Homework (40pts) chapter 3 _ text book (Lent)

Problem (1-6)Write program for each of the following. Format each program as instructed in chapter 1. Write the programs and their outputs in one script. Please add the axis, title, labels for each plot.

Q1(5pts) 3.1

Q2(5pts) 3.5

Q3 (5pts)- 3.9

Q4 (5pts)- 3.10

Q5 (10pts)- 3.11

Q6 (10pts)

a- Make a histogram of normally distributed random numbers if the mean =3, the standard deviation = 0.3 and the number of data =5000. Write down the labels.

b- Plot the normal distributed function for the histogram in part a.

Looking ahead

The plotting commands covered in this chapter are the bread and butter of MATLAB graphics. Subsequent chapters detail more capabilities that can enhance graphical visualization of information. Visualization techniques are always best employed with an eye toward increasing insight, rather than just show. Chapter 6 describes methods for making graphics that move—animations. Well-conceived animations can make computational tools far more effective at communicating model behavior to the user. Creating animations requires the programming constructions of Chapter 5. The graphical user interfaces (GUI) capability of Part II (Chapters 9–11) enables the user to interact with the program and displayed graphics. More advanced graphics commands, including three-dimensional plotting, are explored in Chapter 13.

PROGRAMMING PROBLEMS

1. **Plotting points.** Write a program, `ConnectPoints.m`, that plots the points defined by the two arrays $x = [0, 1, 2, -2, -1, 0]$ and $y = [0, 0, 1, 1, 0, 0]$. Each point should be plotted as a star, and the points should be connected with line segments.

2. **Plot parabola.** Write a program, `plotparabola.m`, that plots the function $f(x) = ax^2 + bx + c$ for x on the interval $[-3, 3]$. Use `linspace` to define a vector of x values and calculate $f(x(k))$ at each point $x(k)$. Try various values of a, b, and c.

3. **Plot sine curve.** Write a program, `sinewave.m`, that plots the function

$$f(x) = \sin\left(\frac{x}{\lambda}\right)$$

for x in the interval $[-3p, 3p]$. Use `linspace` to define a vector of x values and calculate $f(x(k))$ at each point $x(k)$. Try various values of $\lambda > 0$.

4. **Plot Series.** Write a program, `AvSequence.m`, that plots the sequence defined by:

$$\begin{aligned} f_1 &= 0 \\ f_2 &= 1 \\ f_k &= \frac{(f_{k-1} + f_{k-2})}{2} \quad \textit{for } k > 2 \end{aligned}$$

for k up to 20. Since this f is actually only defined on the integers, you should plot using, for example: `plot(f, 'o-')`.

5. **Plotting damped motion.** Write a program, `plotdamped.m`, that plots the following function:

$$f(x) = e^{\frac{-x}{a}} \cos\left(2\pi\frac{x}{\lambda}\right)$$

Choose an appropriate domain for the function and vary the parameters a and λ (by changing the values set in the program and rerunning).

6. **Plot ballistic motion.** Write a program, `plotballistic.m`, that plots the following function:

$$h(t) = h_0 + v_0 t - \frac{1}{2} g t^2$$

Let $g = 9.8$ and $h_0 \geq 0$. Choose an appropriate domain for the function and vary the parameters h_0 and v_0 (by changing the values set in the program).

7. **Plot derivative.** A numerical approximation of the derivative at every point in an interval, except the endpoints, can be determined by the expression:

$$\left.\frac{df(x)}{dx}\right]_{x=x_0} \approx \frac{f_{n+1} - f_{n-1}}{2\Delta x}$$

The derivatives at the endpoints can be approximated by:

$$\left.\frac{df(x)}{dx}\right]_{x=x_1} \approx \frac{f_2 - f_1}{\Delta x}$$
$$\left.\frac{df(x)}{dx}\right]_{x=x_n} \approx \frac{f_n - f_{n-1}}{\Delta x}$$

Write a program, `Plotdfdx.m`, that plots the function $y = (\sin(\pi x))^{10}$ and this numerical approximation of the derivative of the function on the interval [0, 1].

8. **Plot the logistic function.** Write a program, `plotlogistic.m`, that plots the following function:

$$p(y) = \frac{1}{1 + e^{-\left(\frac{y-y_0}{a}\right)}}$$

Choose an appropriate domain for the function and vary the parameters y_0 and a (by changing the values in the program).

9. **Harmonic motion plot.** Write a program, `plotharmonic.m`, that plots harmonic motion of x in time, as described by the following equation:

$$x(t) = A\cos(\omega t + \varphi)$$

In this equation, A is the amplitude of the motion, ω is the angular frequency, and φ is the phase shift, all of which are constants in the equation. Run the program with the values

$$A = 2, \text{ and } \varphi = \frac{\pi}{2}.$$

Pick a value for the period T that is related to ω by the relation $\omega = \frac{2\pi}{T}$. Also pick a good value for the final time T_f that sets the range of $t = [0, \ldots, T_f]$.

10. **Creative plot.** Draw a figure of your own choosing on a piece of graph paper and write a MATLAB program, `plotoriginal.m`, to draw the figure. Drawing the figure should require at least four different sections of code and use the MATLAB `hold` function to keep adding new elements to the same set of axes. The title of your plot and the figure itself should clearly communicate the image to a viewer.

11. **Probabilities for three dice.** Write a program `ThreeDiceProb` to calculate and display the probability $P(N)$ of rolling three dice and getting a total (sum of the face values) of N. Use the Monte Carlo technique, simulating many repeated rolls of the dice and estimating the probability by the fraction of rolls with each result. Display the probabilities as a bar graph. You may find the `hist(x,bins)` function useful.

12. **Probabilities for multiple dice.** Extend the previous problem to calculate $P(N)$ for any number $N_d > 1$ of dice.