Midterm Practice Problems

Problem 1. A certain genetic mutation occurs in 0.5% of the population. A test to detect the mutation has a 99% chance of detecting it when present, and if a person does not have the mutation, the test has a 90% chance of correctly determining the mutation is not present. If a person tests positive, what is the chance they have the mutation?

Problem 2. Suppose every time you run a red light you have chance 0.1 of being caught by an automated traffic camera. What is the chance that you run exactly 12 lights before being caught? If X is the number of lights you run before being caught, find the mass function for X and find its expected value.

Problem 3. Suppose that the number of lightning strikes in a large area during a storm occur at 2 per minute. In a 50 minute time period, find approximately the chance that there are more than 90 lightning strikes.

Problem 4. Suppose that a lightning strike has a 5% chance of starting a fire when it lands in a forest. If there are 100 lightning strikes, find the chance that 10 fires are started. What is the expected number of fires? What is the standard deviation for the number of fires?

Problem 5. Suppose that the lifetime of a lightbulb has an expected value of 1000 hours. Find the chance that it lasts fewer than 800 hours. Assume it has an exponential distribution

Problem 6. Suppose that the average trip to work is 15 minutes, with a stan dard deviation of 3 minutes. Find the chance, approximately, that the total time spent commuting over 100 days of work exceeds 1530 minutes.

Problem 7. Explain how you could use a computer to approximate the proba bility that the sum of 5 geometric(1/2) random variables exceeds 12.

Problem 8. Suppose that X has a Normal(2, 1) distribution, and Y has a Poisson(3) distribution. Find the expected value and the standard deviation of $X + Y$.

Problem 9. Let X has a Binomial(100,0.5) distribution, and Y have a Bino mial(10,0.5) distribution. Find the probability mass function for $X + Y$. *Hint:* Think about the interpretation of X and Y.

Problem 10. Suppose that $X_1, X_2, \ldots, X_{10}$ are independent and all have expected value 1. Find the expected value of

$$1/10\ (X_1 + X_2 + \ldots + X_{10})$$

Also find its standard deviation, assuming the standard deviation of each X_i is 2.