Math 694 Matlab Homework:

1) The command

```
>> A = rand(100,3)
```

will produce a 100x3 array of random numbers. Suppose each row represents the three coefficients of a quadratic $ax^2 + bx + c$ so that column 1 of A represents all the "a" coefficients, column 2 the "b" coefficients, and so forth. Apply the quadratic formula $r = \frac{-b \pm \sqrt{b^2 - 4ac}}{2a}$ to calculate the roots of the corresponding quadratics, once to calculate the "+" roots in a 100x1 array r1, and once to calculate the "-" roots in a 100x1 array r2. Use array operations.

(see first set of notes on array operations)

2) Suppose $A = \begin{bmatrix}
-1 & 2 & 3 & -5 \\
3 & 1 & 5 & 2 \\
1 & 0 & 5 & 1 \\
-2 & 3 & 1 & 3 \\
\end{bmatrix}$, $b = \begin{bmatrix}
4 \\
3 \\
2 \\
1 \\
\end{bmatrix}$.

Using Matlab, solve $Ax = b$ and check your answer with Matlab. Look up the function eig.m and calculate the eigenvalues and eigenvectors of A.

(see first set of notes)

3) Plot the following:

a) the function $f(x) = \frac{e^{-x^2}}{1 + \sqrt{1 + \sin^2 x}}$ on the interval $[-2, 2]$

b) The functions $f(x) = \frac{x^n e^{-x}}{n!}$ for $n = 1, 2, \ldots, 20$ (use a for loop and hold on to display them all)

c) The "figure 8" given by the parametric equations $x = \cos t, y = \sin 2t$, $0 \leq t \leq 2\pi$

4) Use a loop to calculate and plot the partial sums of the series $\sum_{k=1}^{20} \frac{(-1)^{k+1}}{k} \sin kx$ on the interval $[0, \pi]$. Put a pause after each plot to cause the plot to display - do not use the hold command, rather display each plot separately in sequence.

5) Write a Matlab function A=mytri(n) that will produce the nxn tridiagonal matrix defined by

$A(i,j) = \begin{cases}
-2 & \text{if } i = j; \\
1 & \text{if } |i-j| = 1; \\
0 & \text{otherwise}
\end{cases}$

For instance, A=mytri(5) should produce the matrix below
A = \[
\begin{bmatrix}
-2 & 1 & 0 & 0 & 0 \\
1 & -2 & 1 & 0 & 0 \\
0 & 1 & -2 & 1 & 0 \\
0 & 0 & 1 & -2 & 1 \\
0 & 0 & 0 & 1 & -2 \\
\end{bmatrix}
\]

6) Use ode45 to solve the differential equation below on the interval \(0 \leq t \leq 30\)
\[
x' = 0.2xy - 3x \\
y' = -0.3xy + 2y \\
x(0) = 2, \ y(0) = 3
\]
Plot the trajectory of the solution in the \((x, y)\) plane

7) Plot the function \(f(x, y) = x^2 + xy + y^3\) on the square \(-1 \leq x, y \leq 1\).
   Use a pcolor plot and a surface plot using surf.