PLAYING ROULETTE EXERCISE

Playing Roulette

One plays roulette repeatedly at a casino. In a single play, one bets $5 on "red" and that player wins $5 with probability 18/38 and loses $5 with probability 20/38. If the roulette game (with the same bet) is played 20 times, then the individual play winnings can be viewed as a sample of size 20 selected with replacement from the vector (5, −5), where the respective probabilities are given in the vector (18/38, 20/38). These play winnings can be simulated using the function **`sample()`** with the **`prob`** vector that gives the sampling probabilities.

```
sample(c(5, -5), size=20,
                 replace=TRUE,
                 prob=c(18 / 38, 20 / 38))
```

a. Write a short function to compute the sum of the winnings from 20 plays at the roulette wheel. Use the **`replicate()`** function to repeat this "20 play simulation" 10000 times. Find the approximate probability that the total winning is positive.

```
roulette = function(){
# < your work goes here >
  sum(winnings)
}

s = replicate(<your work goes here>)

mean(s > 0)
```

b. The number of winning plays is a binomial random variable with 20 trials where the probability of success is 18/38. Using the **`pbinom()`** function, find the exact probability that your total winning is positive and check that the approximate answer in part (a) is close to the exact probability.

```
# the probability the total winning is positive is equal to
# the probability P(X > 10), where X is binomial(20, 18/38)

# < your work goes here >
```

c. Suppose you keep track of your cumulative winning during the game and record the number of plays *P* where your cumulative winning is positive. If the individual play winnings are stored in the vector **`winnings`**, the expression **`cumsum(winnings)`** computes the cumulative winnings, and the expression **`sum(cumsum(winnings)>0)`** computes a value of *P*. Adjust your function from part (a) to compute the value of *P*. Simulate the process 500 times and construct a

frequency table of the outcomes. Graph the outcomes and discuss which values of *P* are likely to occur.

```
roulette2 = function(){
# < your work goes here >
}

s = replicate(<your work goes here>)
table(s)
plot(table(s))
```