**Math 365 Mathematical Modeling** **Homework 4**

Ch 2.2 & 2.3 Developing Models Using Proportionality

This activity is intended to reinforce proportionality skills used in model construction.

Here is our modeling scenario:

Suppose that after much discussion about a phenomena of interest, problem identification and assumptions, we develop two models using proportionality arguments:

(Model 1)

(Model 2)

We are not sure which one is better, so we collect some data to corroborate our model, and then we complete our model by estimating the proportionality constant. Here is the data:

|  |  |
| --- | --- |
| **x** | **y** |
| 3 | 67 |
| 4 | 134 |
| 6 | 497 |
| 9 | 1535 |
| 10 | 2267 |

1. Use Excel to complete the following table. Copy and paste your table in the space below, resizing as needed (not to big, not too small). Be sure your table is well formatted (borders, centering, bold face titles).

|  |  |  |  |
| --- | --- | --- | --- |
| **x** | **y** | **x^2** | **x^3** |
| 3 | 67 | 9 | 27 |
| 4 | 134 | 16 | 64 |
| 6 | 497 | 36 | 216 |
| 9 | 1535 | 81 | 729 |
| 10 | 2267 | 100 | 1000 |

1. (a) Use Excel to graph y vs  and then copy and paste the graph below, resizing as needed. Be sure your graph is well labeled (chart title, axis titles, *x*-axis max bound, etc).
   1. How well does the data corroborate Model 1?

It doesn’t corroborate Model 1 the best, the biggest reason for this is that there isn’t a trendline that goes through the origin for this graph. We can’t necessarily say that it is proportional right now with the intercept not presently at 0, but it is possible that there is a number times x squared that makes this Model 1 true. This data does a decent job corroborating Model 1, but with an intercept at 0 it would be better.

* 1. Use Excel’s trendline feature to find the proportionality constant *k*. Support your answer by showing the appropriately labeled Excel graph below.

The proportionality constant k for this graph is,

* 1. Using the Equation editor in Word, give the equation for Model 1. (See top of page 1.)

1. (a) Use Excel to graph y vs  and then copy and paste the graph below, resizing as needed. Be sure your graph is well labeled (chart title, axis titles, *x*-axis max bound, etc).
   1. How well does the data corroborate Model 2?

The data from the Y vs. X^3 graph is like the one from Model 1. Here, its evident that the Y values may determined by some number times the X cubed values, but it doesn’t have an intercept of 0. Which Model 2 indicates at the top of the assignment. It does a good job corroborating here, but with the intercept at 0 it would be better.

* 1. Use Excel’s trendline feature to find the proportionality constant *k*. Support your answer by showing the appropriately labeled Excel graph below.

The constant of proportionality when the intersection is set to 0, is .

* 1. Using the Equation editor in Word, give the equation for Model 2 (See top of page 1.)

1. Use Excel to complete the following table, where PRE means Percent Relative Error. Copy and paste your table below, replacing this incomplete one. Be sure your table is well formatted (borders, centering, bold face titles).

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **x** | **y** | **x^2** | **x^3** | **Model 1 Values** | **Model 2 Values** | **Model 1 PRE** | **Model 2 PRE** |
| 3 | 67 | 9 | 27 | 183.9 | 59.7645 | -174.406 | 10.79925 |
| 4 | 134 | 16 | 64 | 81.7 | 141.664 | 39.0209 | -5.7194 |
| 6 | 497 | 36 | 216 | 122.6 | 478.116 | 75.33843 | 3.799598 |
| 9 | 1535 | 81 | 729 | 183.9 | 1613.642 | 88.02267 | -5.12322 |
| 10 | 2267 | 100 | 1000 | 204.3 | 2213.5 | 90.98897 | 2.359947 |

1. (a) Use Excel to graph Model 1 along with the original data and then copy and paste the graph below, resizing as needed. Your graph should show both the original   
   *x* and *y* data plot together with the graph of the smoothly connected *x-y* scatter plot for Model 1. Be sure your graph is well labeled (chart title, axis titles, *x*-axis max bound, legend if needed, etc).
   1. How well does the model fit the data? Answer this question both visually from graph and numerically by creating a column for percent relative error. Show this table below.

This model does not fit the values very well, as one can see from the graph. Here are the percent relative errors for model 1,

|  |  |  |
| --- | --- | --- |
| **Y - Values** | **Model 1 Values** | **Model 1 PRE** |
| 67 | 183.9 | -174.406 |
| 134 | 81.7 | 39.0209 |
| 497 | 122.6 | 75.33843 |
| 1535 | 183.9 | 88.02267 |
| 2267 | 204.3 | 90.98897 |

As we can see, the best value from this model comes from when y is supposed to be 134, and instead is 81.7. This yields a PRE of 39% and that is the closest this model gets.

1. (a) Use Excel to graph Model 2 along with the original data and then copy and paste the graph below, resizing as needed. Your graph should show both the original *x* and *y* data plot together with the graph of the smoothly connected *x-y* scatter plot for Model 2. Be sure your graph is well labeled (chart title, axis titles, *x*-axis max bound, legend if needed, etc).
   1. How well does the model fit the data? Answer this question both visually from graph and numerically by creating a column for percent relative error. Show this table below.

From this graph, we see that model two fits the actual values of y better. The data has smaller deviation from the actual numbers and has the PRE’s as follows,

|  |  |  |
| --- | --- | --- |
| **Y - Values** | **Model 2 Values** | **Model 2 PRE** |
| 67 | 59.7645 | 10.79925 |
| 134 | 141.664 | -5.7194 |
| 497 | 478.116 | 3.799598 |
| 1535 | 1613.642 | -5.12322 |
| 2267 | 2213.5 | 2.359947 |

Showing that the PRE of this model in collective is a lot better and more accurate. This implies that model 2 is a better model.