MATH 1550, LAB 4:   DUE: 4 October 2019
BINOMIAL PROBABILITIES AND SAMPLING

Commands needed for R:
   (1) Binomial Probabilities
        (a) To find a probability of the form $P(\text{BIN}(n,p) = x)$, use the command

                              dbinom(x,size=n,prob=p)

        (b) To find a probability of the form $P(\text{BIN}(n,p) \leq x)$, use the command

                              pbinom(x,size=n,prob=p)

   (2) Binomial Sampling
        (a) When you want to generate random binomial data, use the command

                              rbinom(N,n,p)

        Here, **n** and **p** are the parameters of your binomial random variable. The parameter **n** is the number of times you want to repeat the binomial experiment. For example if the binomial experiment consists of attempting 10 free throws with probability $p = .6$, then rbinom(100,10,.6) will run this experiment 100 times (i.e., $100 \times 10 = 1000$ free throw attempts). The output of this command would be 100 numbers, each representing how many shots were made in each set of 10 trials.

Problems:

A. The website basketball-reference.com reports that that over the course of his entire NBA career, Steve Nash has made 90.43% of his free throw attempts.

   (1) Assume that the probability that Steve Nash makes any future free throw attempt is .9043 (90.43%). What kind of probability is this (i.e., "theoretical" or "empirical")? Explain.

   (2) Nash attempts 15 free throws in a game. What is the probability that he makes exactly 12 of them? (Use Part (1) of the guide.)

   (3) What is the probability that he makes **more than** 12 of his attempts?
   (4) By hand (i.e., no calculator), calculate the probability that he makes 12 or fewer of his attempts. Also, write down any calculation(s) you use to get your answer. (*hint: you do **not** have to do 13 calculations for this!*)

B. Carmello Anthony's career free-throw average is 81.14%. Let X denote the number of free throws he makes in the next 100 attempts.

   (1) Calculate $P(X = 78)$ and $P(X \leq 78)$.

   (2) Find $P(75 \leq X \leq 86)$.

C. The lowest listed free throw percentage is for Joe Caldwell, who made 49.72% of his free throws. My own personal free throw average is probably pretty close to 11%. In an amazing and unlikely turn of events, Steve Nash, Joe Caldwell, and I are playing basketball, and each of us attempts 10 free throws.

(1) Create a list of 100 of these games played by Nash:

$$\texttt{Nash=rbinom(100,10,0.9043)}$$

(2) Create similar lists for Caldwell and me using our respective parameters.

(3) Create histograms for each player and submit them with your answers to all the above questions.