Instructions: In this lab, we will use Python to simulate randomness.

You are required to work on your own and submit a report on lab notebook by Friday (Sep. 2) 5:30pm. Upload all your Python files on Moodle before you leave the lab. The late submission of files on Moodle is allowed till Friday (Sep. 2) 5:30pm.

Exercise 1: Simulation for Decision Making
Let us revisit the problem running a milk depot. Shreyas must decide in the morning how much milk he should stock for the day. The cost of milk is ₹32 per liter, and it is sold at the fixed price of ₹38 per liter. Any milk that is left unsold at the end of the day can be sold to Bindu Sweets (for making dairy sweets) at a discounted price of ₹30 per liter. Shreyas does not know the demand, but he knows from past experience that the average demand is about 500L, and the demand is approximately normally distributed. Also, the demand almost never falls below 410L or rises above 590L.

1. [**R**] Let us generate a randomly distributed (gaussian) demand with mean 500 and standard deviation 30 in Python. Create a sufficiently large set of points drawn from this distribution. Let us assume that these numbers denote the demand seen in a day. How many times do you observe a demand less than 410L or more than 590L?

2. [**R**] For each of the above random data points, what is profit Shreyas makes? What is the distribution of his profit? Report some important measures of this distribution. Assume that the initial stock is 500L every day.

3. [**R**] Now suppose we want to find out the fixed quantity that Shreyas must stock every morning to maximize his average profit. Write a routine which takes as input the mean of the demand, the standard deviation of the demand, the cost price, selling price and the salvage price of the milk to find the optimal quantity.

4. [**R**] Write a routine to plot the optimal quantity as a function of the standard deviation of the demand. Comment on how the two are related.

Exercise 2: A virus
Bindu is a student in a class of n students. Each student in the class has stored in his/her computer the email addresses of all other students (but not his/her own). Assume that the students have not stored any other email-addresses of people outside of the class. Bindu's computer is infected with a virus. The virus selects exactly one address randomly from the addresses stored on the computer and spreads to the computer of that student. Then it tries to spread in the same fashion from the newly infected computer. If at any stage, the next computer that the virus selects is already infected, the virus stops spreading any further. We are interested in finding how many students are expected to have their computers infected (including Bindu) after the virus has stopped spreading.

1. [**R**] Explain clearly how you can simulate this situation. Your answer should mention what type of loops and/or arrays will be used and why your logic is correct.

2. Implement a `function k = simvirus(n)` which takes n (the number of students) as an input and returns the number of computers infected in a single simulated run.

3. [**R**] Run your simulation keeping $n = 20$ for a sufficiently large number of times and report the mean and the variance (and the number of runs used).

4. Plot a histogram of the frequency of different values of k.

5. [**R**] Comment on the histogram and why you think the distribution shown makes sense.