NTNU

Kunnskap for en bedre verden

TDT4171 - Artificial Intelligence Methods

Assignment 1

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1 Exercise 1

a)

To find how many 5 card hand there are in a 52 card deck, we can use the binomial coefficient.

$$\binom{n}{k} = \frac{n!}{k!(n-k)!}$$

where $n = 52$ and $k = 5$ this gives

$$\binom{52}{5} = \frac{52!}{5!(52-5)!} = 2,598,960 \text{ atomic events}$$

b)

Since there are 2,598,960 atomic events, there is a $\frac{1}{2{,}598{,}960}$ probability for each atomic event.

c)

A royal straight flush can only occur with 4 hands, one royal straight for each type of card. This means that there is a

$$\frac{4}{2,598,960} = \frac{1}{649,740}$$

probability for being dealt a royal straight flush.

There are 13 different values in a deck, which means that there are 13 ways to get a four of a kind. However we have a fifth card, which means that there are

$$13 * 48 = 624$$

hands where there is a four of a kind. And the probability for beeing dealt a hand with four of a kind is

$$\frac{624}{2,598,960} = \frac{1}{4165}$$

2 Exercise 2

a)

Firstly we need to calulate the propability for each event happening:

BAR/BAR/BAR $= \frac{1}{4} * \frac{1}{4} * \frac{1}{4} = \frac{1}{64}$ with 20 coins in pay.

BELL/BELL/BELL $= \frac{1}{4} * \frac{1}{4} * \frac{1}{4} = \frac{1}{64}$ with 15 coins in pay.

LEMON/LEMON/LEMON $= \frac{1}{4} * \frac{1}{4} * \frac{1}{4} = \frac{1}{64}$ with 5 coins in pay.

CHERRY/CHERRY/CHERRY $= \frac{1}{4} * \frac{1}{4} * \frac{1}{4} = \frac{1}{64}$ with 3 coins in pay.

CHERRY/CHERRY/? $= \frac{1}{4} * \frac{1}{4} * \frac{3}{4} = \frac{3}{64}$ with 2 coins in pay.

CHERRY/?/? $= \frac{1}{4} * \frac{3}{4} * \frac{3}{4} = \frac{9}{64}$ with 1 coins in pay.

The expected payback percentage is therefore

$$\frac{20*1}{64} + \frac{15*1}{64} + \frac{5*1}{64} + \frac{3*1}{64} + \frac{2*3}{64} + \frac{1*9}{64} = \frac{58}{64} = 90,62\%$$

b)

The propability of winning playing once is the sum of the propabilities of all the winning events

$$\frac{1}{64} + \frac{1}{64} + \frac{1}{64} + \frac{1}{64} + \frac{3}{64} + \frac{9}{64} = \frac{16}{64} = 25\%$$

c)

