1. Repeated Independent Variables

Again Repeated Independent variables

E: Heads on an odd toss

T_1 = Tail on first toss

$P(E) = P(E \cap T_1) + P(E \cap T_1')$ $P(E \mid T_1) = P(E') = 1 - P(E)$

$P(E) = P(E \cap T_1) + p$

$P(E) = P(E \mid T_1) P(T_1) + p$

$P(E) = P(E \mid T_1) q + p$

$P(E) = (1 - P(E)) q + p$

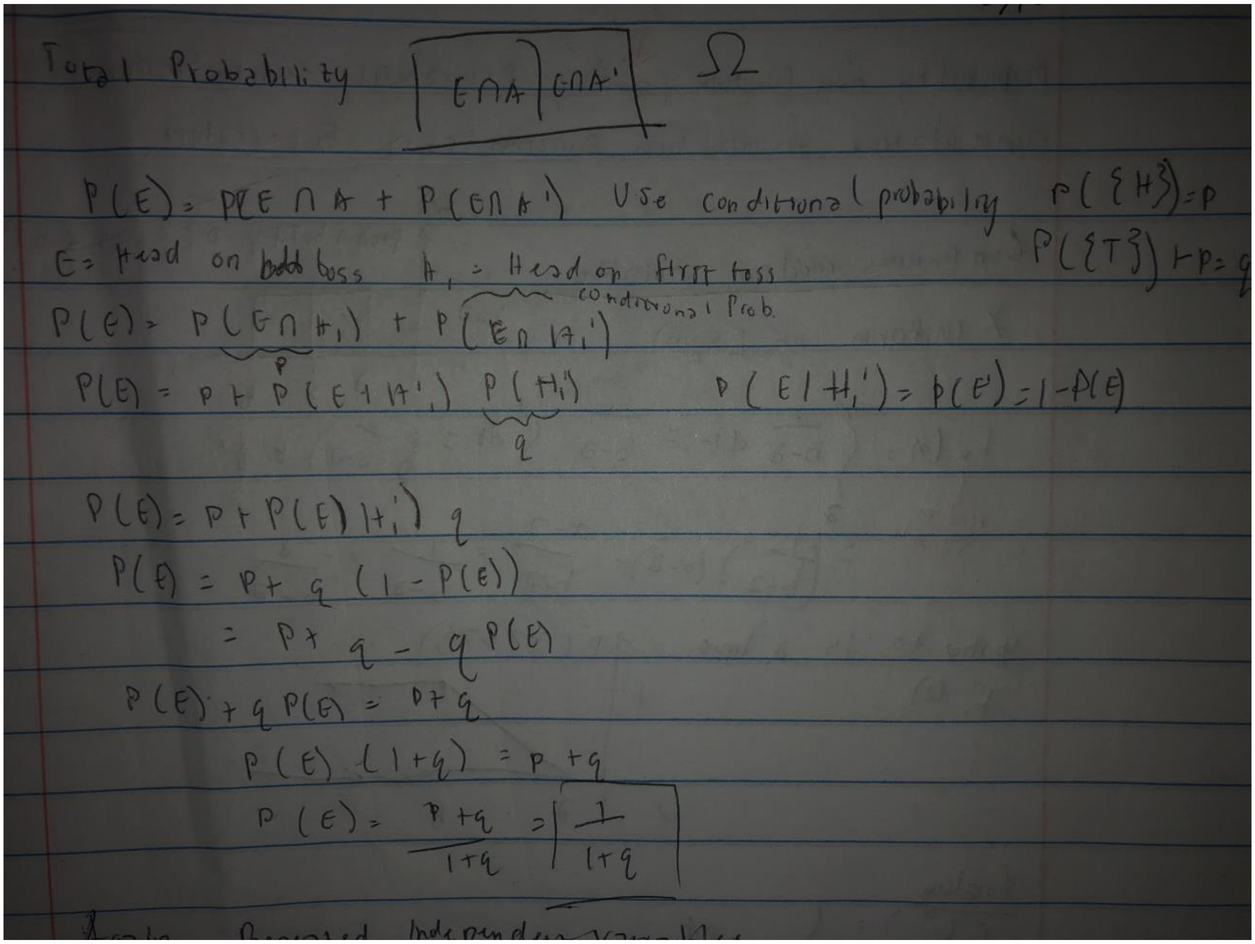
$P(E) = q - q P(E) + p$

$P(E) + q P(E) = q + p$

$P(E)(1+q) = q + p$

$$P(E) = \frac{q+p}{1+q} = \boxed{\frac{1}{1+q}}$$

2. Total Probability



Total Probability $\boxed{E \cap A \mid E \cap A'}$ Ω

$P(E) = P(E \cap A) + P(E \cap A')$ Use conditional probability $P(\{H\}) = p$

E = Head on odd toss H_1 = Head on first toss $P(\{T\}) = 1 - p = q$

$P(E) = \underbrace{P(E \cap H_1)}_{p} + P\overbrace{(E \cap H_1')}^{\text{conditional Prob.}}$

$P(E) = p + P(E \mid H_1') \underbrace{P(H_1')}_{q}$ $P(E \mid H_1') = P(E') = 1 - P(E)$

$P(E) = p + P(E \mid H_1')\, q$

$P(E) = p + q(1 - P(E))$

$= p + q - qP(E)$

$P(E) + qP(E) = p + q$

$P(E)(1 + q) = p + q$

$P(E) = \frac{p+q}{1+q} = \boxed{\frac{1}{1+q}}$

3. Simulation

```
# -*- coding: utf-8 -*-
"""
EE 381 spring 2020
Project 2
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"""
import math


Coin = [] # List of coin flips
```

```
N = 10000 # The norm.
A = 4987 # The adder.
M = 122021 # The multiplier.
# ------------------------------------------
# ------------------------------------------
S = float(input("Enter a seed value. "))

for i in range(100000):
    S = (M*S + A) % N
    v = S/N # Random numbers onthe interval [0, 1)
    coin = math.floor(2*v)
    Coin.append(coin)
# Above generate list of coin flips
#-----------------------------------

game = [] # One trial of game
count = 0 # Accumulator for number of flips
win = 0 # Accumulator for number of wins

for i in Coin:
    game.append(i)
    if i == 1: #We have flipped a head
        count = count + 1
        L = len(game) # How many flips before head
        if L % 2 == 1: # We have a head on an odd flip
            win = win + 1 # Increment the 'win' record
        game = [] # Refresh for a new game
p = win / count
```

print(p)

```
Enter a seed value. 13417
0.6672

In [14]:
```