

Mrs. Rader's Blue 4 (Math SL)

Math Portfolio Type II

Crows Dropping Nuts

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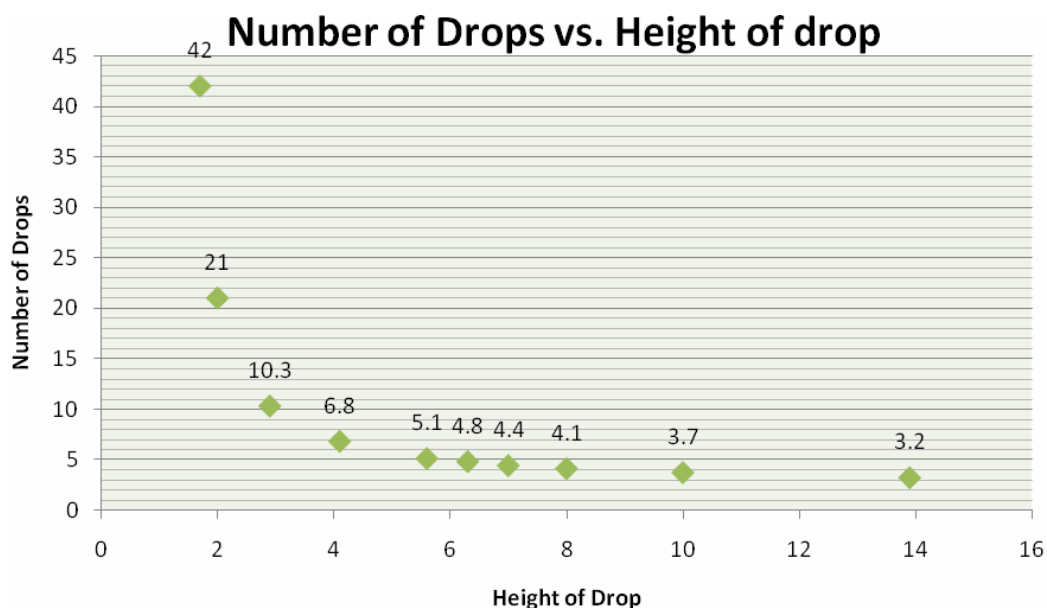
In this project, I will attempt to model the function of a group of crows dropping various size nuts from varying heights. The model will help to predict the number of drops it takes to break open nuts from even more heights.

The following table shows the average number of drops it takes to break open a nut from a given height.

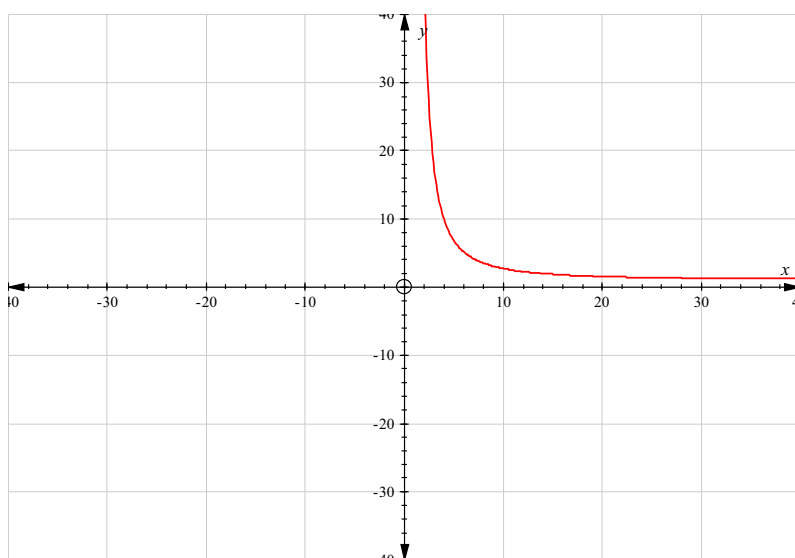
Large Nuts

Height of drop (m)	1.7	2.0	2.9	4.1	5.6	6.3	7.0	8.0	10.0	13.9
Number of drops	42.0	21.0	10.3	6.8	5.1	4.8	4.4	4.1	3.7	3.2

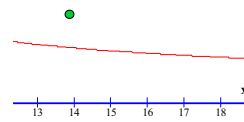
When graphed in Excel, the points form this graph:



