MATH 245, Spring 2015
Homework 2
due 10:45am on Wednesday, March 4.

Background reading: Section 1.3 to page 25 and Section 1.4.

Follow the posted homework guidelines when completing this assignment.

You may not use any resources other than class material, your Math Modeling classmates, and your professor.

Don't forget to include acknowledgments for those who helped you with the assignment!

2-1. (6 pts) Here is some data that represents an independent variable x and a dependent variable y.

x	1	3	4	7	9	10	13	15	18	20
y	3	10	2	20	31	27	33	39	41	50

It is thought that y satisfies a function of type (a) $y = Cx^k$ or type (b) $y = Ck^x$, but it is not known which one is more likely.

- Use the method of transforming the data using logarithms combined with **visual fitting** to determine the curve of best fit. (Use graph paper.)
  Do this twice—once for a curve of type (a) and once for a curve of type (b).
- Now compare and contrast your two curves of best fit. Create the residual graphs for each fit. In a paragraph or two, discuss which one you think gives a better fit and why.
  [*Important: Residual graphs are* **always** *plotted with respect to the original dataset, not the transformed dataset.*]

2-2. (6 pts) Here is some data related to the growth of a plant after grafting:

Months after grafting	1	2	3	4	5	6
Height, in inches	0.8	2.4	4.0	5.1	7.3	9.4

(a) Do a **linear regression** manually to determine the best fit line. Work under the assumption that the height (h) is *proportional* to the time (t).
(You will need to write down your calculations that you perform. You may use a computer to help you with the algebra, but make sure you mention where you used a computer when you write up your work. You may not use a computer to do the linear regression for you.)

(b) Use the model from part (a) to predict the height of the graft at four and one-half **months** and again the height of the graft at 5 **years**. Which prediction is more reliable? Give specific reasons why one might be more reliable than the other.

The following question involves *Mathematica* and is worth 8 points. You may use online resources to learn more about Mathematica to solve these questions. **Do not handwrite any answers.** Create one *Mathematica* notebook for the homework question. Type your answers in `Text Cells` throughout the notebook. Print out your notebook and turn it in on 3/4/15.

2-3. (a) Watch the first two videos at the following link:

`http://www.wolfram.com/broadcast/screencasts/handsonstart/`

These videos are for helping to get started with Mathematica. It is highly suggested that you follow along with Mathematica open alongside to try out the presented commands yourself. The first video is about 7 minutes long and it introduces you to how to add sections and text into your notebooks. The second video is about 19 minutes long and discusses how Mathematica allows 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 one less than multiples of five. [*Your output will start* `{4,9,14...}`] Next, use the `Table` command to create the list of the square numbers that are between 100 and 1000 and the 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,...`, and `list2` starts off `{4,5,6,...`, then `list3` should start off `{{1,4},{2,5},{3,6},...`.
- Name a second Section "Plotting Questions" and create subsections as necessary to answer the following question. Generate three individual plots and combine them in a fourth plot, as follows.
  - First, plot $4\cos(x/2)$ from 0 to 2π using a thick green line.
  - Second, plot $3\sin(3x)$ 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 $\left(x, x^2 - 2x\right)$ 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.