Problem Set 9

Problem 1

Given $a = -2, b = 3, c = 5$. Evaluate the following expressions without using MATLAB. Check the answers with MATLAB

a) $y = a - b?a - c < b$

b) $y = -4 < a < 0$

c) $y = a - c <= b > a + c$

d) $y = 3 \times (c + a \sim= a/b - b) == (a + c) \sim= b$

Problem 2

Given: $v = [4, -1, 2, 3, 1, -2, 5, 0]$ and $u = [5, -1, 0, 3, -3, 2, 1, 5]$. Use relational operators to create a vector w that is made up elements of u that are smaller than or equal to the elements of v.

Problem 3

The average monthly precipitation (in.) for Boston and Seattle during 2012 are given in the vectors below from the U.S. National Oceanic and Atmospheric Administration).

BOS = [2.67 1.00 1.21 3.09 3.43 4.71 3.88 3.08 4.10 2.62 1.01 5.93]

SEA= [6.83 3.63 7.20 2.68 2.05 2.96 1.04 0.00 0.03 6.71 8.28 6.85]

where the elements in the vectors are in the order of the months (January, February, etc.) Write a program in a script file to answer the following: (a) Calculate the total precipitation for the year and monthly average precipitation in each city. (b) How many months was the precipitation above the average in each city? (c) How many months, and on which months, was the precipitation in Boston lower than the precipitation in Seattle?

Problem 4

Write a program in a script file that determines the real roots of a quadratic equation $ax^2 + bx + c = 0$. Name the file *quadroots*. When the file runs, it asks the user to enter the values of the constants a, b, and c. To calculate the roots of the equation the program calculates the discriminant D, given by:

$$D = b^2 - 4ac$$

If $D > 0$, the program displays message "The equation has two roots," and the roots are displayed in the next line.
If $D = 0$, the program displays message "The equation has one root," and the root is displayed in the next line.
If $D < 0$, the program displays message "The equation has no real roots."
Run the script file in the Command Window three times to obtain solutions to the following three equations:
(a) $3x^2 + 6x + 3 = 0$
(b) $-3x^2 + 4x - 6 = 0$
(c) $-3x^2 + 7x + 5 = 0$

Problem 5

The value of π can be estimated by:

$$\sqrt{6\left(\sum_{\{n=1\}}^{\infty} \frac{1}{n^2}\right)}$$

Write a program (using an loop) that determines the expression. Run the program with $n = 100, n = 10000,$ and $n = 1000000$. Compare the result with π. (Use format long)

Problem 6

Write a program that asks the user to input a vector of integers of arbitrary length. The program then counts the number of elements, the number of positive elements, and the number of negative elements divisible by 3. The program displays the vector that was entered and the results in sentence form, i.e. "The vector has XX elements. XX elements are positive and XX elements are negative divisible by 3 ", where XX stands for the corresponding number of elements. Execute the program and when the program ask the user to input a vector type randi ([- 2 0 2 0] , 1, 16) . This creates a 16-element vector with random integers between -20 and 20.

Problem 7

A list of 30 exam scores is: 31, 70, 92, 5, 47, 88, 81, 73, 51, 76, 80, 90, 55, 23, 43,98,36,87,22,61, 19,69,26,82,89,99, 71,59,49,64 Write a computer program that determines how many grades are between 0 and 19, between 20 and 39, between 40 and 59, between 60 and 79, and between 80 and 100. The results are displayed in the following form:

Grades between 0 and 19 2 students
Grades between 20 and 39 4 students
Grades between 40 and 59 6 students
and so on. (Hint: use the command fprintf to display the results.)

Problem 8

Write a program in a script file that calculates the cost of shipping a package according to the following price schedule:

Type of service	Weight		
	0–0.5 lb	0.5–5 lb	More than 5 lb
Ground (5-7 days)	$0.70+ $0.06/oz	$1.18 + $0.42 for every additional 0.5 lb (or fraction).	$4.96 + $0.72 for every additional lb (or fraction).
Express (3-4 days)	$2.40+ $0.25/oz	$4.40 + $1.20 for every additional 0.5 lb (or fraction).	$15.20 + $1.80 for every additional lb (or fraction).
Overnight (One day)	$12.20+ $0.80/oz	$18.60 + $4.80 for every additional 0.5 lb (or fraction).	$61.80 + $6.40 for every additional lb (or fraction).

Figure 1: Problem 8 Table

The program asks the user to enter the type of service (Ground, Express, or Overnight) and the weight of the package (two numbers. First for number of pounds and second for number of ounces.) The program then displays the cost for the shipment. Run the program three times for the following cases:
(a) Ground 2 lb 7 oz.
(b) Express 0 lb 7 oz.
(c) Overnight 5lb 10 oz.

Problem 9

Cam is a mechanical device that transforms rotary motion into linear motion. The shape of the disc is designed to produce a specified displacement profile. A displacement profile is a plot of the displacement of the follower as a function of the angle of rotation of the cam. The motion of a certain cam is given by the following equations:

$y = 6[2\theta - 0.5sin\theta]/\pi$ for $0 \leq \theta \leq \pi/2$

$y = 6$ for $\pi/2 \leq \theta \leq 2\pi/3$

$y = 6 - 3[1 - 0.5cos(3(\theta - 2\frac{\pi}{3}))]$ for $2\pi/3 \leq \theta \leq 4\pi/3$

$y = 3$ for $4\pi/3 \leq \theta \leq 3\pi/2$

$y = 3 - 1.5 \left(\frac{\theta - 3(\pi/2)}{\pi/4} \right)^2$ for $3\pi/2 \leq \theta \leq 7\pi/4$

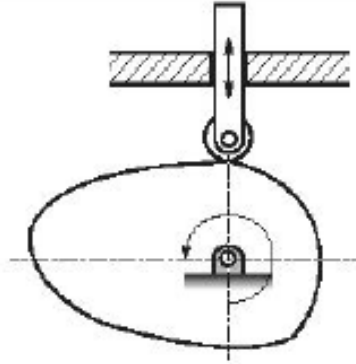$y = 0.75 - 0.75 \left(1 - \frac{\theta - 7(\pi/4)}{\pi/4} \right)^2$ for $7\pi/4 \leq \theta \leq 2\pi$

Figure 2: Problem 9 Diagram