Monty Hall Monte Carlo Simulation

Carlos Mercado, Maria Guimaraes, Edgar Renteria, Jordan Nicholls

Motivations

- Understand the correct approach to the problem.
- To demonstrate the role of probability in decision-making.
- To explore variations of the problem.

Problem Statement

In the game, a contestant chooses one of three doors, behind one of which is a car, while behind the other two are goats. After the contestant has made their initial selection, the host, who knows what is behind each door, opens one of the other two doors to reveal a goat. The contestant is then given the option to switch their choice to the remaining door(s) or stick with their original choice.

This is game is extended to 6, 9, 20 and 100 doors.

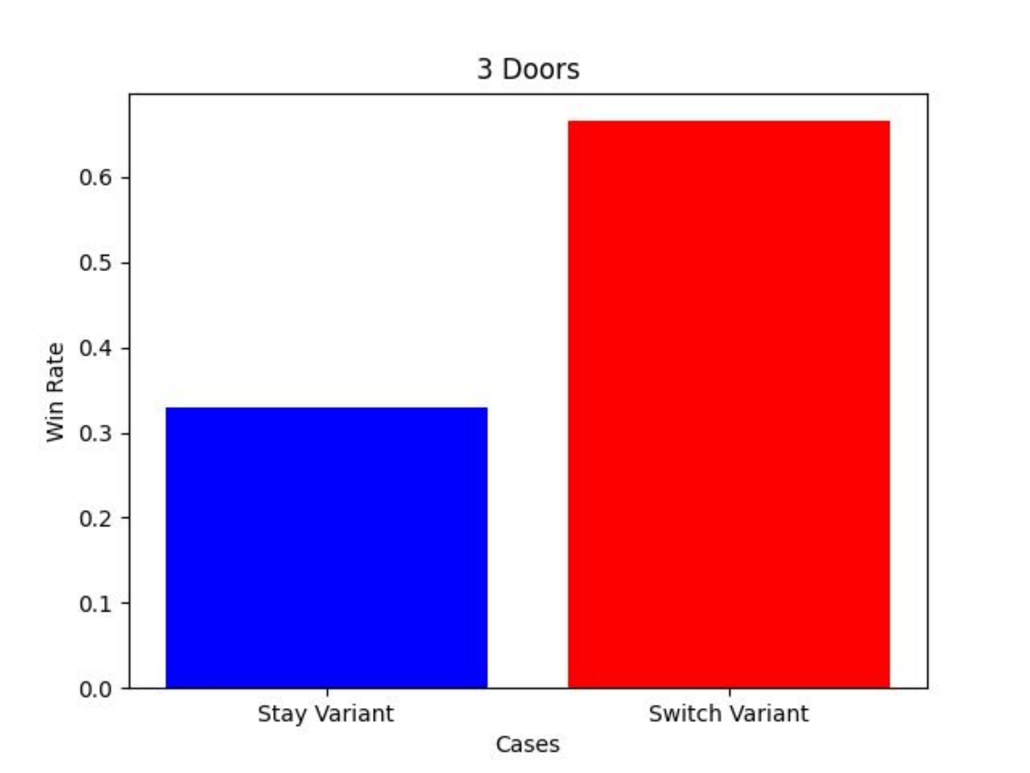
Approach

1. Build the stage
    a. create a list with goats stored in every cell except for one.
2. Contestant choice
    a. generate a random number between 0 and the size of the list.
3. Take away a door.
    a. Find a cell in the list that is not the one that the contestant chose, and one that does not contain the car, and delete it.
4. Second choice.
    a. If the approach is to stay with the original door, then check the chosen cell to see if the car was chosen, if so, the contestant wins.
    b. If the approach is to switch doors, then delete the current cell and go to a random cell in the list.

Do this multiple thousands of times to get good, representative rate of wins.