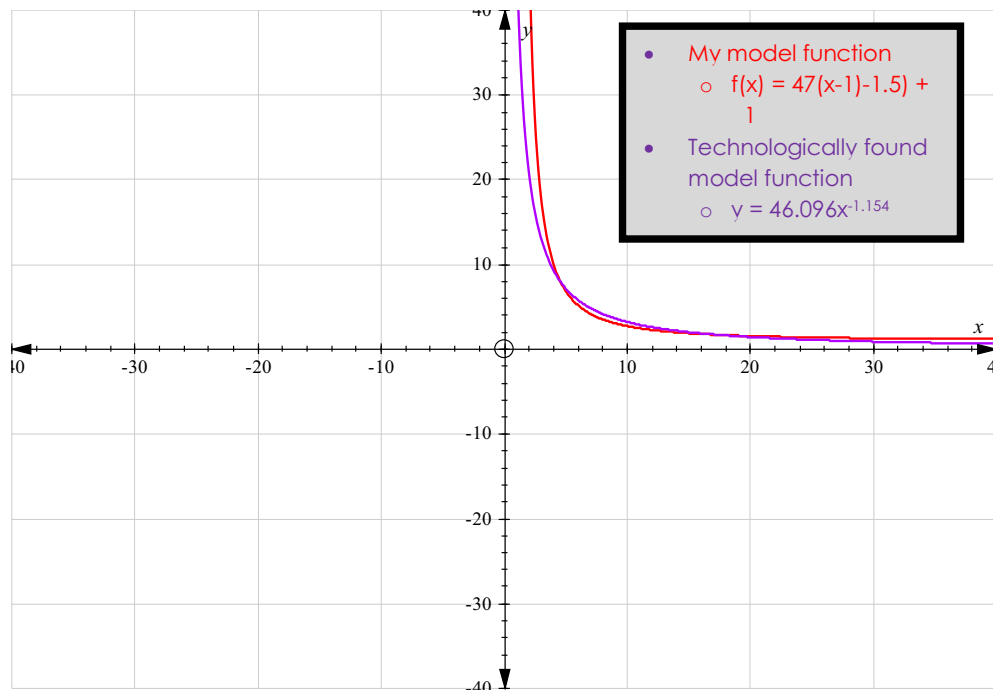
To model this graph a power function can be used. There is an x variable and a y variable. For my model of the graph, I used a function with the following parameters: $(a(x-b)^c) + d$ where a controls the curve of the model, b controls the shifts of the model, c is the rate of fall, and d is the horizontal asymptote. My function was $f(x) = (47(x-1)^{-1.5}) + 1$. I chose this function because it seems to fit closely with the data provided. I used the parameters stated above to create the equation in my Graphic Display Calculator and adjusted based on how well it fit the data provided. This is how my model appears by itself:



▲And with the data points included:



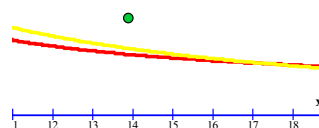
When graphed with Excel, a function of $y = 46.096x^{-1.154}$ is found to be the best model of the data provided. Here it is graphed with comparison to my model:



▲And with the data points:

Yellow is Excel's equation

Red is my equation



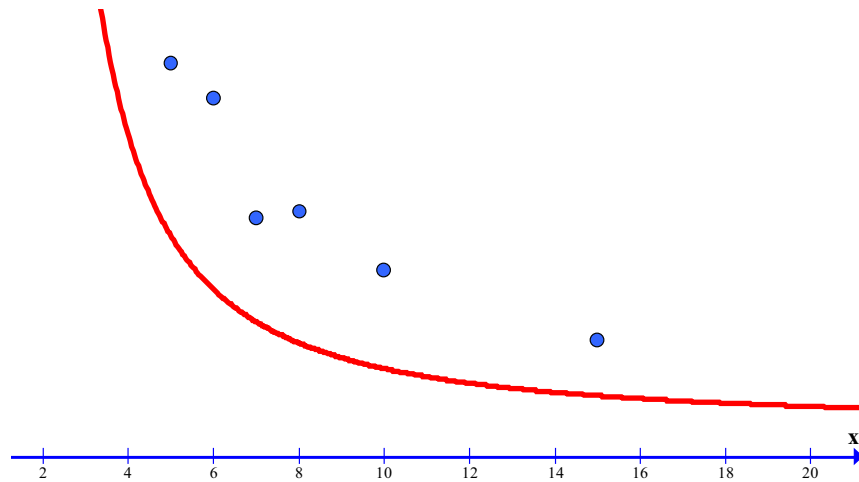
As you can see, the function produced by me and the function produced by technology only differ slightly. The technologically found function uses different parameters, but still has the same variables. Each function is not an exact fit to the data, but both models are fairly close.

