Math 422 - Week 3 Homework **Due Monday, Feb 12**

1. About 200,000 Americans are hospitalized for the flu each year, on average. If we assume that the number 200,000 is the population mean of the random variable X which represents the number of people who will need hospitalization for the flu in a given year, then what does Markov's inequality say about the probability of having a year where more than 1% of the U.S. population needs hospitalization for the flu? The population of the U.S. is currently 320 million people.

2. Suppose that a random variable X has mean and variance both equal to 40. What can you say about $P(X \geq 80)$?

3. Suppose that X is a random variable with mean μ and variance σ^2. Show that

$$P(|X - \mu| \geq k\sigma) \leq \frac{1}{k^2}$$

   for any $k > 0$. How does this compare with the 68-95-99.7 rule for the normal distribution? (For a normal random variable, roughly 68% of the results are within 1 standard deviation of the mean, 95% are within 2 standard deviations, and 99.7% are within 3 standard deviations.)

4. Let $X_1, \ldots, X_{20}$ be independent Poisson random variables with mean $\lambda = 2$. Use the Markov inequality to obtain a bound on

$$P\left(\sum_{i=1}^{20} X_i > 30\right).$$

5. Suppose a state lottery sells 500 million lottery tickets each year, and suppose each ticket earns the state \$1 on average, but with a standard deviation of \$16. The state can be 99% certain that it will make at least how much money on the lottery?