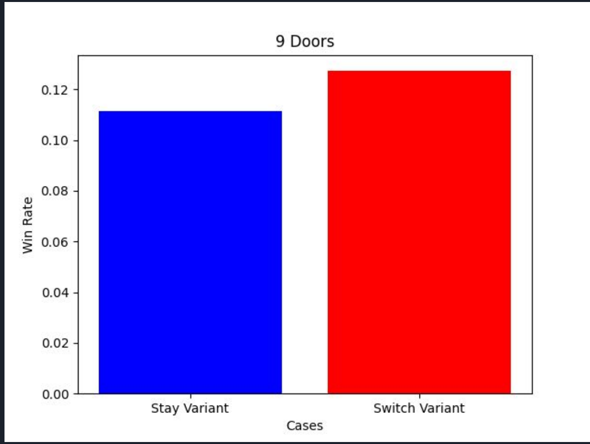
Results & Discussion

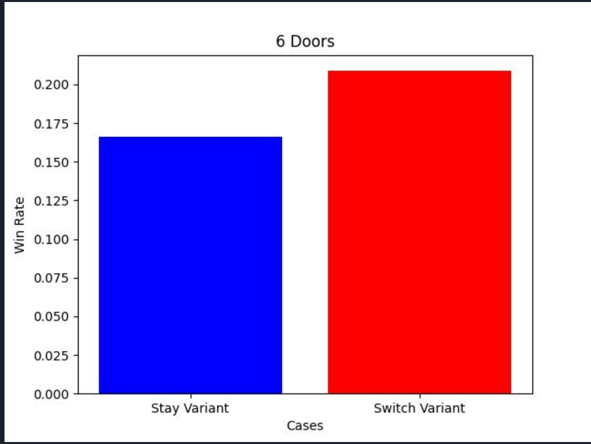
Switch is the obvious choice in the n=3 doors case. Twice as likely to get the car if we switch doors ⅓ -> ⅔ .



Results & Discussion

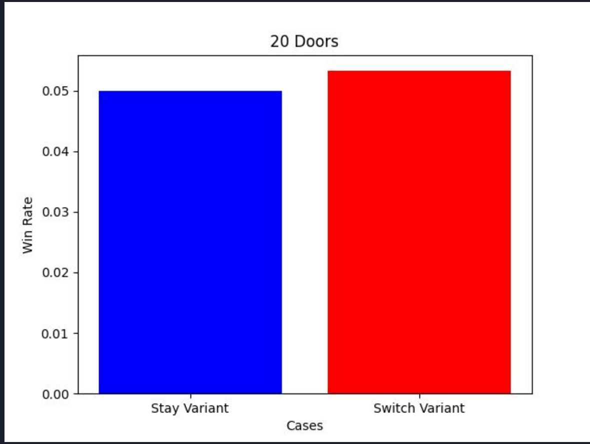
Switch is still best choice in the n=6 doors case as well as the n = 9 doors case but the difference is not as dramatic.