Simulating with 10000 iterations we get

estimated mean = 223.23 games

estimated median = 21 games

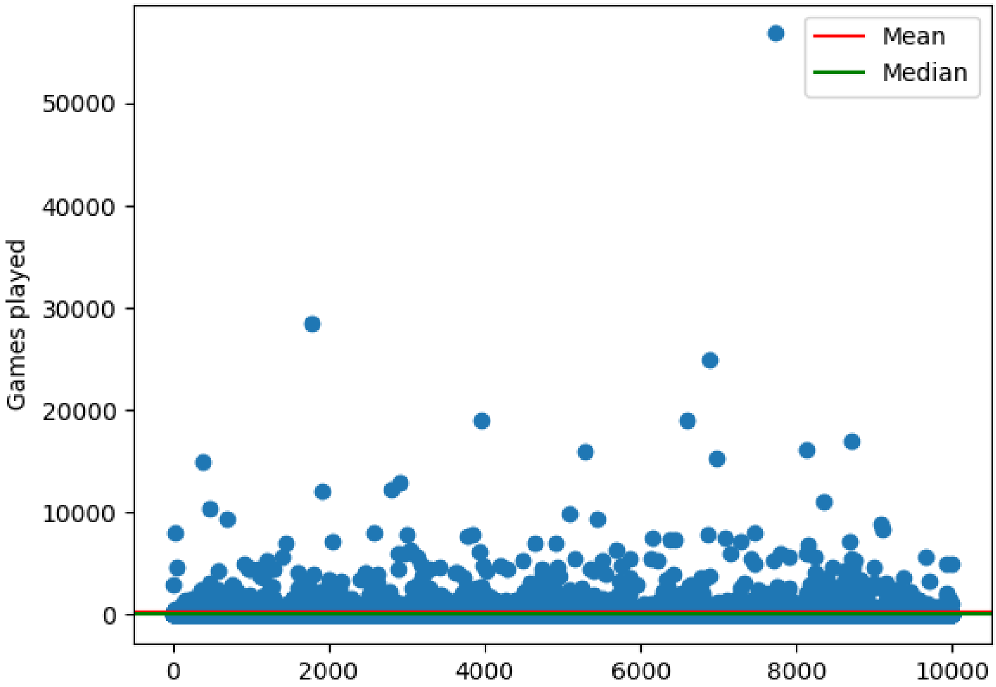

Figure 1: Games played to go broke with 10 coins.

3 Exercise 3

3.1 Part 1

I decided after some trial and error use 10000 simulations for each N, using more simulations resulted in a slow runtime. After running the simulation I got the graph under.

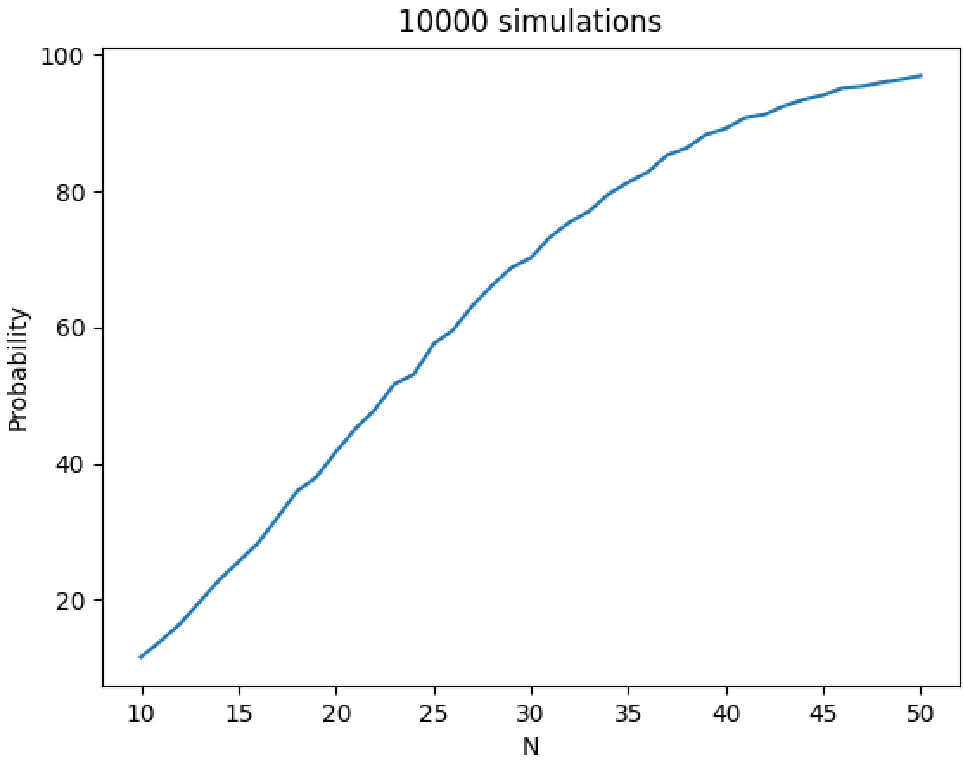

Figure 2: Probability of events happening with N people

Where N = 23 is the smallest number of people where the event has at least 50% chance of occuring.

3.2 Part 2

After running the simulation with 1000 iterations, the group size averaged out to a group size of 2373.71 people.