Homework 7

Create a single MATLAB script with each problem below as a separate section (hint: %%).

1. Create a new script
2. Create a comment section at the top with your name, date, HW#, class, etc.
3. The first script commands should erase all the workspace data, command window output, and close all figures.
4. Create separate sections (%%) for each problem

Problem 1 (25 pts)

Biomedical engineers are developing an insulin pump for diabetics. To do this, it is important to understand how insulin is cleared from the body after a meal. The concentration of insulin at any time t is described by the equation

$$C = C_0 \, e^{-30t/m}$$

where C_0 is the initial concentration of insulin, t is the time in minutes, and m is the mass of the person in kg. Write a script that will graphically show how the weight of the person influences the time for insulin to be cleared from the body. It will show in a 2×1 **subplot** the concentration of insulin for two subjects, one who weighs 120 pounds, and one who weighs 300 pounds. For both, the time should increment from 0 to 4 minutes in steps of 0.1 minute, and the initial concentration should be 85. The concentration over time will be shown in each subplot, and the weight of the person should be in the title. The conversion factor is 1 pound = 0.4536 kg. In order to better compare, use consistent axes for both plots.

Problem 2 (25 pts)

The Wind Chill Factor (WCF) measures how cold it feels with a given air temperature T (in degrees Fahrenheit) and wind speed (V, in miles per hour). One formula for it is

$$WCF = 35.7 + 0.6T - 35.7\,(V^{0.16}) + 0.43T\,(V^{0.16})$$

Experiment with different plot types to display the WCF for varying wind speeds and temperatures.

Problem 3 (25 pts)

A very interesting iterative relationship that has been studied a lot recently is defined by:

$$y_{k+1} = r y_k (1 - y_k)$$

(this is a discrete form of the well-known *logistic model*). Given y_0 and r, successive y_ks may be computed very easily, e.g., if $y_0 = 0.2$ and $r = 1$, then $y_1 = 0.16, y_2 = 0.1334$, and so on.
This formula is often used to model population growth in cases where the growth is not unlimited, but is restricted by shortage of food, living area, amongst other things.
y_k exhibits fascinating behavior, known as *mathematical chaos*, for values of r between 3 and 4 (independent of y_0). Write a program which plots y_k against k (as individual points).
Values of r that give particularly interesting graphs are 3.3, 3.5, 3.5668, 3.575, 3.5766, 3.738, 3.8287, and many more that can be found by patient exploration.

Problem 4 (25 pts)

The arrangement of seeds in a sunflower head (and other flowers, like daisies) follows a fixed mathematical pattern. The nth seed is at position:

$$r = \sqrt{n},$$

with angular co-ordinate $\pi dn/180$ radians, where d is the constant angle of divergence (in degrees) between any two successive seeds, i.e., between the nth and $(n+1)$th seeds. A perfect sunflower head (Figure 9.18) is generated by $d = 137.51°$. Write a program to plot the seeds; use a circle (o) for each seed. A remarkable feature of this model is that the angle d must be exact to get proper sunflowers. Experiment with some different values, e.g., 137.45° (spokes, from fairly far out), 137.65° (spokes all the way), 137.92° (Catherine wheels).

Bonus question (20 pts)

1. Import the data from "dotData.txt" into MATLAB.

a. The file contains a large set of numbers with each set containing an x (column 1) and y
(column 2) coordinate and a size value (column 3).

2. Use the **rectangle( )** function to plot solid circles at each x,y coordinate that have a diameter equal to the size value imported from the file.

3. If done correctly, you will recognize the plotted object.

4. Hide the numbers around the perimeter of the plot

5. Add your name somewhere on the figure using your previously created function.

6. Make sure the x and y have the same scale (i.e. a circle will look round instead of like an ellipse if done correctly).

7. Don't do steps 4-6 inside a loop unless you want your code to take a LONG time to run.

8. Modify your code to make the letters in the image red and the rest black.

Turn in the following:

1. A Word (.doc, .docx) document created using the MATLAB publish feature to publish your script.

2. Your .m script file(s) (these are separate files from the document above). Make sure you use plenty of comments. Before submitting, rename all *.m files to have a .txt extension. For example, rename MyHW6.m to MyHW6.txt before submitting.

Submit all files electronically on Blackboard. See syllabus for late assignment policy.

Late submissions will receive a 10% deduction!
No submissions will be accepted after one day!