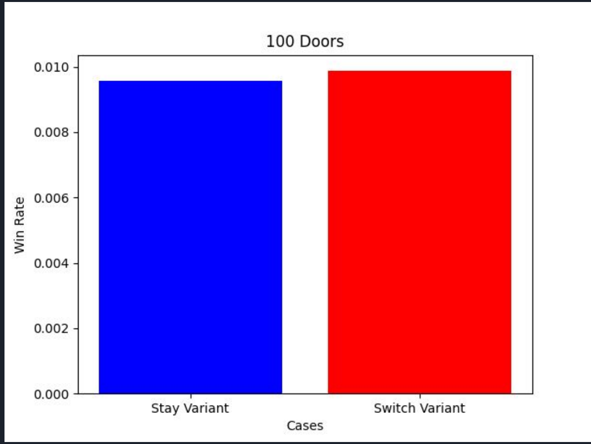




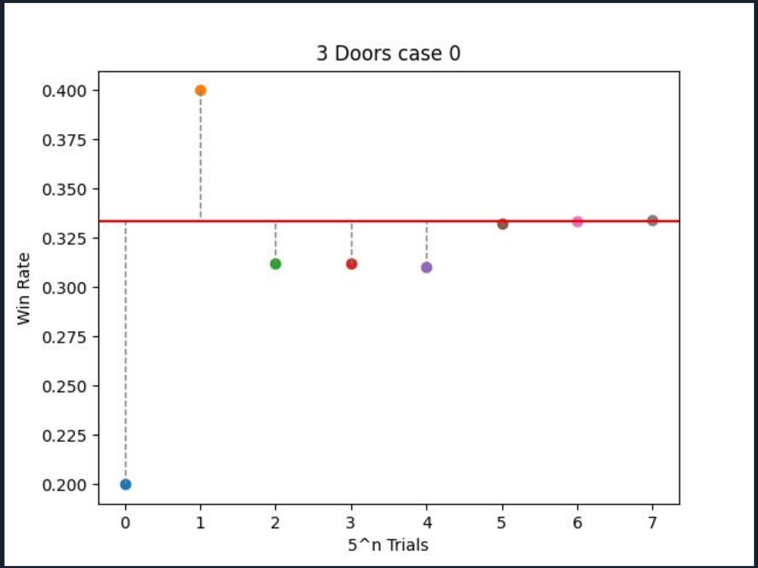
Results & Discussion

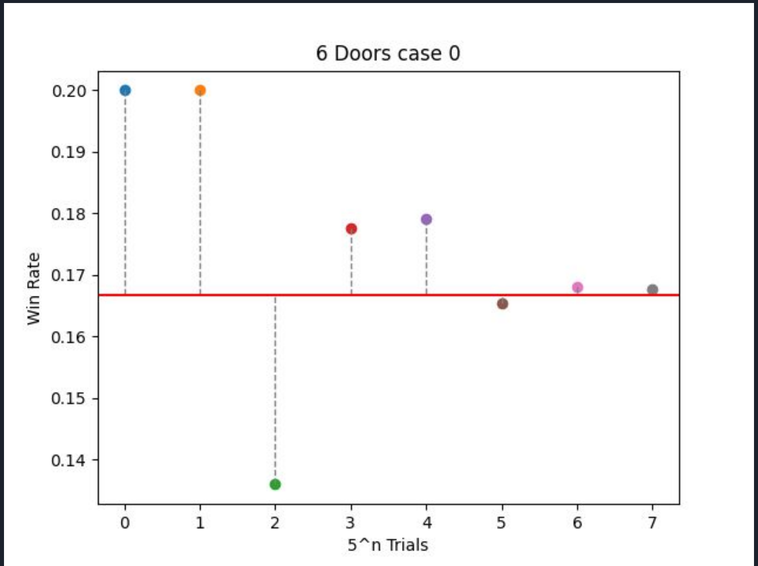
Switching in the last two cases is still better than staying but the difference becomes marginal.



