**Math 107**
**Probability Assignment #1**

1. You draw a single card from a standard deck of 52 cards. What is the probability that it is a face card (jack, queen, or king)?

2. Suppose I flip two identical coins. What is the probability that I get 1 head and 1 tail?

3. You have a plate of 45 cookies. Ten have chocolate chips and 16 have pecans. Of the cookies mentioned in the preceding sentence, 6 have both chocolate chips and pecans. You select a cookie at random. What is the probability that your cookie has chocolate chips or pecans?

4. A city finds empirically that an automobile going through the intersection of 5th and Main will run a red light sometime during a given day with probability 2.3%. What is the probability that an automobile will *not* run a red light at that intersection on a given day? Write your answer as a percentage.

5. Suppose there are 15 jelly beans in a box—5 red, 3 blue, 4 white, and 3 green. A jelly bean is selected at random. What is the probability that the jelly bean is not red?

6. Suppose there are 15 jelly beans in a box—3 red, 7 blue, 4 white, and 1 green. A jelly bean is selected at random. What is the probability that the jelly bean is neither red nor blue?

7. The following table shows the results of a medical test.

| | **Has disease** | **Does not have disease** |
|---|---|---|
| Test positive | 190 | 30 |
| Test negative | 34 | 410 |

   a) Use the preceding data to estimate the sensitivity of the test.
   b) Use the preceding data to estimate the specificity for that test
   c) Use the preceding data to calculate the positive predictive value of the test
   d) Use the preceding data to calculate the negative predictive value of the test

8. The accompanying table gives the results of a screening test for a disease. Estimate the sensitivity, PPV, NPV and specificity of the test.

| | **Has disease** | **Does not have disease** |
|---|---|---|
| Test positive | 285 | 280 |
| Test negative | 15 | 420 |

9. Suppose a test for a disease has a sensitivity of 75% and a specificity of 85%. Further suppose that in a certain country with a population of 1,000,000, 20% of the population has the disease.

   Fill in the accompanying table.

| | **Has disease** | **Does not have disease** | **Totals** |
|---|---|---|---|
| Test positive | | | |
| Test negative | | | |
| Totals | | | |

10. A certain screening test for Crohn's has a sensitivity of 85% and a specificity of 90.3%. Assume that this test is applied to the group of approximately 3.3 million Americans who suffer from symptoms that are very similar to those of Crohn's. Suppose also that all of the 0.58 million Crohn's sufferers belong to this group.

    The following table is based on this group of 3.3 million.

| | **Has disease** | **Does not have disease** | **Totals** |
|---|---|---|---|
| Test positive (millions) | 0.49 | 0.26 | 0.76 |
| Test negative (millions) | 0.09 | 2.46 | 2.54 |
| Totals | 0.58 | 2.72 | 3.30 |

    Find the PPV and NPV

11. Suppose a certain drug test is 93% accurate, meaning that if a person is a user, the result is positive 93% of the time, and if she or he isn't a user, it's negative 93% of the time. Assume that 7% of all people are drug users.

    The following table assumes that the population is 10,000.

| | **Drug user** | **Not a drug user** | **Totals** |
|---|---|---|---|
| Test positive | 651 | 651 | 1302 |
| Test negative | 49 | 8649 | 8698 |
| Totals | 700 | 9300 | 10,000 |

    Suppose a randomly chosen person from the population in question tests positive. How likely is the individual to be a drug user? That is, what is the PPV of this test for this population? What does this mean about the effectiveness of the test?

12. Suppose that a certain HIV test has both a sensitivity and specificity of 99.9%. This test is applied to a population of 1,000,000 people.
    Suppose that the population comes from the blood donor pool that has already been screened. In this population, 0.1% of the population is actually infected with HIV.
    (a) Calculate the PPV. *Suggestion*: First make a table.
    (b) Calculate the NPV
    (c) Is the test effective – why or why not?

13. A college finds that 10% of students have taken a distance learning class and that 40% of students are part time students. Of the part time students, 20% have taken a distance learning class. Let $D$ = event that a student takes a distance learning class and $E$ = event that a student is a part time student

    a. Find $P(D \text{ AND } E)$.
    b. Find $P(E \text{ given } D)$.
    c. Find $P(D \text{ OR } E)$.