Instructions: All of the questions on this examination should be answered on the sheets provided. Write your name and your student number at the top of each sheet. Be certain to indicate the proper number before each of your answers. You will answer a total of six questions for this test (two questions from each group). Remember to show your work if an answer requires a mathematical solution. If you need additional space, you may write on the back of the answer sheets.

Answer any two of the following four questions. Each answer is worth 15%.

1. Assume you have a data set from a normally distributed random variable. Answer the following questions about it.

   a. Will the random variable be discrete, continuous, or neither? How do you know?
   b. Will the data be qualitative or quantitative? How do you know?

2. Assume the following data were gathered by a manufacturer of a robotics component, in units of days of continuous use until the component fails. There are 60 measurements in this data set. Show a histogram of this data set with 10 bins of equal size, spanning the range from the data minimum to the data maximum.

142	147	127	161	145	137	122	123	141	139	139
135	135	130	147	118	154	133	136	129	139	131
143	130	160	127	127	145	144	155	128	124	144
133	136	133	151	131	133	119	122	139	128	121
142	136	148	136	121	131	125	120	123	145	140
150	136	135	133	134						

3. A university has been tracking the percentage of alumni giving to its annual fund each year for the past 10 years. The data is given here.

14%   13%   15%   21%   19%   24%   25%   28%   25%   31%

Answer the following questions about this data.

a. What are its mean and median?
b. What is the procedure for using mean and median to determine whether the data is skewed, and if so, in what direction?
c. Apply the procedure you described to the mean and median computed in part a.

4. A large department store records the number of returns per day in women's dresses for reasons such as wrong size, didn't like it, color, and so on. The manager of the women's dresses department recalls from her statistics class in college that the Poisson distribution might describe such events. A random sample of 150 days is taken. The number of returns per day in the sample as well as the observed frequencies are shown below.

Number of returns per day	Observed frequency
0	21
1	37
2	44
3	30
4	14
>4	4

The manager tests the hypothesis that returns per day are Poisson distributed with a population mean equal to 1.90. Her significance level is 0.05. State the null and alternative hypotheses. What are the appropriate degrees of freedom? Identify the critical value. Calculate the expected frequencies.

Answer any two of the following three questions. Each answer is worth 20%.

