A Numerical Solution To The Optimal Solution To Guessing Playing Card Colour

Willoughby Seago

5th June 2019

Abstract

We wanted to calculate whether there was a better solution than randomly guessing the colour of the next card if the colour of the first card was already known. We have discovered that guessing the opposite colour to the first card is better to a statistically significant level ($p = 0.05$).

Contents

Introduction

The question to be answered is:

"Is there a significant difference between guessing the colour of a card randomly and predicting the opposite colour to the previously revealed card"

We set about answering this question numerically.

1 Methodology

A program[1] was written that would create a deck of cards, shuffle, draw the first card and then guess the colour of the next card as the opposite of the colour of the first card.

2 Results

The program was set to run one thousand repeats and guess a million cards each time. The results are available in a csv file file[2]
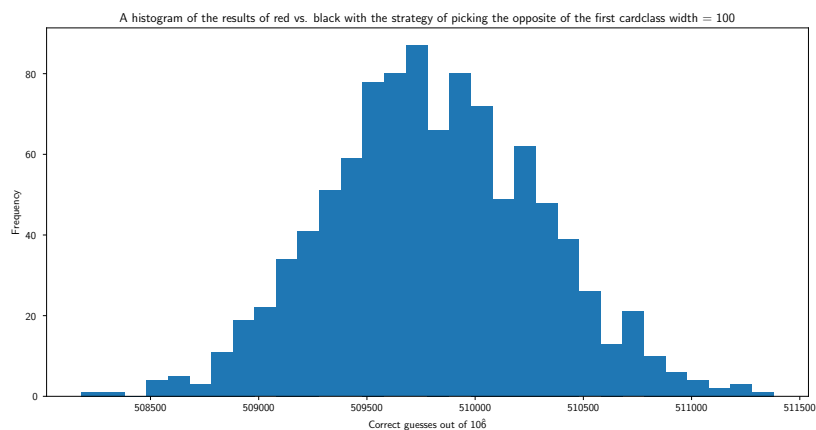

A histogram of the results of red vs. black with the strategy of picking the opposite of the first cardclass width = 100

Figure 1: A histogram of results with class width 100

---

[1]Source code on github.com - `https://github.com/WilloughbySeago/Cards/tree/master/Cards`

[2]csv on github.com - `https://github.com/WilloughbySeago/Cards/tree/master/Results/results.csv`

3 Analysis

The mean number of correct guesses out of one million was: 509803 to the nearest integer

The standard deviation is: 497.29 to 5 significant figures

The null hypothesis H_0 is:

> The probability of guessing correctly when applying the opposite colour technique is 0.5

The alternative hypothesis H_1 is:

> The probability of guessing correctly when applying the opposite colour technique is greater than 0.5

We tested against this at a 5% significance level comparing to a binomial distribution $p = 0.5$, $n = 1000$. The probability that the mean would be as it is or greater is of the order 10^{-86}. This is less than the significance level so we reject the null hypothesis.

Conclusion

We can conclude at the opposite colour technique is better at a significance level of $p = 0.05$