

Queen of Hearts Simulation Studies

Greg Petrucci Jr

4/5/2018

Introduction

Queen of Hearts is a silly game that is played at the Elks in Norwood, Ma. This is a simulation of the probability of winning during the first week (n=54 cards remain) and 1000 unique participants enter the drawing, each selecting a random number that corresponds to where the Queen of Hearts is on the board, randomly from 1 through 54.

Methods

```
#Here I make the deck of cards
set.seed(886600)
buildDeck <- function(noOfDecks=1){
  suits <- c("Clubs", "Spades", "Diamonds", "Hearts")
  cards <- c("Ace", 2:10, "Jack", "Queen", "King")
  Deck <- paste(cards, rep(suits, each = 13), sep = "-")
  Deck <- as.data.frame(Deck)
  Joker <- c("Joker")
  Jokers_In <- as.data.frame(paste(rep(Joker, 2)))
  names(Jokers_In) <- "Deck"
  Full_Deck <- rbind(Deck, Jokers_In, stringsAsFactors = F)
  d <- rep(Full_Deck, noOfDecks) #Build decks
  shuffledDeck <- sample(d, length(d)) #Shuffle decks
  return(as.data.frame(shuffledDeck))
}
deck <- buildDeck(1)
deck <- deck[sample(1:nrow(deck)),]
deck <- as.data.frame(deck)
queen_of_hearts_number <- 40
```

In the code above I simulate a deck of cards.

```
#Here I make a function for weekly name entry and column
#2 is the corresponding card number for that participant
weeklyName_Entry <- function(n=1000){
  names <- c(rep("Greg", n ))
  for (i in 1:length(names)){
    names[i] <- paste(names[i], i, sep="")
  }
  names<- as.data.frame(names)
  names$card_number <- NA
```

```

for ( i in 1:nrow(names)){
  names$card_number[i] <- sample(1:54, 1)
}

return(names)
}

week1_names <- weeklyName_Entry(n=1000)

##Output from above is week1_names which has 1000 names and random numbers ranging from 1 through 54. This represents 1000 unique names entering the drawing in week one and each of the choose a random card number from 1 through 54.

set.seed(Sys.time())

weekly_drawing_for_names_and_queen <- function(week1_names){
  #This function evaluates if the true name is selected
  #from the fish bowl, if yes, counter = 0, else counter = 1

  week1_name_winner_index <- sample(1:nrow(week1_names), 1)
  week_1_criterion <- week1_names[week1_name_winner_index,]

  drawing_winner_index <- sample(nrow(week1_names), 1)

  if (week1_names[drawing_winner_index,][1,1] == week_1_criterion[1,1]){
    #check to see if the name hits
    counter_name <- 0
  } else {
    counter_name <- 1
  }

  if(week1_names[drawing_winner_index,][,2]== 40){
    #check to see if the queen of hearts numbers hit
    counter_queen <- 0
  } else {
    counter_queen <-1
  }

  return(c(counter_name, counter_queen))
  # double 0 denotes hitting both
  #names and queen of hearts number
}

```

##Code above is a function which evaluates the following:

- 1.) Sampled from 1 through all names that entered in week 1 randomly select a participant to represent the winner. I have to do this because in real life there is a winner that is picked. Here, week_1_criterion represents what we will call the truth for week 1.
- 2.) Next, I randomly sample from all the names that entered in week 1 and denote this person as the person who has their name drawn.
- 3.) Next I check to see if the name that was randomly selected is the same as the criterion; this step represents “your” card being chosen from the bin of names.
- 4.) Finally, we need to check that the number you had on your card is the same as the week of hearts. This

would represent you being a “winner, winner”; your name was drawn and you had the correct card number corresponding to the queen of hearts.

```
INF <- 100000
two_pull_results <- matrix(NA, nrow=INF, ncol=3)
colnames(two_pull_results) <- c("First_Pull", "Second_Pull", "Sum")

for (i in 1:INF){
  two_pull_results[i,1] <- weekly_drawing_for_names_and_queen(week1_names) [1]
  two_pull_results[i,2] <- weekly_drawing_for_names_and_queen(week1_names) [2]
  two_pull_results[i,3] <- two_pull_results[i,1] + two_pull_results[i,2]
}
```

##The code above simulates 100000 trials at “week 1” (all n=54 cards remain on the board) where there are 1000 unique participants entered into the contest, each randomly selected one number from 1 through 54. The outcome of interest is having your name selected and the number you selected equal to the card number for the queen of hearts.

##Based on 100000 simulations the probability of winning one week 1 is approximately .00003.

```
two_pull_results <- as.data.frame(two_pull_results)
ggplot(two_pull_results, aes(First_Pull, Second_Pull)) +
  geom_jitter() +
  labs(title="Probability of Winning on Both Draws Based on 100000 Simulations" , x="Your Name Was Drawn", y="Your Number Was Drawn") +
  scale_x_discrete(limits=c(0,1), labels=c("TRUE", "False")) +
  scale_y_discrete(limits=c(0,1), labels=c("TRUE", "False"))
```

```
## Warning: Continuous limits supplied to discrete scale.
## i Did you mean `limits = factor(...)` or `scale_*_continuous()``?
## Continuous limits supplied to discrete scale.
## i Did you mean `limits = factor(...)` or `scale_*_continuous()``?
```

Probability of Winning on Both Draws Based on 100000 Simulations