5. In the diagram below, events A, B, and C are shown with numbers in various regions of the graph indicating how many sample points lie in each. For example, the number 3 in the top left of the diagram indicates that there are 3 sample points in B that are not also in either A or C.
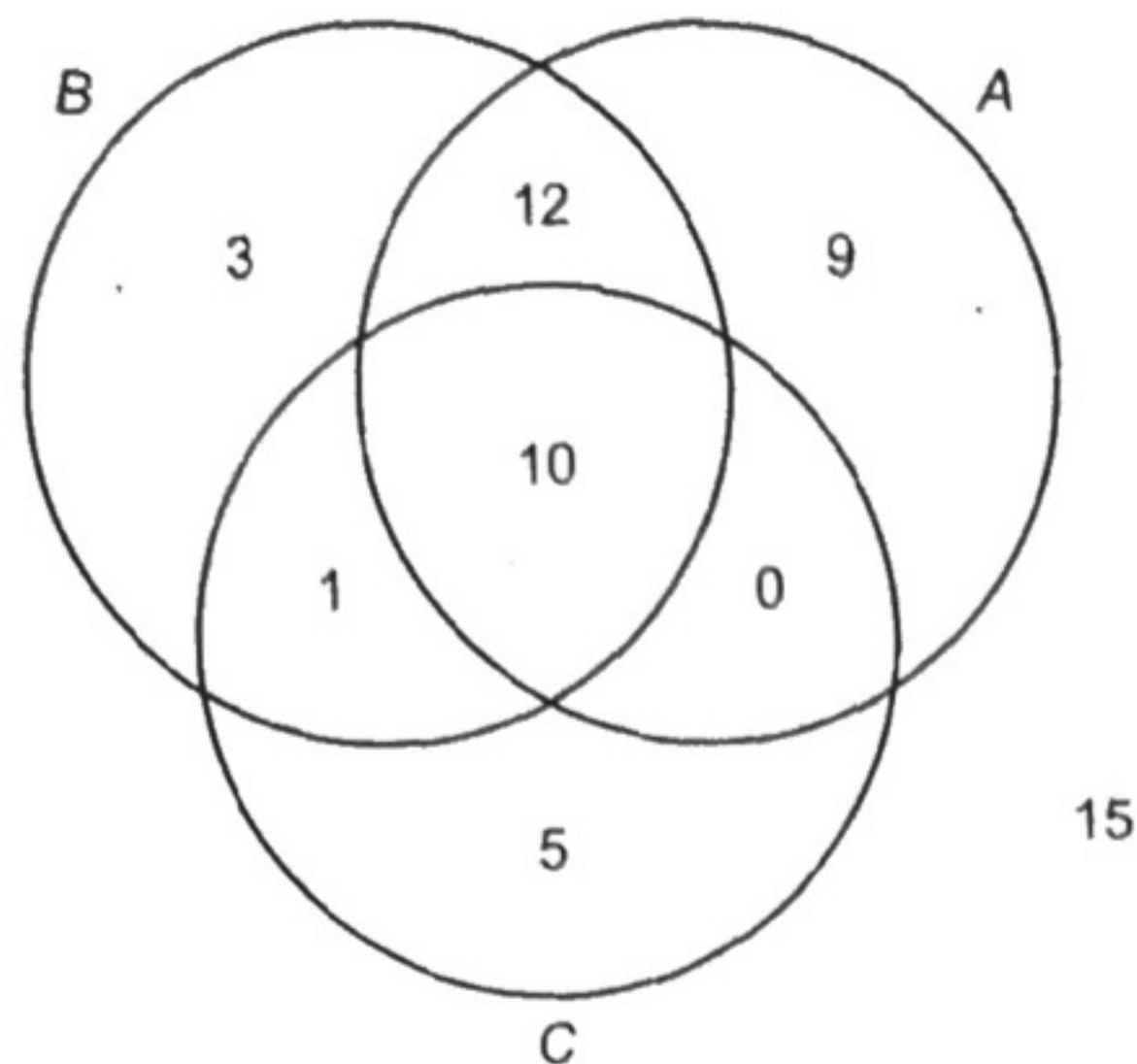
a. Are the events A and B independent?

b. Are the events $A \cap B^c$ and $C \cap B^c$ mutually exclusive?

6. Under which of the following conditions would it be appropriate to use a Binomial random variable? In each case, explain why your answer is correct.

a. A department will interview 10 candidates for a position, and call back for second interviews those who answer the interview questions to the satisfaction of all the interviewers. They hope to call back at least 3, but past experience suggests an average of about 1 call back per 4 interviews.

b. A factory posts on the wall the number of days since its last safety infraction or injury. In the past year, the factory has had a safety infraction or injury on 6 different days. The factory is interested in the number of days that can be expected to elapse without an injury.

c. Fifteen of a doctor's patients have the same ailment. Studies have shown that about 86.5% of patients with this ailment respond to a certain drug. The doctor prescribes the drug to all 15, but the number who will respond in this case is, of course, not known in advance.

7. The mean time for a racecar driver's crew to perform a pit stop is 13.2 seconds, with a standard deviation of 0.9 seconds. To maintain his current lead, the driver needs a pit stop in 12.5 seconds or less. Assuming this random variable is normally distributed, what is the probability of the driver getting the pit stop in a short enough time to maintain his lead?

Answer any two of the following three questions. Each answer is worth 15%.

8. From a sample of size 175, the sample mean is $\bar{x} = 54.37$ and sample standard deviation is $s = 7.07$.

   a. Construct a 95% confidence interval for the population mean and show your work.
   b. Explain how your work in part a would have been different if the sample size had been only 12 instead.

9. A random sample from the population of registered voters in California is to be taken and then surveyed about an upcoming election. What sample size should be used to guarantee a sampling error of 3% or less when estimating p at the 95% confidence level?

10. An elementary school teacher learned that 40% of school children have at least three cavities. The teacher has 30 students in his class. How many students would he expect in his class to have at least three cavities? What is the standard deviation? Using the appropriate approximation, determine $P(x > 20)$; that is, the probability that more than 20 students in his class will have 3 cavities.