Stat 550, Spring 2019
Lab #2 Jan Domingo

For this lab, we will run some simulations of rolling dice and tossing coins using the statistical software program R. Your solutions should contain clearly identified numerical answers and well labeled tables/figures, where appropriate. Make sure to include clear and concise interpretations (that is, clear full sentences) of any values, figures, and responses to queries posed. Place all code in an appendix, at the end of your solutions document.

1) Simulate the probability that a random integer between 1 and 5000 is divisible by 4, 7, or 10.
   a) Run this simulation for 10, 100, 500, and 1,000 trials

      See attached appendix

   b) For each simulation in a), calculate the estimated proportion of this event for each simulation

      We obtained the following estimated proportions of each simulation of 10, 100, 500, and 1,000 trials respectively: 0.2, 0.49, 0.394, 0.434

2) A 20-sided DnD die is tossed ten times
   a) Calculate by hand the theoretical probability of rolling at least one 15 in ten tosses

$$p(no\ 15\ showing\ up\ in\ ten\ tosses) = \left(\frac{19}{20}\right)^{10}$$

$$p(at\ least\ one\ 15\ showing\ up\ in\ ten\ tosses) = 1 - \left(\frac{19}{20}\right)^{10} = .40126$$

   b) Simulate and estimate the probability of obtaining at least one 15 when tossing a 20-sided DnD die ten times for 1,000 trials

      For our simulation of 1,000 tosses, we obtained an estimated proportion of 0.406 chance of rolling at least one 15 when tossing a 20-sided die.

   c) Compare the theoretical probability from (a) with your empirical proportion from (b)

      Our empirical proportion was more than the theoretical probability. Thus for 1,000 tosses, the sample proportion is close to that of the estimated proportion with an absolute difference in error of .00474

```r
#R Code for Lab 2

#1
#(a)(b)

#This function calculates the proportion of numbers that are divisible by
4, 7, or 10 in the sample set
propCalc = function(n) {  #n represents the number of trials
  success = 0 #Success counter
  for (i in 1:n) {
    x = sample (1:5000, 1)
    if(x %% 4 == 0 || x %% 7 == 0 || x %% 10 == 0) {
      success = success + 1  #Increases success counter by 1
    }
  }
  return (success/n)  #Returns the estimated proportion of successes
}

prop10 = propCalc(10) #Calculates the proportion for 10 trials

prop100 = propCalc(100) #Calculates the proportion for 100 trials

prop500 = propCalc(500) #Calculates the proportion for 500 trials

prop1000 = propCalc(1000) #Calculates the proportion for 1000 trials



#=========================================================================

#2
#(b)

#This function calculates the proportion of how many times a '15' shows up
in a 20 sided die in 10 rolls given n trials
dieRoll = function (n) {
  success = 0
  for (i in 1: n) {
    trial = sample(1:20, 10, replace=TRUE) #Roll a 20 sided die 10 times
    if (sum(trial==15) >= 1) #Calculates how many times a '15' rolled
      success = success + 1
    }
    return(success/n)
}

sim1000 = dieRoll(1000) #Simulates 1000 trials
```