# Team Pi Monty Hall Simulation by Team Pi: Teng Gao, Zhaohua Huang

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from random import randint import random import seaborn as sns
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#intiallize simulation, return key values
def monty_hall():
                     """define a function for similation of monty hall game % \left( 1,...,N\right) =\left( 1,...,N\right) 
                   in Car Hidden, First Choice, Monty Open, Second Choice, Winfirst, WinSwitch for one simulation
                  # randomly select a door which has a car
                    car_hidden=randint(1,3)
                      # randomly made the first choice
                    first_choice=randint(1,3)
                    #initialize three doors
                   doors=[1,2,3]
# Monty won't show the door with car
                   doors.remove(car_hidden)
                   # if contestant pick the door with goat,monty has only one choice
if first_choice!= car_hidden:
                                         doors.remove(first choice)
                                         monty_open= doors[0]
                                         second_choice=car_hidden
                     #contestant pick the door with car, then monty has two other choice to open a door
                                         monty_open=random.choice(doors) # monty randomly pick from the other two doors
                   doors.remove(monty_open)
   second_choice=doors[0] # the other choice in this situation
if first_choice==car_hidden:
                                       winfirst='yes'
                                         winfirst=' '
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# count constestant second choice win times
    if second_choice==car_hidden:
        winswitch='yes'
    else:
        winswitch=' '
    return car hidden, first choice, monty open, second choice, winfirst, winswitch
# print out simulation results
def simulation(count):
    l winfirst=[]
    l winswitch=[]
    title = ('Index|', 'Car Hidden Here|', 'Your First Choice|', 'Monty Opended Door|', 'Your Second Choice|', 'Win if S
    print (f'{title[0]:7}{title[1]:15}{title[2]:19}{title[3]:20}{title[4]:20}{title[5]:14}{title[6]:15}')
    for i in range(count):
        car_hidden,first_choice, monty_open, second_choice, winfirst, winswitch=monty_hall() #return the result column
        l_winfirst.append(winfirst)
        l_winswitch.append(winswitch)
        print (f'{i+1:>3}{car_hidden:>14} {first_choice:>13} {monty_open:>20} {second_choice: >18} {winfirst:>16} {winfirst:>16}
    count_winfirst=l_winfirst.count('yes')
    count_winswitch=l_winswitch.count('yes')
    print (f'{count_winfirst} wins if you stayed with your first choice')
print (f'{count_winswitch} wins if you switch to your second choice')
    print(f'Win ratio of switching over starying: {count_winswitch/(count_winfirst):.2f}')
    return count_winfirst,count_winswitch
# run the simulation, out put result
def show_result(count):
    count_winfirst,count_winswitch=simulation(count) # return two lists of win first and win switch result
    sns.set_style('whitegrid')
    stay_percentage=count_winfirst/(count_winfirst+count_winswitch)
    switch_percentage=count_winswitch/(count_winfirst+count_winswitch)
    montyhall = sns.barplot(x =["Stay", "Switch"],y =[stay_percentage*100,switch_percentage*100])
montyhall.set_title(f'Stay vs.Switch Win Percentage after {count} Simulations ')
    montyhall.set(ylabel='Percentage')
    montyhall.set_ylim(top=100)
    toppers=[f'{stay_percentage:.0%}',f'{switch_percentage:.0%}']
    for bar, topper in zip(montyhall.patches,toppers):
             text_x = bar.get_x() + bar.get_width() /
text_y = bar.get_height()
             montyhall.text(text_x, text_y, topper,
                        fontsize=11, ha='center', va='bottom')
show result(100)
Index | Car Hidden Here | Your First Choice | Monty Opended Door | Your Second Choice | Win if Stay | Win if Switch
                                                                                                                 yes
                                                                                                                 yes
                                                                                                                 yes
                 1
                                 1
                                                                                              ves
                                                                                              yes
                 2
                                                                                              yes
                                                                                                                 yes
 8
                 2
                                 1
                                                        3
                                                                             2
                                                                                                                 yes
 9
                 1
                                 1
                                                        3
                                                                                              yes
 10
                 3
                                 2
                                                                                                                 yes
 11
                 3
                                 1
                                                                                                                 yes
                 2
12
                                 1
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                 2
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13
                                                                                                                 yes
14
                                 1
                 1
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                 3
 15
                                                                                                                 yes
 16
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 17
                 1
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                                                        2
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18
                 1
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                                                        2
19
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20	3	3	1	2	yes	
21	2	3	1	2		yes
22	1	3	2	1		yes
23	1	3	2	1		yes
24	3	3	2	1	****	765
					yes	
25	1	1	3	2	yes	
26	2	3	1	2		yes
27	3	2	1	3		yes
28	2	2	3	1	yes	_
29	1	3	2	1	1	yes
30						
	3	2	1	3		yes
31	1	1	3	2	yes	
32	3	3	2	1	yes	
33	1	2	3	1		yes
34	2	1	3	2		yes
35	1	2	3	1		
35			3	2		yes
36	3	1	2	3		yes
37	3	2	1	3		yes
38	1	2	3	1		yes
39	3	2	1	3		yes
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40	2	3	1	2		yes
41	1	1	2	3	yes	
42	2	1	3	2		yes
43	2	1	3	2		yes
44	3	3	1	2	yes	-
45	1	3	2	1	7	yes
					1167	169
46	2	2	1	3	yes	
47	2	2	3	1	yes	
48	2	3	1	2		yes
49	3	1	2	3		yes
50	2	2	1	3	yes	1
					yes	
51	3	2	1	3		yes
52	1	2	3	1		yes
53	1	2	3	1		yes
54	2	2	1	3	yes	
55	1	1	3	2	yes	
		2		2	yes	
56	3		1	3		yes
57	3	1	2	3		yes
58	2	1	3	2		yes
59	2	3	1	2		yes
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	2	2	2	1		
60	3	3	2	1	yes	
60 61	1	1	3	2	yes yes	
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