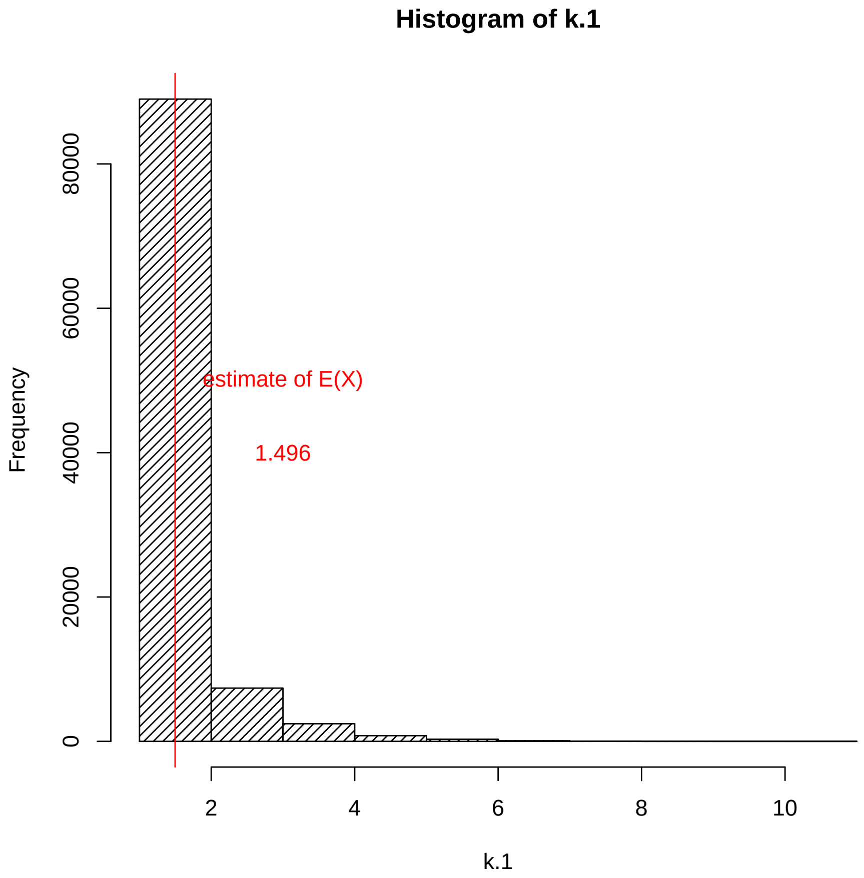
Problem Statement

Monty Hall problem

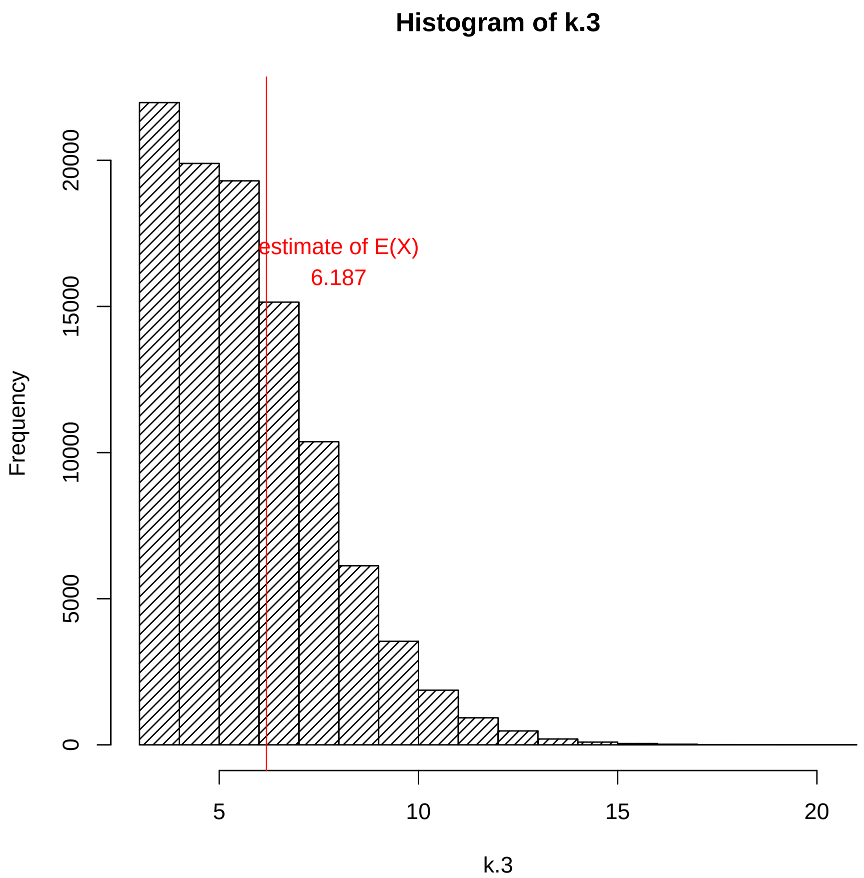
When a contestant is to choose one of three gates, where behind one of them is a prize, one can choose strategy as a result of the rules of the game. After the initial choice of the gate one ot the remaining gates that *has no car behind it* gets reveiled. Now the strategy is either to keep the initial gate or switch.[1]
The most effective strategy *in the long run* is to ALWAYS SWITCH. This is because, one has always $\frac{2}{3}$ chance of winning by swithcing. This is obvoius because, there is $\frac{1}{3}$ chance of finding the prize which is behind 1 of the 3 gates, that means that there is $\frac{2}{3}$ chance of NOT finding the prize. If we set our goal to NOT find the prize, and then switch when the empty gate opens, we will win with a $\frac{2}{3}$ probability, because there is $\frac{2}{3}$ chance of not finding the prize!
The simulation from [Listing 1] shows that there is approximately [1]0.6771 chance of winning with strategy 2.

