**HW 7 Monty Hall Problem and Problem 3.3**

**Problem 1 (Monty Hall)**

**Python Code and Output**

**import numpy as np**

**N = 1000**

**door\_number = np.array([1,2,3])**

**stay = np.zeros(N)**

**swap = np.zeros(N)**

**for i in range(N):**

**prize = np.random.choice(door\_number, prob = [1/3, 1/3, 1/3])**

**first\_choice = np.random.choice(door\_number, prob = [1/3, 1/3, 1/3])**

**if first\_choice == prize:**

**bust = np.array(list(set(door\_number) - set([prize])))**

**bust2 = np.random.choice(bust, prob = [1,2, 1,2])**

**else:**

**bust2 = list(set(door\_number) - set([prize, first\_choice]))[0]**

**second\_choice = list(set(door\_number) - set([bust2, first\_choice]))[0]**

**if first\_choice == prize:**

**stay[i] = 1**

**if second\_choice == prize:**

**swap[i] = 1**

lswap = round(sum(swap)/N, 5)

lstay =  round(sum(stay)/N, 5)

lstay, lswap

**Output:**

**(0.339, 0.661)**

**Explanation in write up**

**Problem 3.3 MATLAB Code, Output, and explanation**

>> %Problem 3.3 Joseph High

>> count = 0;

for i = 1:1000

T=400;

x=150;

xx = [150];

tt = [0];

t=0;

ev\_list = inf\*ones(3,2);

ev\_list(1, :) = [7 + 3\*rand, 1];

ev\_list(2, :) = [25 + 10\*rand, 2];

ev\_list(3, :) = [-log(rand), 3];

ev\_list = sortrows(ev\_list, 1);

while t<T

t = ev\_list(1,1);

ev\_type = ev\_list(1, 2);

switch ev\_type

case 1

x = x + 16\*-log(rand);

ev\_list(1, :) = [7 + 3\*rand + t, 1];

case 2

x = x + 100;

ev\_list(1, :) = [25 + 10\*rand + t, 2];

case 3

x = x - (5 + randn);

ev\_list(1, :) = [-log(rand) + t, 3];

end

ev\_list = sortrows(ev\_list, 1);

xx = [xx, x];

tt = [tt, t];

end

if sum(xx(1:100)<0)>0

count = count + 1;

end

end

disp(count)

267

Thus, out of 1000 run, 267 of them lead to a negative account balance during the first 100 days.

As t grows very large, the account balance should natural approach its expected value. Since frequent payments are made every t1 days where t1 is between 7 and 10 days, inclusive, the

average time a frequent payment is made is (7+10)/2 = 8.5 days - where each frequent payment is $16,000. Occasional payments are made every t2 days where t2 is between 25 and 35 days, inclusive. Thus, the average time an occassional payment is made is every 30 days, where each occasional payment is $100,000. Lastly, money is debited from the account once a day, so the average is one a day. Therefore, the average account balance should be X(t) = (16/8.5)t + (100/30)t - 5t = 0.2157t (approximately).