

Hot Water (Class Activity for Section 3: Applications of Graphs)

The difference in temperature between a warm object and its surrounding temperature can be modeled by a decreasing exponential function. We took a cup of hot water, heated it in a microwave, and allowed it to cool on the kitchen counter. We recorded the temperature of the water (in degrees Celsius) every 5 min for 85 min. The following table shows our results.

Time (min)	0	5	10	15	20	25	30	35	40
Temperature (°C)	64.9	58.8	54.0	50.1	46.8	44.0	41.6	39.4	37.5
Time (min)	45	50	55	60	65	70	75	80	85
Temperature (°C)	35.9	34.5	33.3	32.0	30.8	29.9	29.0	28.2	27.6

Because the *difference* in temperature between a warm object and its surrounding temperature can be modeled with an exponential function, we first need to transform our data. The surrounding temperature (the temperature of the kitchen) was 21.4°C .

1. Transform the table so that the output is the *difference* in temperature between the cup of water and the kitchen. Show a plot your transformed data. Describe the shape of your graph in terms of concavity and increasing/decreasing.
2. Use exponential regression on your calculator to determine an equation of an exponential function that fits the data. [Stat > Calc > 0:ExpReg] Give your equation.
3. Plot your transformed data along with your function. Does your function do a good job of modeling the data?
4. There are two numbers in your exponential regression equation from question 4. One is the y -intercept and the other is the growth (or decay) factor.
 - a) What is the y -intercept of your exponential regression equation? Is this close to the initial temperature difference of the water?
 - b) The growth factor in your exponential function should be between 0 and 1. When this is the case, it is often called a decay factor since the function is getting smaller and smaller. For example, if the decay factor is 0.7, this means after each minute, the temperature is 70% of what it was. (Or that it has decreased by 30%.) What is the growth factor for your regression equation? What does this specifically tell you how the temperature decreases?
5. Transform your exponential function so that it models the original data given in the table. Give the equation of your transformed function and show a plot of this function along with the original data.