Biostatistics

Homework 6

1. **Making auto parts.** An automatic grinding machine in an auto parts plant prepares axles with a target diameter $\mu = 40.125$ millimeters (mm). The machine has some variability, so the standard deviation of the diameters is $\sigma = 0.002$ mm. A sample of 4 axles is inspected each hour for process control purposes, and records are kept of the sample mean diameter. What will be the mean and standard deviation of the numbers recorded?

2.

Dust in coal mines. A laboratory weighs filters from a coal mine to measure the amount of dust in the mine atmosphere. Repeated measurements of the weight of dust on the same filter vary Normally with standard deviation $\sigma = 0.08$ milligram (mg) because the weighing is not perfectly precise. The dust on a particular filter actually weighs 123 mg. Repeated weighings will then have the Normal distribution with mean 123 mg and standard deviation 0.08 mg.

(a) The laboratory reports the mean of 3 weighings. What is the distribution of this mean? $\bar{X} = (X_1 + X_2 + X_3)/3$

(b) What is the probability that the laboratory reports a weight of 124 mg or higher for this filter?

3. **Pollutants in auto exhausts.** The level of nitrogen oxides (NOX) in the exhaust of a particular car model varies with mean 0.9 grams per mile (g/mi) and standard deviation 0.15 g/mi. A company has 125 cars of this model in its fleet.

(a) What is the approximate distribution of the mean NOX emission level $\bar{x}$ for these cars?

(b) What is the level L such that the probability that $\bar{x}$ is greater than L is only 0.01? (Hint: This requires a backward Normal calculation.

4. **How many people in a car?** A study of rush-hour traffic in San Francisco counts the number of people in each car entering a freeway at a suburban interchange. Suppose that this count has mean 1.5 and standard deviation 0.75 in the population of all cars that enter at this interchange during rush hours.

(a) Could the exact distribution of the count be Normal? Why or why not?

(b) Traffic engineers estimate that the capacity of the interchange is 700 cars per hour. According to the central limit theorem, what is the approximate distribution of the mean number of persons $\bar{x}$ in 700 randomly selected cars at this interchange?

(c) What is the probability that 700 cars will carry more than 1075 people? (Hint: Restate this event in terms of the mean number of people $\bar{x}$ per car.)

5. **Random-digit dialing.** When an opinion poll or telemarketer calls residential telephone numbers at random, 20% of the calls reach a live person. You watch the random dialing machine make 15 calls. The number that reach a person has the binomial distribution with $n = 15$ and $p = 0.2$.

(a) What is the probability that exactly 3 calls reach a person?

(b) What is the probability that 3 or fewer calls reach a person?

6.

The average height of a raccoon is 10 inches.

1. Given an upper bound on the probability that a certain raccoon is at least 15 inches tall.
2. The standard deviation this height distribution is 2 inches. Find a lower bound on the probability that a certain raccoon is between 5 and 15 inches tall.
3. Now assume this distribution is normal. Use a normal CDF table to repeat the calculation from part (b). How close was your bound to the true probability?