Monty Hall Monte Carlo Simulation

Jeffrey Cheng

5/22/2019

Problem: Suppose you're on a game show, and you're given the choice of three doors: Behind one door is a car; behind the others, goats. You pick a door, say No. 1, and the host, who knows what's behind the doors, opens another door, say No. 3, which has a goat. He then says to you, "Do you want to pick door No. 2?" Is it to your advantage to switch your choice?

IF YOU DON'T SWITCH:

```
sample_size <- 10000
count <- 0

#function to sample regardless of length of list of available doors
varSamp <- function(x) {
  if (length(x) <= 1) {
    return(x)
  } else {
    return(sample(x, 1))
  }
}

#door numbers
vals <- 1:3

for(i in 1:sample_size) {
  doors <- array(0, dim = c(1, 3))
  #set a random door to have the car behind it (the number 1)
  car_door <- sample(vals, 1, replace = TRUE)
  doors[car_door] <- 1
  #player picks a random door
  init_door <- sample(vals, 1, replace = TRUE)

  can_open <- 1:3
  indexes <- c(init_door, car_door)
  indexes <- sort(indexes, decreasing = TRUE)
  if(indexes[1] != indexes[2]) {
    for(i in 1:2) {
    can_open <- can_open[-indexes[i]]
    }
  } else {
    can_open <- can_open[-indexes[1]]
  }

  #host opens one door showing a goat, and you switch to the other   door: "new door"
  opened_door <- varSamp(can_open)
  doors[init_door] <- doors[init_door] + 1
  if(doors[car_door] == 2) {
    count <- count + 1
  }
}
```

```
print(count/sample_size)
```

```
## [1] 0.3276
```

IF YOU SWITCH:

```
sample_size <- 10000
count <- 0

#function to sample regardless of length of list of available doors
varSamp <- function(x) {
  if (length(x) <= 1) {
    return(x)
  } else {
    return(sample(x, 1))
  }
}

#door numbers
vals <- 1:3

for(i in 1:sample_size) {
  doors <- array(0, dim = c(1, 3))
  #set a random door to have the car behind it (the number 1)
  car_door <- sample(vals, 1, replace = TRUE)
  doors[car_door] <- 1
  #player picks a random door
  init_door <- sample(vals, 1, replace = TRUE)

  can_open <- 1:3
  indexes <- c(init_door, car_door)
  indexes <- sort(indexes, decreasing = TRUE)
  if(indexes[1] != indexes[2]) {
    for(i in 1:2) {
    can_open <- can_open[-indexes[i]]
    }
  } else {
    can_open <- can_open[-indexes[1]]
  }

  #host opens one door showing a goat, and you switch to the other   door: "new door"
  opened_door <- varSamp(can_open)
  new_door <- 1:3
  indexes2 <- c(init_door, opened_door)
  indexes2 <- sort(indexes2, decreasing = TRUE)
  for(i in 1:2) {
    new_door <- new_door[-indexes2[i]]
    }

  doors[new_door] <- doors[new_door] + 1
  if(doors[car_door] == 2) {
    count <- count + 1
  }
}
print(count/sample_size)
```

```
## [1] 0.6742
```