

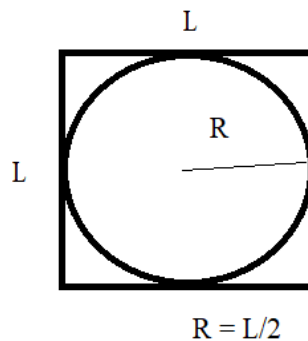
Numeric Examination

Instructions. Use MATLAB or Python to solve the questions. Remember to create the correct code structure, readable comments and code efficiency. Please send all your code files in a zipped folder and title it with your "First_Last Name". Submit to: https://b24-im7h02.bitrix24.site/crm_form9/

1. Find the values of X_i for i from 1 to n ($n=100$).

$$\begin{aligned}x_1 + x_2 &= 3, \\ x_i + 1 - x_{i+2} &= 1, \text{ for } i=1, \dots, n-1 \\ x_n + x_{n+1} &= 3,\end{aligned}$$

2. Estimate π using the following statistical method:
 - Generate a large number of random points (N) in a square.
 - Estimate π using the ratio of random points located in the circle to the total number of the points.



3. Generate a sample of raining rate (cm) data in Florida for three years. Then, find the days where their raining rates are more than 3 cm for 4 successive days. Plot the results and save the sample and results in an excel file.

Note: make the sample such a way that the mentioned condition occurs more than 3 times.

4. Assume that there is a pattern of feeding for a special fish in a day (10 hours a day) as below.

150	100	30	30	30	20	20	10	5	5
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Today, the fish is fed in the second hour 60 unit instead of 100 unit. Accidentally. Implement some methods to distribute the remaining 40 unit in the rest of the day and propose the new patterns.

Note: pay attention that the total feeding amounts should be fix in a day.

5. Generate a sample data with 2000 elements and call it A. Compute the following items based on
 - a. Compute median of A in sequential windows with 200 sample lengths with 199 sample overlap between successive windows. Store the results in B. Plot A and B.
 - b. Add two spikes to random samples of A. Write an algorithm to detect the samples which have spikes. Plot the samples and remark the spikes.

Note: Spikes are samples whose amplitudes are apparently larger than other signal samples.

6. Find X and Y values by maximizing R function using a solver in MATLAB or Python (e.g., Linear programming, GA):

$$\begin{aligned}
 A &= [500, 700, -450, 600, 640] \\
 B &= [300, -200, 350, -400, 100] \\
 R(t) &= A * X(t) + B * Y(t) - 40000 \quad t = 1, \dots, 5
 \end{aligned}$$

The following conditions should be satisfied:

$$\begin{aligned}
 150 &\leq X(t) \leq 400 \text{ for all } t \\
 120 &\leq Y(t) \leq 320 \text{ for all } t
 \end{aligned}$$

$$\begin{aligned}
 X(t+1) - X(t) &< 200 \\
 Y(t+1) - Y(t) &< 100
 \end{aligned}$$

- b) solve the above problem using the following extra constraint:

$$X(t) + Y(t) < 400$$