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# 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
    this function will return results
    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
    else:
        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'
    else:
        winfirst=' '
```

```
        # 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 columi
        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} {wi
    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() / 2
            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
  1              1               3                   2                   1                              yes
  2              1               2                   3                   1                              yes
  3              2               3                   1                   2                              yes
  4              1               1                   3                   2             yes
  5              1               1                   2                   3             yes
  6              2               2                   1                   3             yes
  7              1               2                   3                   1                              yes
  8              2               1                   3                   2                              yes
  9              1               1                   3                   2             yes
 10              3               2                   1                   3                              yes
 11              3               1                   2                   3                              yes
 12              2               1                   3                   2                              yes
 13              2               3                   1                   2                              yes
 14              1               1                   2                   3             yes
 15              3               1                   2                   3                              yes
 16              1               2                   3                   1                              yes
 17              1               3                   2                   1                              yes
 18              1               3                   2                   1                              yes
 19              3               1                   2                   3                              yes
```

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	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		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		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
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		yes
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	
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	
56	3	2	1	3		yes
57	3	1	2	3		yes
58	2	1	3	2		yes
59	2	3	1	2		yes
60	3	3	2	1	yes	
61	1	1	3	2	yes	
62	2	2	1	3	yes	
63	1	3	2	1		yes
64	2	1	3	2		yes
65	2	2	3	1	yes	
66	3	3	1	2	yes	
67	3	3	1	2	yes	
68	3	1	2	3		yes
69	1	1	3	2	yes	
70	2	2	1	3	yes	
71	3	3	1	2	yes	
72	1	1	2	3	yes	
73	3	2	1	3		yes
74	1	1	3	2	yes	
75	3	1	2	3		yes
76	1	1	3	2	yes	
77	3	1	2	3		yes
78	1	3	2	1		yes
79	1	1	3	2	yes	
80	1	2	3	1		yes
81	2	1	3	2		yes
82	3	3	1	2	yes	
83	1	3	2	1		yes
84	1	3	2	1		yes
85	1	1	2	3	yes	
86	2	1	3	2		yes
87	3	1	2	3		yes
88	1	3	2	1		yes
89	1	2	3	1		yes
90	2	3	1	2		yes
91	1	3	2	1		yes
92	1	1	3	2	yes	
93	2	2	1	3	yes	
94	1	3	2	1		yes
95	2	3	1	2		yes
96	1	3	2	1		yes
97	1	2	3	1		yes
98	1	2	3	1		yes
99	3	2	1	3		yes

```
100             3             2                   1                   3                              yes
35 wins if you stayed with your first choice
65 wins if you switch to your second choice
Win ratio of switching over starying: 1.86
```