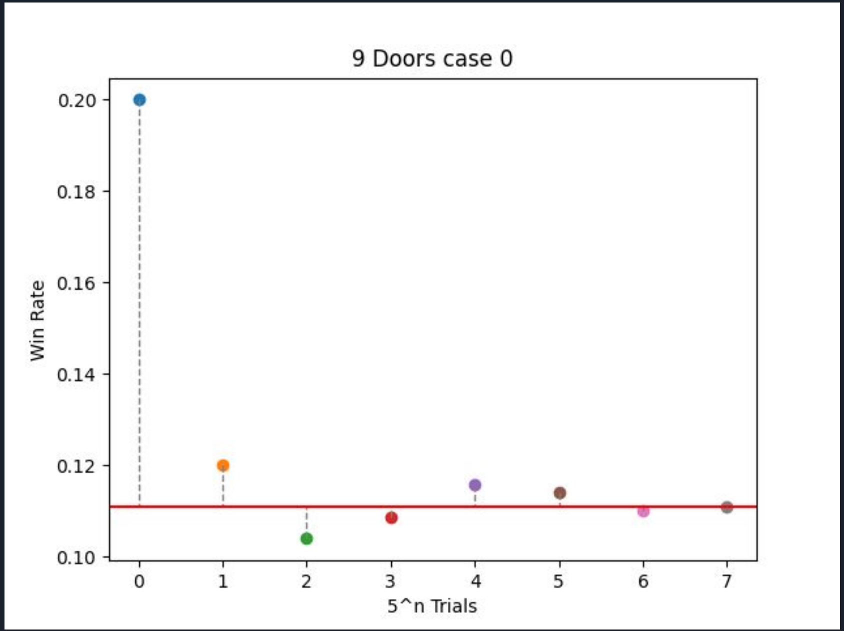


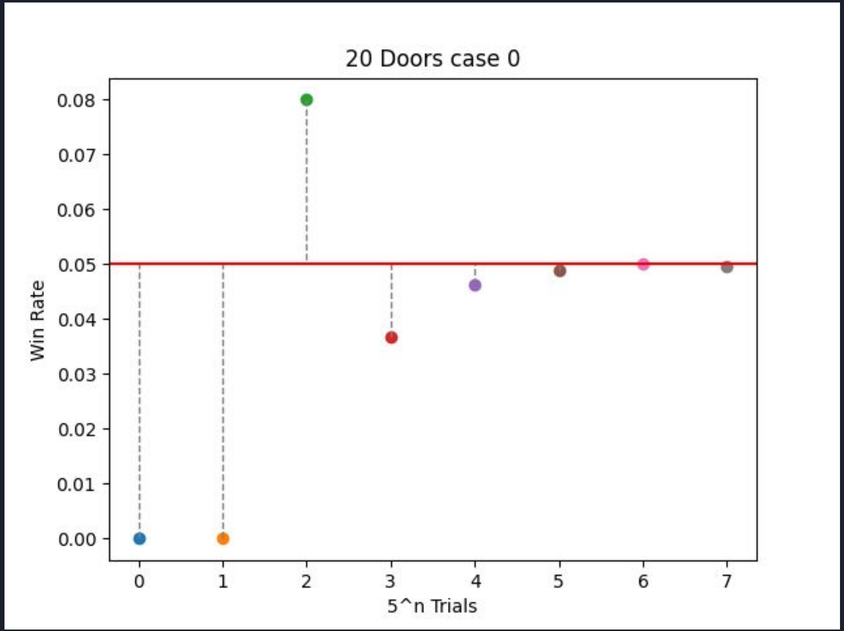
Results & Discussion (The Importance Of Iterations)



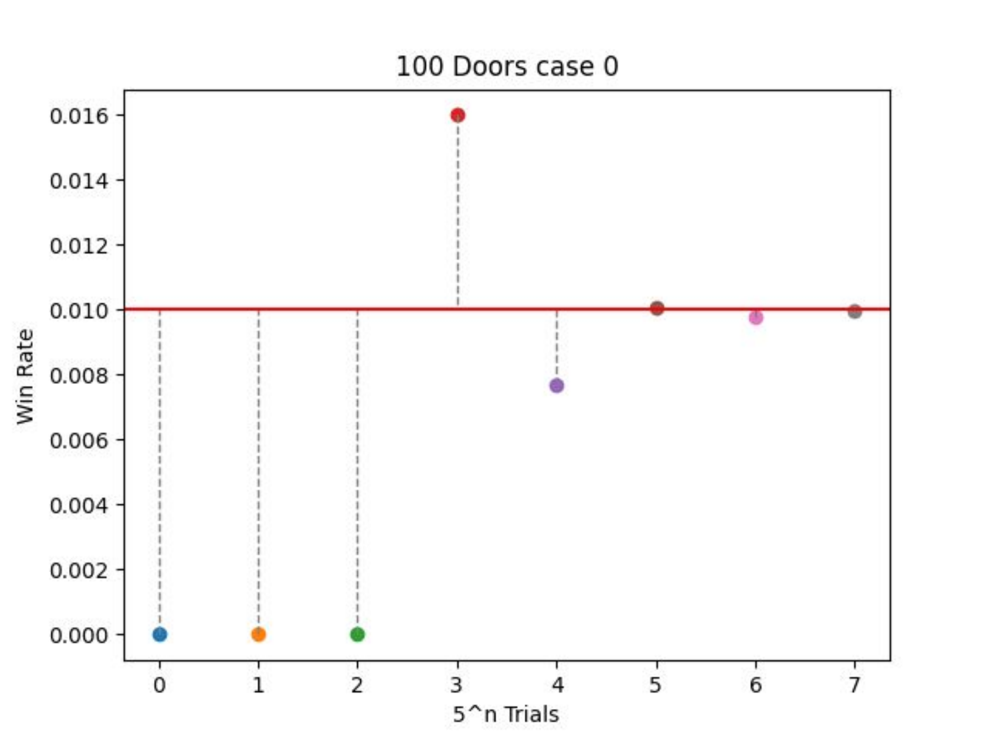


Results & Discussion (The Importance Of Iterations)





