

# COMP6481/COMP8481

## Class 1: A simple simulation in Jupyter Notebook

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January 24, 2023

Suppose you are on a game show, and you are given the choice of three doors. Behind one door is a car, behind the others, goats. You pick a door, say #1, and the host, who knows what is behind the doors, opens another door, say #3, which has a goat. He says to you, ‘Do you want to pick door #2?’ Is it to your advantage to switch your choice of doors?

### 1 Pen-and-paper exercise

You are encouraged to study the above question and think whether it would be advantageous to switch the choice of doors or not. Discuss your conclusions with 2–3 students who sit near you. You don’t need to spend more than 10–15 minutes on this section.

### 2 Simulation in Python

If you are not confident what the answer to the above question is, don’t worry. Paul Erős<sup>1</sup>, one the most accomplished mathematicians of the twentieth century, could not believe the solution until a computer simulation showed to him experimental evidence. For this reason, you are asked to write a computer simulation<sup>2</sup> that will verify which option will increase the probability of winning a car.

Detailed instructions:

1. Create a new Jupyter Notebook for your simulation.
2. Write a section in your Jupyter Notebook that will summarise your findings that you obtained while working on the pen-and-paper section above.
3. Use a random number generator in Python to implement both solutions in your Jupyter Notebook, i.e., the one in which the person on the game show sticks to their original choice and the other one in which the person decides to switch the doors. For both options, compute and report the probability of winning a car. In order to compute accurate estimates of the probabilities, you will need to run the simulation many times (e.g. 100 or 200 simulations is a good number) for every option. One iteration of the simulator will emulate one game on the TV show. This will involve deciding the real location of the car, the first choice of doors, the opening of the doors by the host, etc.
4. Your notebook should be easy to read and well-structured with appropriate section names.

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<sup>1</sup><https://www.britannica.com/biography/Paul-Erdos>

<sup>2</sup><https://www.britannica.com/technology/computer-simulation>

Listing 1 shows how to sample random integers in the range 1–3. You can extend this code to implement your simulation.

Listing 1: Sampling integers in Python

```
1 import random
2
3 n_samples = 200
4
5 for game in range(n_samples):
6     print("Game #" + str(game) + " starts")
7     car_door = random.randint(1, 3)
8     print(car_door)
```

### 3 Reflection

Compare your original conclusions with the results of the simulation. Try to find a technical justification for the results returned by your simulation. Is there an intuitive explanation?