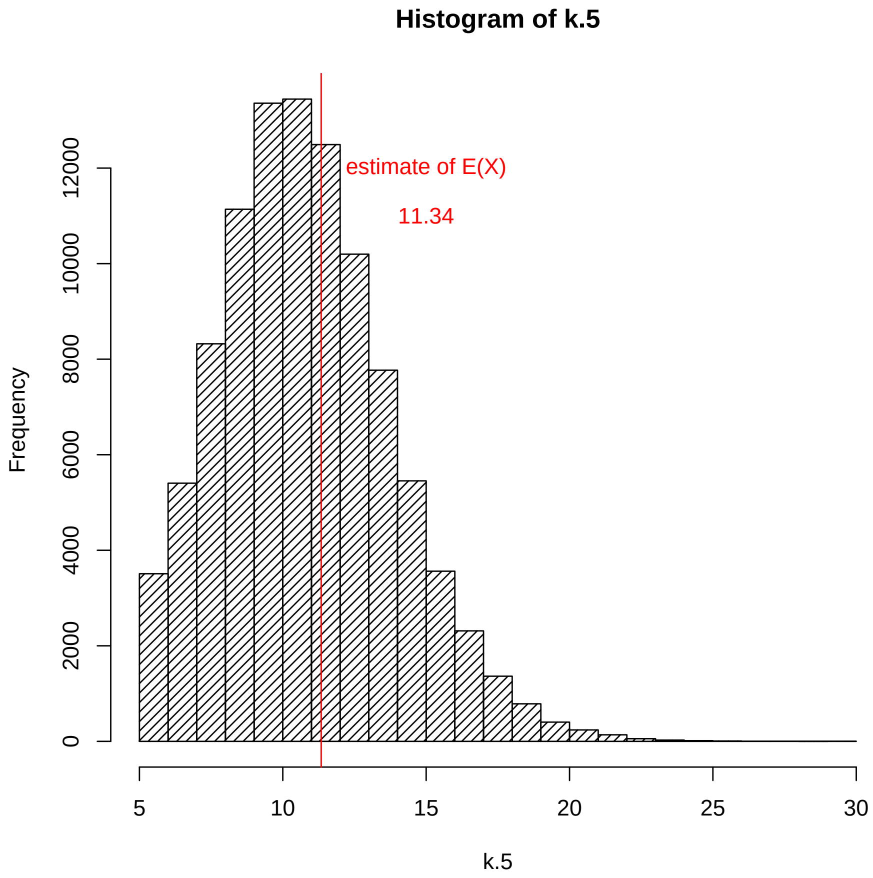
Rock Paper Scissors

There is $\frac{1}{3}$ chance of choosing either of the shapes. Probability for a person to NOT choose "rock" is $\frac{2}{3}$ because then it's either "paper" or "scissors". Whatever the eperson chooses has no influence on what the other chooses, that means there is $\frac{2}{3}$ chance for one person to not choose whatever the other person choose, thus giving $\frac{2}{3}$ chance for the game to end successfully. If on the other hand we look at the possibility to end the game in a tie, it is clearly $\frac{1}{3}$ because if we look at the possibility to choose "rock", then its abviously $\frac{1}{3}$, if one person will choose rock independently the other has $\frac{1}{3}$ chance of doing the same.
The expected number of trials until there is a winner is: $1/\frac{2}{3}$
The results of k = 1 from the simulation is very close to $1/\frac{2}{3} = 1.5$


Histogram of k.1
Frequency
0
20000
40000
60000
80000
estimate of E(X)
1.496
2
4
6
8
10
k.1

The estimatet number of trials untill there is a winner after 10^5 simulations is as follows:




Histogram of k.5
estimate of E(X)
11.34
Frequency
0
2000
4000
6000
8000
10000
12000
5
10
15
20
25
30
k.5

Solutions

Construction/Implementation

Listing 1: Simulation of "swtich" strategy in Monty Hall problem

```
for (i in c(0:1e4)) {
  gate_distribution <- sample(possible_items, prob=c(1/3,1/3,1/3));
  contestant_choice <- sample(possible_choices,size=1,prob=c(1/3,1/3,1/3));
  # amount of wins strategy 2
  if (``car'' %in% gate_distribution[-contestant_choice]) {
  switch <- switch+1;
  }
}
```

Listing 2: Number of trials needed to finish the game given k lives

```
play_rps <- function(lives=1) {
  k <- 0;
  while(1) {

    #independent choices
    player0 <- sample(elements,size=1,prob=p);
    player1 <- sample(elements,size=1,prob=p);

    ifelse ((player0==''R'' && player1==''S''), p0win <- p0win+1,
    ifelse ((player0==''R'' && player1==''P''), p1win <- p1win+1,

    ifelse ((player0==''P'' && player1==''R''), p0win <- p0win+1,
    ifelse ((player0==''P'' && player1==''S''), p1win <- p1win+1,

    ifelse ((player0==''S'' && player1==''P''), p0win <- p0win+1,
    ifelse ((player0==''S'' && player1==''R''), p1win <- p1win+1,NA))))));

    k <- k+1;

    if (p0win>=lives || p1win>=lives) {
      break
    }
  }

  return(k);
}
```

Attachments

montyhallproblem.R rps.R Rplots.pdf

References

[1] Monty Hall problem, [cited 27.September 2016]. Available at https://en.wikipedia.org/wiki/Monty_Hall_problem