Results & Discussion (The Importance Of Iterations)



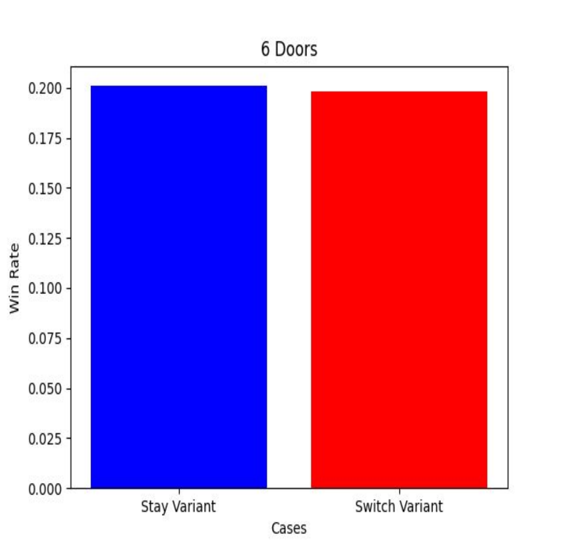
Problem Statement 2 (Monty Fall)

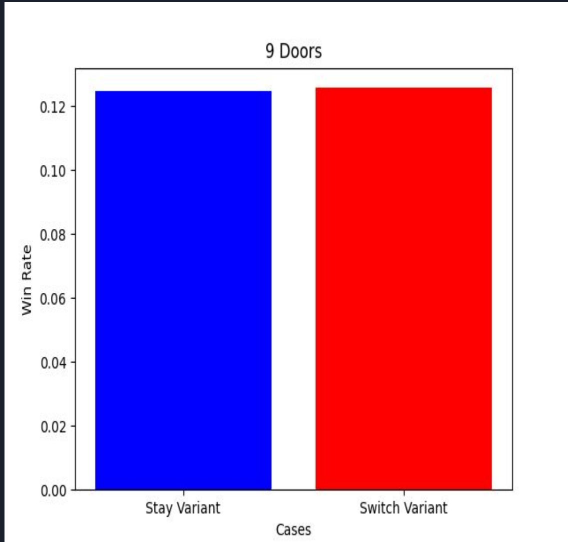
In this variant of the game, once the contestant has selected one of the doors, the host slips on a banana peel and accidentally pushes open another door (that could be the car).

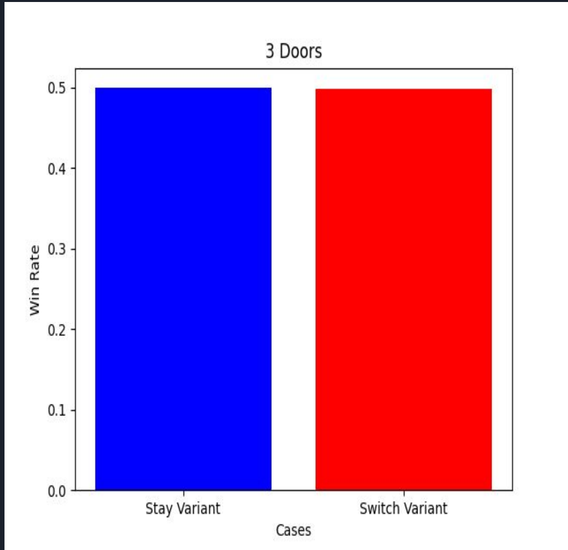
This is variant is also extended to 6, 9, 20 and 100 doors.

