PHYS 139 Assignment 1

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October 2022

Problem 1

a.

$$P(3H) = 0.35 \times 0.65 \times 0.40 = 0.091$$

$$P(3T) = 0.65 \times 0.35 \times 0.60 = 0.1365$$

$$P(HHT) = 0.35 \times (0.65 \times 0.6 + 0.35 \times 0.4) + 0.65 \times 0.65 \times 0.4 = 0.3545$$

$$\begin{aligned} P(TTH) &= 0.35 \times 0.35 \times 0.6 + 0.65 \times 0.65 \times 0.6 + 0.4 \times 0.35 \times 0.65 \\ &= 1 - P(HHT) - P(3T) - P(3H) = 0.418 \end{aligned}$$

b.
Random number generators are used in *problem1.py* to conduct simulations. The results are saved in *result.txt*
c.
Take P(3H) as an example. A 1 percent accuracy yields 0.091 ± 0.00091 or [0.09009, 0.09191]. This level of accuracy can be reached when the trial number reaches around 10000.

Problem 2

a.
The oracle should toss the coins two times. If both are heads, then she should give the answer "YES". Any other result yields answer "NO".
b.
Use conditional probability. Toss the coins three times per round, until the combination of one head and two tails. The oracle must toss coins till she gets this combination. If the sequence is "HTT" (as opposed to "TTH", "THT"), then the oracle should answer "YES". Otherwise, she should say "NO".

$$P(HTT) = \frac{0.5 \times 0.5 \times 0.5}{3C1 \times 0.5^3} = \frac{1}{3}$$

d.
problem2.py demonstrates the simulations.

1 Problem 3

a.
The possible combinations are [4,4], [1,7], [7,1]. Therefore the theoretical probability should be,

$$P(sum = 8) = \frac{3}{7 \times 7} = 0.06122$$

The simulation is in *problem3.py*.

2 Problem 4

a.
The theoretical calculations are as follows. If always switch doors,

$$P(win) = P(originaldoordoesnotcontainprize) = \frac{2}{3}$$

If always not switch doors,

$$P(win) = P(originaldoorcontainsprize) = \frac{1}{3}$$

The simulation is in *problem4.py*

3 Problem 5

Theoretical calculations yield the following result,

$$P(safe|captureoneofthecreatures) = 0.5 + 0.3 \times 0.2 = 0.56$$
$$P(safe|captureT) = \frac{0.3 \times 0.2}{0.1 \times 0.6 + 0.3 \times 0.2 + 0.1 \times 0.4} = 0.375$$

Simulation is in *problem5.py*