**Graded Activity #7a**:  Binomial Test & Sign Test

We're once again going to detour to study a couple more statistical inference tests based on the binomial distribution.

Situation:  You're interested in determining whether homing pigeons really do know how to return home.  You blindfold 12 pigeons and drive them 20 miles due west.  One at a time, you release the pigeons and look at the direction they begin to fly.  If a pigeon begins to fly more eastward than westward, you will conclude that the pigeon really does know the way home.

1)  State the null and alternate hypotheses for this study in plain English.

2)  Working under the assumption that the null hypothesis is true, what is the probability that a pigeon will fly more eastward than westward?  How many pigeons do you expect to fly eastward?

3)  Restate the hypotheses using proper notation.

4)  Suppose 10 pigeons flew more eastward than westward.  If the null hypothesis is true, what's the likelihood of observing 10 or more pigeons flying eastward?

5)  We call this probability a *p-value*.  It represents the probability of observing results as extreme or even more extreme than our actual results if the null hypothesis is true.  Based on this p-value, what would you conclude about the homing pigeons?

6) Suppose you observe 8 pigeons flying eastward. Would you still make the same conclusion? What's the p-value?

Situation: It is estimated that at least half of the men who currently undergo an operation to remove prostate cancer suffer from a particular undesirable side effect. In an effort to reduce the likelihood of this side effect the FDA studied a new method of performing this operation. Out of 19 operations, only 3 men suffered the unpleasant side effect. Is it safe to conclude the new method of operating is effective in reducing the side effect?

State the hypotheses, conduct the test, report the p-value, and state your conclusion.

Situation: A civic group reported to the town council that at least 60% of the town residents were in favor of a particular bond issue. The town council then asked a random sample of 15 residents if they were in favor of the bond issue. Twelve said yes. Is the group's report reasonable?

State the hypotheses, conduct the test, report the p-value, and state your conclusion.

Situation: It is believed that a diet rich in fish oils will reduce blood pressure.  To study this, ten middle-aged men were randomly selected to begin a fish oil diet.  The researchers tested their blood pressure before the experiment began and then again after three months on the fish oil diet.  The change in blood pressure for each subject was measured:

| Change in Blood Pressure | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Fish Oil | -5 | +2 | +10 | -8 | -6 | -10 | -5 | +2 | -5 | -8 |

7)  State the null and alternate hypotheses for this study.

8)  Instead of worrying about the individual data values, change the data to +'s and –'s.

| Change in Blood Pressure | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| Fish Oil | - | + | + | - | - | - | - | + | - | - |

9)  If the null hypothesis is true, what is the probability of observing a +?  How many +'s did we observe?  What's the probability of observing this many +'s if the null hypothesis is true?

10)  State your conclusion.

Situation: The reaction time before lunch was compared to the reaction time after lunch for six individuals.  The following results were obtained:

| | Abdul | Ed | Jim | Max | Phil | Ray |
|---|---|---|---|---|---|---|
| Before | 174 | 191 | 188 | 182 | 201 | 188 |
| After | 165 | 186 | 183 | 178 | 203 | 181 |

State the hypotheses, conduct the test, report the p-value, and state your conclusion.