**Homework # 3**

**Problem 1.** A politician is concerned that her support on a current issue may have dropped below 50%. To determine her support, she commissioned a random survey of 186 of her constituents. This survey found 88 people supporting her position.

a. plot the binomial for n = 186, p = 0.5

b. What are the mean, variance, and standard deviation for this problem?

c. What is the probability that X, the number of people supporting her position, will be 88 or less based on this distribution?

d. Should the politician conclude that her support is less than 50%?

**Problem 2**. Clerical workers process checks in batches of 1000. This process results in a 4% average error rate.

a. For a batch of 1000 checks, what is the expected number of errors?

b. Provide a 3-std. deviation (3-sigma) lower and upper bound for the number of errors in a batch of 1000.

c. One worker had 60 errors in a batch of 1000. He claimed that 60 errors is not an unusual occurrence. Is this claim reasonable?

**Problem 3.** In an automobile engine plant, cylinders are bored and fitted with machined pistons. For the engine to work correctly, the clearance between each piston cylinder pair (defined as the difference between the inner diameter of the cylinder and the outer diameter of the piston) must be within certain design specifications. Suppose that the probability of any given piston/cylinder pair meeting design specifications is 95%. Furthermore, assume that the clearances of different piston/cylinder pairs are independent random variables. What is the probability that an entire engine will be functional (that is, all piston/cylinder pairs will meet design specifications)? Assume the engine has 6 cylinders.

**Problem 4.** You company has 400 employees. Suppose there is a 20% chance that each employee will develop cancer.

(a) What is the probability that, out of 20 randomly chosen employees exactly 5 will develop cancer?

(b) What is the probability none will develop cancer?

(c) What is the probability that they will all develop cancer?

**Problem 5.** Consider a population consisting of 1000 married couples, all of whom carry the sickle cell trait (but do not develop the disease)---that is, they are coded SA. Suppose each married couple produces exactly two children.

1. What is the expected number of children that will develop sickle cell disease?
2. What is the expected number of children that will carry the sickle cell trait but not develop the disease?
3. What is the expected number of children that will NOT carry the sickle cell trait at all?
4. What is the probability that the number of children who develop sickle cell disease is greater than or equal to 500?

**Problem 6.** Suppose that each couple in the initial population from problem 6 continues to have children until each couple produces exactly two children who do not develop sickle cell disease.

1. What is the expected number of children who do NOT carry the sickle cell trait?
2. What is the probability that the number of children who do NOT carry the sickle cell trait is less than or equal to 500?

**Problem 7.** What is the probability that the World Series will last 4 games? 5 games? Assume that the teams are evenly matched---that is, each team has an equal 50-50 chance of winning each game. Also, assume that each game is independent of any other game---that is, the probability of any team winning any game is 50%, independent of the outcome of previously played games. In the World Series, there are two baseball teams, one from the National League and one from the American League. The series ends when the first (and winning) team wins 4 games. Thus, the series cannot end in less than four games. Since each game is played until there is a winner (no ties allowed), the series cannot extend past 7 games.