

Problem set -4

Q1

For a simulation, we need to generate random variate numbers (RVN). The cumulative distribution F is known and is according the following code:

```
x=0:(pi/100):pi/2;  
F=sin(x); % an always growing curve
```

Generate 2000 random variate number and show the histogram of the numbers.

Q2

We discussed about warm-up in a simulation run in the lectures. We argued that without warm-up procedure the result will be non-stationary. Now we would like to simulate a non-stationary sequence of random numbers which has Gaussian characteristic.

You can simulate this sequence in many ways. Please show one of these ways.

Q3

The information arrival to the router of an IOT system is via two channels.

- A- The arrival to the first channel is according to a Gaussian white random process $X(t)$ that is $N(0, \sigma = 9)$ for $2 < t < 5$, and 0 elsewhere. Simulate and plot 3 data sequences of such arrival, on the range $t \in (0, 6)$.
- B- The arrival to the second channel is according to another Gaussian white random process $Y(t)$ that is $N(0, \sigma = 7)$ for $t < 2$ and $t > 5$, and 0 elsewhere. Simulate and plot 3 data sequences of such arrival, on the range $t \in (0, 6)$.
- C- Now consider the information arrival to the router (using $X(t)$ and $Y(t)$ from A and B), simulate and plot 3 data sequences of the information arrival to the router, on the range $t \in (0, 6)$. Show the histograms of your 3 samples. Are the patterns of these 3 histograms the same? Argue/comment your answer.
- D- Is the result from (c), i.e. the information arrival, an iid random variable?

Q4

Paris is an attractive city for tourists who can use the city bus to visit around the city. The city bus can stop in 18 stations besides the central station (where the bus is shown in the figure).

About 2000 tourists are going to use the city service. Some of them are going to stay in the bus and go around. The probability that number of passengers in the bus reduce at each station has an exponential probability function with the mean of 0.01 and dependence of number of station (i.e. 1-18). In central station, more people are going to leave the bus and their leaving also is according to an exponential function with mean of 0.05 and dependence of the number of go arounds of the bus.

- a) Simulate this scenario where there are 200 seats in the bus. How many rounds of the city bus are necessary for 2000 tourists (i.e. there will be no tourist in central station who will get the bus)?

- b) Show the progress of decreasing number of tourists in central station?
- c) Show how changes in the seats numbers effects the progress in b.