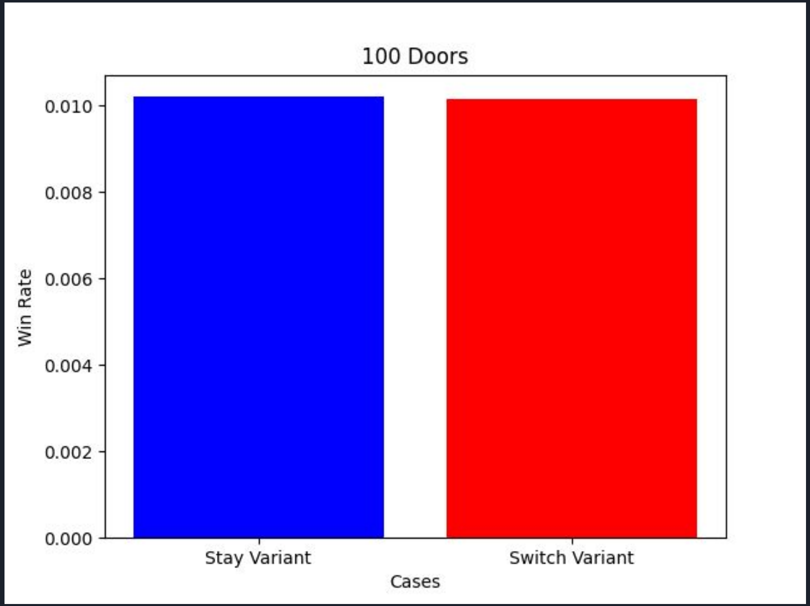
Results & Discussion

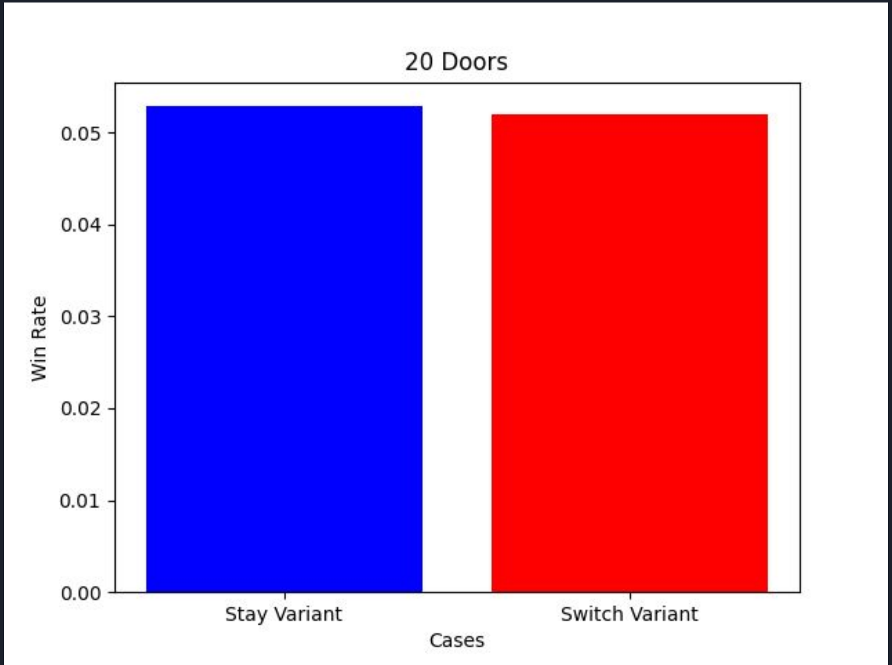
For all door counts, the odds of winning in each of the approaches is the same.








100 Doors
Win Rate
0.010
0.008
0.006
0.004
0.002
0.000
Stay Variant
Switch Variant
Cases


20 Doors
Win Rate
0.05
0.04
0.03
0.02
0.01
0.00
Stay Variant
Switch Variant
Cases

Conclusions

- Switching is always the best choice
- As there is more and more doors, the advantage gained from switching becomes smaller and smaller.
- The more iterations the better.