

## STUDENT VERSION

### Hotel Population Decay

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**Abstract:** We offer students an opportunity to create a simulation model of a hotel population with clients checking in and checking out according to two different disciplines as well as a number of different starting populations in the hotel.

#### Population Simulation

##### Simulation 1:

You will be modeling the following situation: 100 people are in a hotel. Each day, each person has a random chance of 50% of leaving the hotel. No new people enter the hotel.

Before you run the simulation in MATLAB, answer the following questions in your report:

- How many people do you think will be left if you ran this experiment an infinite number of times? Call this the **Steady State** solution.

ANSWER HERE

- How many days do you think it will take to get to the steady state solution?

ANSWER HERE

Directions:

- Create MATLAB code to simulate the number of guests remaining each day until you get to the steady state solution.
  - Use a `while` command around a command that uses `randi([0:1], [N,1])`.
  - N stands for the guests currently in the hotel. A result of 0 indicates the guest leaving the hotel and 1 indicates the guest staying in the hotel.
  - You will need to keep track of the population at the end of each day in a separate array.
- Graph the number of people in the hotel at the beginning of each day as a scatter plot in MATLAB.

- In addition to the population data, you will need to create an array of days, starting at zero and ending when the steady-state solution was reached. The first data point,  $N=100$ , occurs at day 0.
- Use dots or circles as markers and do not connect the points.
- Label the axes and title the graph.
- Publish your MATLAB code and paste here for both the code and the graph:
  - PASTE MATLAB CODE HERE

What type of function does this graph appear to be?

ANSWER HERE

### Simulation 2:

You will be modeling the following situation: 100 people are in a hotel. Each day, each person has a random chance of 50% of leaving the hotel. After the people leave that day, 10 new people check into the hotel. Note: The population of the hotel is AFTER the 10 new people enter. For instance, if there were 80 people in the hotel and 38 of them left, at the end of the day there would be  $80 - 38 + 10 = 52$  people in the hotel.

Before you run the simulation in MATLAB, answer the following questions in your report:

- How many people do you think will be left if you ran this experiment an infinite number of times? Call this the **Steady State** solution.

ANSWER HERE

- How many days do you think it will take to get to the steady state solution?

ANSWER HERE

Directions:

- Create MATLAB code to simulate the number of guests remaining each day until you get to the steady state solution.
  - Use a `for` loop around a command that uses `randi([0:1], [N,1])`. Experiment with maximum values for your `for` loop until a steady-state solution is reached.
  - As before, N stands for the guests currently in the hotel. A result of 0 indicates the guest leaving the hotel and 1 indicates the guest staying in the hotel.
  - Next, add 10 people to the population.
  - You will need to keep track of the population at the end of each day (including the 10 new people) in a separate array.
- Graph the number of people in the hotel at the beginning of each day as a scatter plot in MATLAB.
  - In addition to the population data, you will need to create an array of days, starting at zero and ending when the steady-state solution was reached. The first data point, N=100, occurs at day 0.
  - Use dots or circles as markers and do not connect the points.
  - Label the axes and title the graph.
- Publish your MATLAB code and paste here for both the code and the graph:

○ PASTE MATLAB CODE HERE

What type of function does this graph appear to be? Did the steady state solution surprise you?

ANSWER HERE

### Simulation 3:

You'll be modeling the same situation as Simulation 2, but now you will start with different amounts of initial guests. You will use starting with zero guests, then 10, 20, 30, 40, and 50.

Directions:

- Create a for loop around the code you created for Simulation 2 that is in the form `for N=[0 10 20 30 40 50]`.
- As before, create MATLAB code to simulate the number of guests remaining each day until you get to the steady state solution.
  - Use a for loop around a command that uses `randi([0:1], [N, 1])`. Experiment with maximum values for your for loop until a steady-state solution is reached.
  - As before, N stands for the guests currently in the hotel. A result of 0 indicates the guest leaving the hotel and 1 indicates the guest staying in the hotel.
  - Next, add 10 people to the population.
  - You will need to keep track of the population at the end of each day (including the 10 new people) in a separate array.
- Graph the number of people in the hotel at the beginning of each day as a scatter plot in MATLAB.
  - In addition to the population data, you will need to create an array of days, starting at zero and ending when the steady-state solution was reached.
  - Use dots or circles as markers, but this time, **connect the points**.
  - Each N value should be a different color. You will need to use the command `hold on` to do this.
  - Label the axes and title the graph.
- Publish your MATLAB code and paste here for both the code and the graph:
  - **PASTE MATLAB CODE HERE**

What type of functions does this graph appear to be?

**ANSWER HERE**