~~The following graph shows the average number of drops that a nut will hold before it breaks.~~

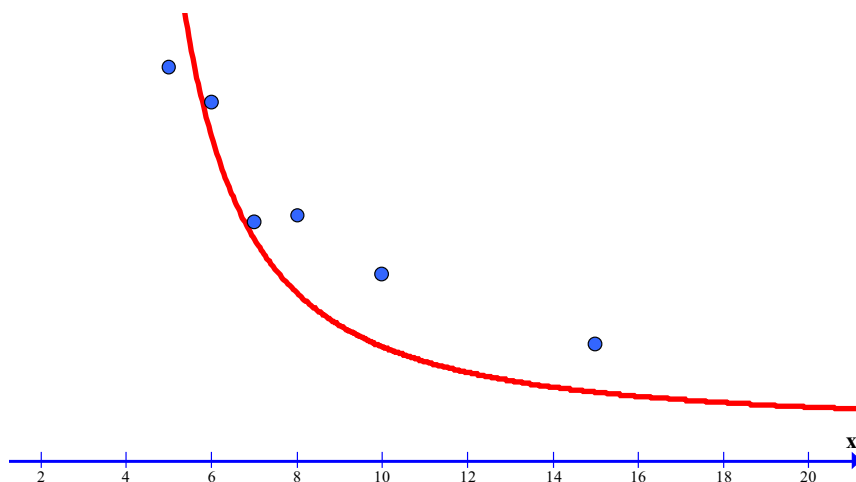
Medium Nuts

Height of drop (M)	1.5	2.0	3.0	4.0	5.0	6.0	7.0	8.0	10.0	15.0
Number of drops	-	-	27.1	18.3	12.2	11.1	7.4	7.6	5.8	3.6

When graphed with my large nut function, it appears as follows:



My function needs to be adjusted a little bit to the right to make the curve fit better with the data points. To do this, my **b** value needs to be increased to 3i. This makes the function now: **$(47(x-3)^{-1.5}) + 1$** . After the slight adjustment, the graph now appears as the following:



My model/function now fits the medium nut data better after this adjustment. This function is limited though. It would be better to create a whole new function to account for the medium nut size than to use the model from the large nut size. This new model/function would possibly create a better fit than using the large nut size function.

The following table shows the average number of drops it takes to reach ground level for different nut sizes.

Small Nut

Height of drop	1.5	2.0	3.0	4.0	5.0	6.0	7.0	8.0	10.0	15.0
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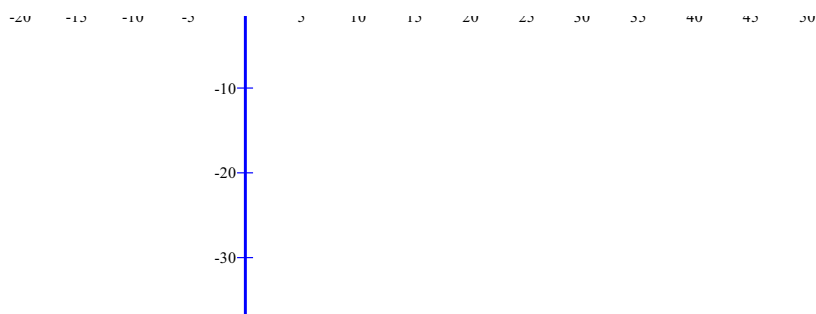
(m)										
Number of drops	-	-	-	57.0	19.0	14.7	12.3	9.7	13.3	9.5

When graphed with my large nut function, it appears as follows:

-30

My function needs to be adjusted a little bit to the right to make the curve fit better with the data points. To do this, my **b** value needs to be increased to 3, and my **d** value needs to be increased to 9. This makes the function now:

$(47(x-3)^{-1.5}) + 9$. After the slight adjustment, the graph now appears as the following:



My model/function now fits the small nut data better after this adjustment. This function is limited though. It would be better to create a whole new function to account for the medium nut size than to use the model from the large nut size. This new model/function would possibly create a better fit than using the large nut size function. Also, the data for the small nut seems more erroneous and spread out with lots of extremities. My model gives a good representation of the small nut data, but is not an exact fit, making this model limited.

In this project, I created functions that served as models for various sizes nuts. Using this data properly, one could possibly predict the amount of drops it might take to crack open a nut from even more heights than are listed here.