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Course: TDT4171 – Artificial Intelligence Methods

Assignment: Assignment 1

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Exercise 1:

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a. $C(n,k) = \binom{n}{k} = \frac{n!}{k!\,(n-k)!}$

$$\binom{52}{5} = \frac{52!}{5!\,(47)!} = \frac{52 \times 51 \times 50 \times 49 \times 48 \times \cancel{47!}}{5!\,\cancel{47!}}$$

$$\boxed{= 2.598.960}$$

b.

$$P_{(event)} = \frac{1}{\text{total numbers of atomic events.}}$$

$$= \frac{1}{2.598.960} \cong 3.84 \times 10^{-7}$$

Royal Straight Flush

c. - 4 suits

- 1 combination per suit
- 4 possible Royal Flush

$$P_{(\text{ROYAL FLUSH})} = \frac{4}{2.598.960} = \frac{1}{649.740}$$

$$\boxed{\cong 0{,}00000154}$$

Four of a kind

- 13 ranks (2 - A)
- 1 way
- kicker (52 - 4 = 48)

↳ $13 \times 1 \times 48 = 624$

$$P_{(\text{Four of a kind})} = \frac{624}{2.598.960} = \frac{1}{4.165}$$

$$\boxed{\cong 0{,}00024}$$

Exercise 2:

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a.

Bar = B
Bell = Bl
Lemon = L
Cherry = C

BBB = 20 (1)
Bl Bl Bl = 15 (1)
LLL = 5 (1)
CCC = 3 (1)
CC? = 2

{ 3rd option can be B, Bl or L
{ Total = 1 × 1 × 3 = 3

C?? = 1

{ 2nd option can be B, Bl or L
{ 3rd option can be B, Bl, L or C
Total = 1 × 3 × 4 = 12

$$\rightarrow \frac{(1\times20)(1\times15)(1\times5)(1\times3)(3\times2)(12\times1)}{64}$$

4x4x4 = 64 (total combinations)

$$\boxed{\cong 0,9531}$$

95,31% payback percentage

b.

$$N_{wins} = 1+1+1+1+3+12 = 19$$

$$P_{(wins)} = \frac{19}{64} \cong 0,296875$$

$$\boxed{29,69\%}$$

c.

To estimate the number of plays a player can expect to make before going broke (starting with 10 coins), I implemented a Monte Carlo simulation in Python.

The simulation mimics the slot machine logic, deducting 1 coin per play and adding coins based on the payout probabilities calculated in part (a). The process was repeated 50,000 times to ensure statistical significance.

Mean number of plays: ~212.4

Median number of plays: 21.0

Obs: The large difference between the mean and the median suggests a highly skewed distribution. While most players go broke quickly (around 21 plays), a small percentage of players hit high-paying combinations repeatedly, extending their game significantly and pulling the average up.

Exercise 3:

Part 1:
Smallest: The smallest group size where the probability of a shared birthday is at least 50% is N = 23

Proportion in Interval [10, 50]: In the range of **N = 10** to **N=50** , the event occurs with at least 50% probability in **28 out of 41** cases.

- Proportion: ~0.6829 or 68.29%

Part 2:

Based on the simulation (averaged over 1,000 runs), the expected group size required to cover all birthdays is approximately **2,360 people**.