PHYSICS 101
ASSIGNMENT #4

1. Use the formula for the binomial probability distribution to calculate the values of $p(x)$, and construct the probability histogram for x when $n = 6$ and $p = .2$. [HINT: Calculate $P(x = k)$ for seven different values of k.]

2. In a certain population, 85% of the people have Rh-positive blood. Suppose that two people from this population get married. What is the probability that they are both Rh-negative, thus making it inevitable that their children will be Rh-negative?

3. Increased research and discussion have focused on the number of illnesses involving the organism *Escherichia coli* (01257:H7), which causes a breakdown of red blood cells and intestinal hemorrhages in its victims. Sporadic outbreaks of *E. coli* have occurred in Colorado at a rate of 2.5 per 100,000 for a period of 2 years. Let us suppose that this rate has not changed.

a. What is the probability that at most five cases of *E. coli* per 100,000 are reported in Colorado in a given year?

b. What is the probability that more than five cases of *E. coli* per 100,000 are reported in a given year?

c. Approximately 95% of occurrences of *E. coli* involve at most how many cases?

4. Seeds are often treated with a fungicide for protection in poor-draining, wet environments. In a small-scale trial prior to a large-scale experiment to determine what dilution of the fungicide to apply, five treated seeds and five untreated seeds were planted in clay soil and the number of plants emerging from the treated and untreated seeds were recorded. Suppose the dilution was not effective and only four plants emerged. Let x represent the number of plants that emerged from treated seeds.

a. Find the probability that $x = 4$.

b. Find $P(x \leq 3)$.

c. Find $P(2 \leq x \leq 3)$.

5. Most weather forecasters protect themselves very well by attaching probabilities to their forecasts, such as "The probability of rain today is 40%." Then, if a particular forecast is incorrect, you are expected to attribute the error to the random behaviour of the weather rather than to the inaccuracy of the forecaster. To check the accuracy of a particular forecaster, records were checked only for those days when the forecaster predicted rain "with 30% probability." A check of 25 of those days indicated that it rained on 10 of the 25.

a. If the forecaster is accurate, what is the approximate value of p, the probability of rain on one of the 25 days?

b. What are the mean and standard deviation of x, the number of days on which it rained, assuming that the forecaster is accurate?

c. Calculate the z-score for the observed value, $x = 10$. [HINT: Recall that $z - score = \dfrac{(x - \mu)}{\sigma}$.]

d. Do these data disagree with the forecast of a "30% probability of rain"? Explain.

6. Insulin-dependent diabetes (IDD) is a common chronic disorder of children. This disease occurs most frequently in persons of northern European descent but the incidence ranges from a low of 1-2 cases per 100,000 per year to a high of more than 40 per 100,000 in parts of Finland. Let us assume that an area in Europe has an incidence of 5 cases per 100,000 per year.

a. Can the distribution of the number of cases of IDD in this area be approximated by a Poisson distribution? If so, what is the mean?

b. What is the probability that the number of cases is less than or equal to 3 per 100,000?

c. What is the probability that the number of cases is greater than or equal to 3 but less than or equal to 7 per 100,000?

d. Would you expect to observe 10 or more cases of IDD per 100,000 in this area in a given year? Why or why not?

7. Many colleges nationwide find that not all applicants who are accepted for admission to a college will actually attend that college. Past experience at Eastview College shows that about 88% of the students accepted will actually attend the college. If the college would like to have an entering freshmen class of 1300 students, how many acceptance letters should it send out?