

Numeric Questions

Use MATLAB or Python to solve the following questions:

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

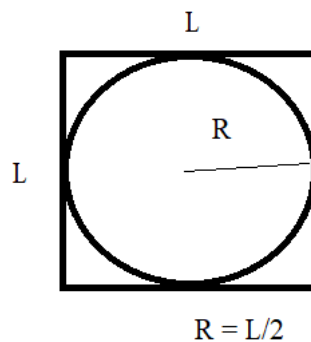
$$x_1 + x_2 = 3,$$

$$x_{i+1} - x_{i+2} = 1, \text{ for } i = 1, \dots, n-2$$

$$x_{n-1} + x_n = 3,$$

2- Estimate π number using the following statistical method:

- Generate a large number of random points (N) located in the square.
- Estimate π using the ratio of the number of points located inside the circle ($M>0$) to the total number of the points (N).
- Expected estimation accuracy of π is at least 2 digits.



3- Generate a sample of raining rate (cm) data in Florida for three years. Then, find the days which their raining rates are more than 3 cm for 4 successive days.

Note: make the samples in 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. Try to keep the distribution similar to the current feeding pattern.

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

5- Generate a sample data with 2000 element and call it A. Compute the following items based on A.

- a. Compute median of A with a sliding windows of size 200 samples. Reduce the window size when you reach to the right end of the vector. Store the results in B. Plot A and B.
- b. Write an algorithm to detect local spikes in A. Plot the samples and remark the spikes.

Note: Spikes are samples which their amplitudes are apparently larger than median of A in window size of 200.

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

$$A = [500, 700, -450, 600, 640]$$

$$B = [300, -200, 350, -400, 100]$$

$$R = \sum_{t=1}^5 A * X(t) + B * Y(t) - 40000$$

The following conditions should be satisfied:

$$150 \leq X(t) \leq 400 \text{ for all } t$$

$$120 \leq Y(t) \leq 320 \text{ for all } t$$

$$X(t+1) - X(t) < 200$$

$$Y(t+1) - Y(t) < 100$$

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

$$X^2(t) + Y^2(t) < 400$$

Good Luck