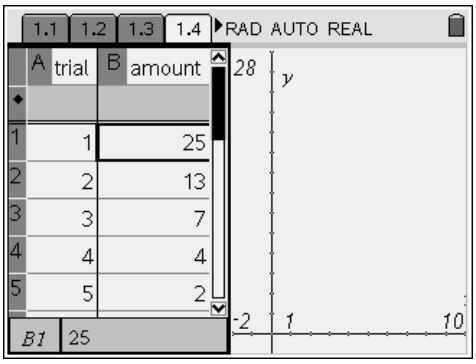
TI-Nspire™ Applications

Calculator, Graphs & Geometry, Lists & Spreadsheet, Notes

Problem 1 – Dropping Pennies

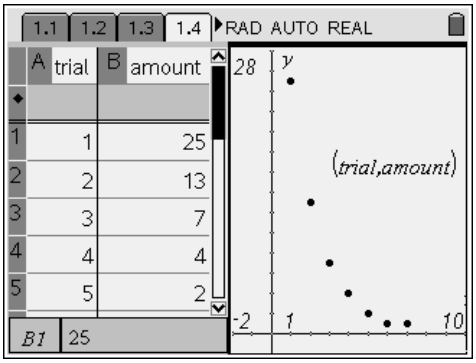
Students will begin the experiment by dropping pennies and then removing the pennies that land tails up. They will record the number of pennies that landed heads up. Students then repeat this process until there are no pennies remaining.

A sample experiment is shown at the right.



Next, students will produce a scatter plot of their data by selecting **trial** for the *x*-value and **amount** for the *y*-value. They may need to move the title of the scatter plot (*trial, amount*) and hide the entry line (ctrl + G) to see all the data points.

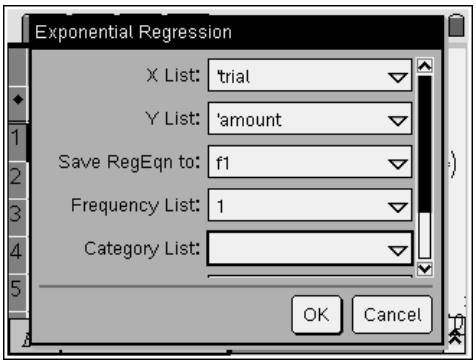
If students still are unable to see all the data points, they can select **Zoom – Data** from the Window menu.

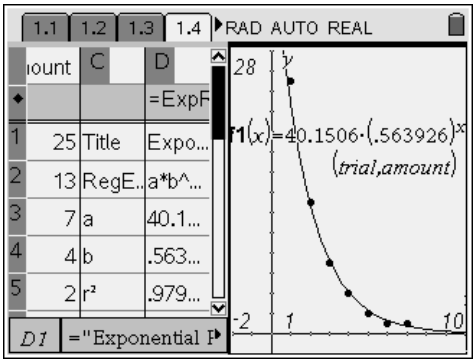


Students can calculate the regression equation by selecting **Exponential Regression** from the Statistics > Stat Calculations menu. They will need to choose **trial** for X List, **amount** for Y List and save the equation to **f1**. Make sure that students have **c[]** as the first result column.

Notice that the results are stored in individual cells in the *Lists & Spreadsheet* application and each of them is also stored as a variable for later use. Here would be a time for each student to compare *r*-values. While this indicates a good fit, it must be compared to the graph for validity.

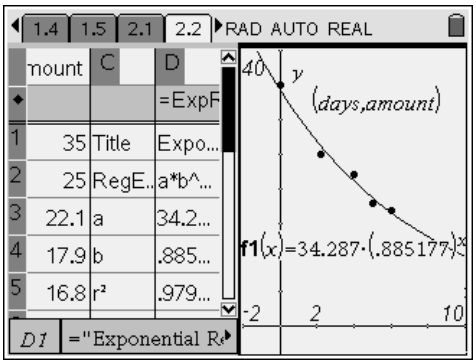
After the exponential graph is displayed, students can compare their graphs, data and equations to those around them. Have the students particularly discuss why everyone's results are not exactly the same.





Problem 2 – Radioactive Decay

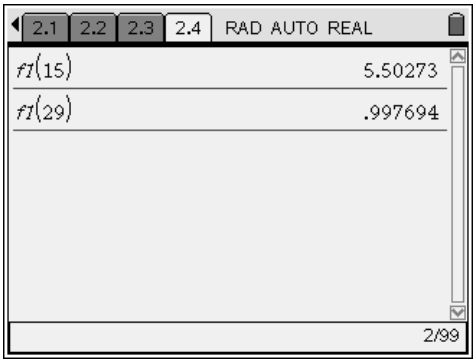
On page 2.2, students are to enter the data given, produce a scatter plot, and calculate the exponential regression equation.



On page 2.4, the student enters the function notation for the desired data point. In this problem, it is **f1**(15).

There are 5.50273 grams left after 15 days.

It will take 29 days for there to be less than a gram remaining. Theoretically, there will never be 0 grams remaining.



Solutions – Student Worksheet Exercises

1. **a.** Answers will vary. Sample response: The equations are not identical, but are close.

b. Answers will vary. Sample response: The values are close, but not identical, since it is only a prediction.

2. **a.** Regression equation is approximately $3.45*(1.01)^x$.

b. Prediction is 6566.12 million. The actual answer is 6605 million.

c. The population of the world would reach 100,000 million in the year 2222. It could be possible, but the world can only hold a finite number of people.

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(Student)TI-Nspire File: *PreCalcAct09_HalfLife_EN.tns*