Statistics 8
Sample Midterm 2

There are *6 problems on 3 pages.* Each part of each problem is worth 6 points except as shown. A copy of Table A.1 is attached. Show all work.

1. An herbal treatment is being tested to see if it will help people who are suffering from seasonal allergies. Suppose the truth is that the treatment actually will help 60% of people who take it, and results are independent from one person to the next. The treatment is administered to 3 people. Define X = number who are helped by the treatment.

   a. What is the probability that X = 0?

   b. (6 pts=2 pts each) Define two events: **A** = the first person is helped by the treatment
   B = the second person is helped by the treatment.

Check off the answer for these questions:	Yes	No
i. Are A and B independent?	____	____
ii. Are A and B mutually exclusive?	____	____
iii. Are A and B complements?	____	____

   c. Event **A** is defined in the previous part as "the first person is helped by the treatment." Explain in words the event $\mathbf{A}^C$ and give the probability $P(A^C)$.

   d. State whether or not X is a binomial random variable. If so, specify n and p. If not, specify which condition is not met.

2. (1 pt for each blank) Specify whether each of the following applies for binomial, uniform and normal random variables. Write yes or no. (Write yes only if it is true for *all* random variables of that type.)

   a. 68% of possible values are in the range $\mu \pm \sigma$.
   Binomial?______ Uniform?______ Normal?______

   b. $\mu = np$
   Binomial?______ Uniform?______ Normal?______

   c. The pdf is constant for all values in the range of possibilities.
   Binomial?______ Uniform?______ Normal?______

   d. Continuous random variable.
   Binomial?______ Uniform?______ Normal?______

   e. Discrete random variable
   Binomial?______ Uniform?______ Normal?______

3. Suppose that weights (X) of girls in a certain age group have a normal distribution with mean $\mu = 80$ pounds and standard deviation $\sigma = 12$ pounds. Find $P(X \leq 92)$ = probability the weight of a randomly selected girl is less than or equal to 92 pounds.

4. In a random sample of $n = 100$ students at a university, 85 said they owned their own computer. Use this information to find an approximate 95% confidence interval (*not* a conservative one) for the true proportion of students at the university who own their own computers. Show all of your work.

5. Matt has been hired to be a telemarketer. He must complete 100 calls a day in which someone actually talks with him. Therefore, during his first week on the job he must complete 500 calls. The company expects him to be successful at least 15% of the time, so during the first week they expect him to be successful in at least 75 calls (15% of 500). Define X = number of calls out of 500 that Matt is successful. Assuming his success is independent from one call to the next, X is a binomial random variable.

   a. If in fact the probability that Matt will be successful on each call is .18, find the mean and standard deviation of X.

   b. (10 pts) Again assuming the probability that Matt will be successful on each call is .18, use the normal approximation to the binomial to find the probability that Matt will *not* meet his quota of 75 calls in the first week. In other words, find (approximately) $P(X \leq 74)$.

   c. (10 pts) Define $\hat{p}$ to be the *proportion* of successful calls Matt has out of 500 calls he makes. Again assume the probability that he is successful on each call is .18. Describe the sampling distribution of $\hat{p}$, including numerical values for its mean and standard deviation.

6. An automobile company has noticed that 30% of people who buy a new car bring it in regularly to the dealer for maintenance. For people who do get regular maintenance, the probability is .20 that they will need something fixed during the warranty period. For people who don't get regular maintenance, the probability is .40 that they will need something fixed during the warranty period.

   a. (10 pts) Draw a tree diagram for this situation ***or*** construct a "hypothetical hundred thousand" table. (To save time, you can use the abbreviations M = regular maintenance and NM = no regular maintenance; F = need something fixed and NF = no need to have something fixed during warranty.)

   b. What is the overall probability that someone who buys one of these cars will need something fixed during the warranty period? (Your results from Part (a) should help you to answer this.)

   c. Given that someone needs something fixed during the warranty period, what is the probability that he or she did *not* get regular maintenance?

7. (1 pt) Which of the following sequences resulting from tossing a fair coin 5 times is *most* likely, where H=head and T=tail? (Circle your choice):

   HHHHH
   HTHHT
   HHHTT
   They are equally likely