City Semester 13-14 Ms. Nelson

# PROBLEM SET 2-4: Curve Fitting with Data Sets – Part II

**Note: To Zoom In on an axis in Fathom:** First, use the hand tool on the right or left side to center the slider in the middle of the number line you see. Use Ctrl-click on a PC, Option-click on a Mac. You can also do that with the axes on the residual plot and the original graph will change accordingly.

1. 🖳 We’ve all heard the “throw a penny off the Empire State Building” story. Turns out there are a number of aspects of that situation that can be mathematically modeled, including the height of the penny with respect to time (since thrown) as it accelerates due to gravity. The data set “PennyOffEmpireState.ftm” shows an example of times in seconds (input) and heights in feet (output).
2. Analyze the Data.



1. What is the “initial height” of the penny? (meaning when time=0) What should that represent? Research if it’s correct.



1. The leading coefficient of the modeling equation should be the acceleration of the penny due to gravity. What is the value of a? Research the acceleration due to gravity in ft/sec2 of any object (who proved that it doesn’t matter what the object is?). How close did you come? What might account for the difference?



1. According to your model, how long will it take for the penny to hit the ground? (think about the value of height when you hit the ground).

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1. 🖳 As mentioned in class, the Consumer Price Index is a way to measure inflation by keeping track of the price over time for a “basket” of goods the average American consumer would purchase. (<http://www.bls.gov/cpi/>) Open “NY-CPI.ftm”, which gives data on the CPI for both NY and the US for the last ten years.
2. Analyze the Data for Year (input) and NY\_Annual\_CPI (output), creating your own linear model. Comment on what the residuals show.
3. Maybe a computer-optimized model would be better – right-click on the graph and choose *Least-Squares Line*. You can click on the two different equations (yours and the Least-Squares) on the bottom of the graph to go back and forth between their residual plots. What do the residuals of the Least-Squares Line tell you?
4. For each year, calculate the difference between NY\_Annual\_CPI and US\_Annual\_CPI. (extension: Figure out how to get Fathom to do this for you by adding an attribute and calculating the value of the attribute using a “formula”. Otherwise do it by hand).
5. We know NY is more expensive, but is it consistently more expensive, or is it also growing faster than the US average? Note any periods of growth or stasis and in which years they occurred.
6. Calculate what % higher the NY\_Annual\_CPI was compared to the US average in 2003 and 2013

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1. 🖳 Open “US\_CPI.ftm” This covers a larger timespan and displays the average CPI for the entire country.
2. Describe the trend you see. Does it look quadratic in nature? Why or why not?
3. Does the pattern of the trend seem to change over time? Explain.
4. From about 1980 onward, CPI seems to be changing linearly. If you asked for a Least-Squares Line or Median-Median Line here, would that be useful? Why or why not? (Try it and see what you get)
5. Find your own linear model for the portion of the data from 1980 onward, and examine the residuals for just that portion of the graph (ignore the others by changing the scale, pushing the years before 1980 off the left side)

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