Homework 5 **Name:** ______________________________

Biostatistics (STAT:3510; Bognar)

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1. Textbook 3.5.5

2. Textbook 3.5.6

3. Textbook 3.6.12

   (a)

   (b)

   (c)

   (d)

4. It can be difficult to insert a needle into a patient to give IV fluids. It is known that 15% of patients require the aid of an ultrasound guided IV (U). Suppose 18 patients are randomly selected (assume independence). Let the random variable X equal the number that require an ultrasound guided IV.

   (a) What is the distribution of X? *Be sure to state all parameters.*

   (b) Find the probability that exactly 3 require an ultrasound guided IV.

   (c) Find the probability that 1 or more require an ultrasound guided IV.

   (d) On average, how many do we expect to require an ultrasound guided IV?

   (e) Find $Var(X)$.

5. In reference to question (4), suppose patients are repeatedly selected at random (assume independence).

   (a) Suppose the random variable X is the patient that is the first to require an ultrasound guided IV. What is the distribution of X? *Be sure to state the parameter.*

   (b) Find the probability that the 10th selected patient is the first to require an ultrasound guided IV.

(c) Find the probability that the first patient to require an ultrasound guided IV occurs on or before the 3rd selected, i.e. find $P(X \leq 3)$.

(d) Find the probability that the first patient requiring an ultrasound guided IV occurs after the 2nd selected, i.e. find $P(X > 2)$.

(e) On average, how many patients must be selected to get the first requiring an ultrasound guided IV?

6. An egg manufacturer knows that 9.6% of its eggs are cracked (C). The eggs are packed in cartons containing 12 eggs. *Assume eggs are independent.*

   (a) If the random variable X counts the total number of cracked eggs in a carton, determine the distribution of X. Also, find $\mu = E(X)$ and $\sigma = SD(X)$.

   (b) Suppose a carton of eggs is randomly selected. Find the probability that exactly 3 eggs are cracked.

   (c) Suppose a carton of eggs is randomly selected. Find the probability that 11 or fewer eggs are cracked.

(d) Suppose eggs are repeatedly selected at random. Find the probability that the 10^{th} selected egg is the 1^{st} cracked egg.

(e) Suppose eggs are repeatedly selected at random. Find the probability that the 10^{th} selected egg is the 2^{nd} cracked egg. *This one is a little more challenging — we are not in a binomial or geometric setting. Hint: Use our old-fashioned methods. Take*

$$P(C_1 \cap C_2^c \cap \cdots \cap C_9^c \cap C_{10}) + \cdots$$

(f) Suppose we randomly select 10 cartons of eggs (assume independence). Determine the probability that all 10 cartons have 0 broken eggs. *Hint: First find the probability that a carton contains 0 broken eggs, then find the probability.*

(g) Suppose we randomly select 10 cartons of eggs (assume independence). Determine the probability that exactly 7 of the cartons have 0 broken eggs. *Hint: First find the probability that a carton contains 0 broken eggs — lets call this probability p. Now, let X equal the number of cartons with 0 broken eggs. We know $X \sim Bin(n = 10, p)$. Now, find $P(X = 7)$.*