Math 338 **Lab Assignment #5** Fall 2019

Suppose that we are randomly guessing on a 30-question multiple-choice exam. We're guessing a little better than chance alone would predict – we estimate we have a 35% chance of getting each question correct.

Question #1 Let X be the number of questions we get correct. Evaluate the BINS assumptions for this scenario to explain why X can be modeled as a binomial random variable. As part of your evaluation, identify the parameters *n* and *p*.

B: we either get the question right or wrong
I: we assume that previous questions do not hint at answers in future problems
N: 30 questions which will be our N variable
S: We assume that we will answer each of the questions on the test. P=0.35

Open a new R script and enter the values of *n* and *p*.

```
> n <- # number of trials

> p <- # probability of success on one trial
```

To find the exact probability of *x* successes in *n* trials, run the command:

```
> dbinom(x, size = n, p = p)  # actually put in value of x; P(X = x) given the parameters n and p specified above
```

Question #2 What is the probability of getting exactly 15 questions correct?

The probability will be 0.03510604 to get 15 questions correct

For **Questions #3-6**, use the `pbinom` and `dbinom` commands as needed.

```
> pbinom(x, size = n, p = p)  # prob. of at most x successes in n trials, P(X <= x)

> pbinom(x, size = n, p = p, lower.tail = FALSE)  # prob. of more than x successes in n trials, P(X > x)
```

Note that you may have to add and subtract probabilities as produced by `pbinom` and `dbinom`. It may be useful to first define the probability statement mathematically to figure out what to add/subtract. For example, `pbinom(15, n, p) – dbinom(15, n, p)` gives $P(X \le 15) - P(X = 15) = P(X < 15)$, the probability of strictly fewer than 15 successes in n trials.

Question #3 What is the probability of getting at most 10 questions correct?

The probability would be 0.5077582

Question #4 What is the probability of getting 18 or more questions correct?

The probability would be 0.001447268

Question #5 What is the probability of getting more than 10 questions correct, but at most 18?

The probability would be 0.5063109

Question #6 What is the probability of getting strictly fewer than 5 questions correct?

The probability would be 0.007517715

We can also think of this problem in terms of sample proportions. Remember that the sample proportions do <u>not</u> have a binomial distribution, but we can use the formula $\hat{p} = X/n$ to convert between sample proportions $\hat{p}$ and sample counts of success X.

Question #7 What is the probability of getting exactly 60% on this 30-question test?

The probability would be 0.003056097

Question #8 What is the probability of getting a score of 45% or lower?

The probability would be 0.8736881

Question #9 What is the probability of getting a score lower than 50%?

The probability would be 0.9348103

Question #10 Suppose that we pass the test (70% or above). Is this consistent with our assumption that we are randomly guessing with a 35% chance on each question? Why or why not?

Although it is theoretically possible to achieve a score of 70% or greater, the likelihood of that occurring by guessing alone is very low. The more questions we try to answer correctly, our overall probability drops exponentially.