

MATH 245, Spring 2014
HOMEWORK 3
due 10:45AM on Wednesday, March 5.

These questions involve *Mathematica* and are each worth 10 points. **Do not handwrite any answers.** Create one *Mathematica* notebook for your entire assignment (or one per homework question). Type your answers in **Text Cells** throughout the notebook. Print out your notebook and turn it in on 3/5/14.

You may use online resources to learn more about *Mathematica* to solve these questions. Your fellow Math Modeling classmates and your professor are also good resources. I ask that you do not contact previous Math Modeling students when completing this assignment. Don't forget to include acknowledgments for those who helped you with the assignment and those resources that you consulted.

3-1. (a) I first ask that you watch two webcasts, on <http://www.wolfram.com/broadcast/>.

- The first video is named “Hands-on Start to *Mathematica*: Notebooks”, found <http://www.wolfram.com/broadcast/video.php?channel=86&video=862>. It is 4.5 minutes long and introduces you to how to add sections and into your notebooks.
- The second video is named “Hands-on Start to *Mathematica*: Methods to Get Started”, found at <http://www.wolfram.com/broadcast/video.php?channel=86&video=863>. This one is 10 minutes long and discusses how *Mathematica* 8 and 9 allow you to use “free-form input” and how else to input information.
[*It is important to realize that free-form input is nice, but to use Mathematica's full capability, you will need to understand its language.*]

(b) Create a new *Mathematica* notebook that satisfies the following properties.

- Your notebook must have a Title (with relevant title), Subtitle (Your name, date, class). Change the stylesheet (Format > Stylesheet) to your liking.
- Name a first Section “List Questions” and create two subsections, named as you wish. The two subsections should answer the following two questions. **Every question should be answered completely and must include text cells that explain what you are doing.**
 - Use the **Range** command to create a list of the numbers from 0 to 100 that are two more than a multiple of six. [*Your output will start {2,8,14...}*] Next, use the **Table** command to create a list of the square numbers that are between 100 and 1000 and a list of the cube numbers that are between 100 and 1000.
 - Define variables `list1` and `list2`, each with 20 entries (You choose!). Have *Mathematica* count the number of entries in each list and also find the sum of the entries in each list. Then have *Mathematica* generate a new list named `list3` that combines the two lists into a set of twenty ordered pairs. For example, if `list1` starts off $\{1,2,3,\dots\}$, and `list2` starts off $\{4,5,6,\dots\}$, then `list3` should start off $\{\{1,4\},\{2,5\},\{3,6\},\dots\}$.

- Name a second Section “Plotting Questions” and create subsections as necessary to answer the following question. Generate three three individual plots and combine them in a fourth plot, as follows.
 - First, plot $\cos(x/2)$ from 0 to 2π using a thick green line.
 - Second, plot $\sin(3x)$ from 0 to 2π using a thin dashed line that is not green.
 - Third, plot ten to twenty large bright fluorescent points of the form $(x, x^2 - 2x)$ with x values between 0 and 6.
 - Last, combine all three graphs on one set of axes.
- Name a third Section “Neat Mathematica things”
 - Find two neat things that you have seen that *Mathematica* is able to do. Copy the code into your notebook and describe what it does. Discuss where you found this code and explain why they are interesting. Further discuss in what ways it would be interesting for you or someone else to modify these things in a new and innovative way.

3-2. Let’s work with some real world data! I have imported some of the data from this website

<http://archive.ics.uci.edu/ml/datasets/Housing>

into Mathematica:

<http://qcpages.qc.edu/~chanusa/courses/245sp14/homework/245hw3-2.nb>

As you can read on the original website, this is a data set that contains housing prices and various other factors from different neighborhoods in Boston. We would like to determine the best predictor of housing prices in terms of the thirteen given variables.

- (a)
- Use *Mathematica* to generate the scatterplots for each of the 13 factors versus home prices (Column 14).
 - Include the best fit line for each of these scatterplots.
 - Determine the R^2 coefficient for the best fit line for each of these scatterplots.

Now in a text box in your Mathematica file, write one or two paragraphs that analyze the data with respect to the following questions.

- Which two or three factors are **the most** linearly correlated with home prices?
 - Which two or three factors are **the least** linearly correlated with home prices?
 - Do your conclusions make real-life sense?
- (b) Run a **multiple linear regression** using at least two of the thirteen factors. Show that the R^2 value for this multiple linear regression is larger than either single linear regression.
- (c) One of the factors appears to be correlated with house prices in a non-linear fashion. Try to fit the data to a different function that makes sense. Display the best fit curve along with the data.