Chapter 9 Review

Free Response Practice – Answer on a separate piece of paper
1. Trains carry bauxite ore from a mine in Canada to an aluminum processing plant in northern New York state in hopper cars. Filling equipment is used to load ore into the hopper cars. When functioning properly, the actual weights of ore loaded into each car by filling equipment at the mine are approximately normally distributed with a mean of 70 tons and a standard deviation of 0.9 ton. If the mean is greater than 70 tons, the loading mechanism is overfilling.
   a. If the filling equipment is functioning properly, what is the probability that the weight of the ore in a randomly selected car will be 70.7 tons or more? Show your work.
   b. Suppose that the weight of ore in a randomly selected car is 70.7 tons. Would that fact make you suspect that the loading mechanism is overfilling the cars? Justify your answer.
   c. If the filling equipment is functioning properly, what is the probability that a random sample of 10 cars will have a mean ore weight of 70.7 tons or more? Show your work.
   d. Based on your answer in part c, if a random sample of 10 cars had a mean ore weight of 70.7 tons, would you suspect that the loading mechanism was overfilling the cars? Justify your answer.

2. The depth from the surface of Earth to a refracting layer beneath the surface can be estimated using methods developed by seismologists. One method is based on the time required for vibrations to travel from a distant explosion to a receiving point. The depth measurement (M) is the sum of the true depth (D) and the random measurement error (E). That is, M = D + E. The measurement error (E) is assumed to be normally distributed with a mean 0 feet and standard deviation 1.5 feet.
   a. If the true depth at a certain point is 2 feet, what is the probability that the depth measurement will be negative? (Hint: A normal random variable plus a constant is a normal random variable.)
   b. Suppose that three independent depth measurements are taken at a particular spot, what is the probability that at least one of these measurements will be negative?
   c. What is the probability that the mean of the three independent depth measurements taken at that spot will be negative?

Multiple Choice Practice
1. A news magazine claims that 30% of all New York City police officers are overweight. Indignant at this claim, the New York City police commissioner conducts a survey in which 200 randomly selected New York City police officers are weighed. 52, or 26%, of the surveyed officers turn out to be overweight. Which of the following statements about this situation is true?
 A. The number 26% is a statistic.
 B. The number 30% is a statistic.
 C. The number 26% is a parameter.

2. In a simple random sample of 1000 Americans, it was found that 61% were satisfied with the service provided by the dealer from which they bought their car. In a simple random sample of 1000 Canadians, 58% said that they were satisfied with the service provided by their car dealer. Which of the following statements concerning the sampling variability of these statistics is true?
 A. The sampling variability is about the same in both cases.
 B. The sampling variability is exactly the same in both cases.
 C. The sampling variability is much smaller for the statistic based on the sample of 1000 Canadians since the population of Canada is smaller than that of the United States, and therefore the sample is a larger proportion of the population.
 D. The sampling variability is much larger for the statistic based on the sample of 1000 Canadians, since Canada has a lower population density than the United States, and having subjects living farther apart always increases sampling variability.

3. In a statistics class containing 250 students, each student is instructed to toss a coin 20 times and record the value of $\hat{p}$, the sample proportion of heads. The instructor then makes a histogram of the 250 values of $\hat{p}$ obtained. In a second statistics class containing 200 students, each student is told to toss a coin 40 times and record the value of $\hat{p}$, the sample proportion of heads. The instructor then makes a histogram of the 200 values of $\hat{p}$ obtained. Which of the following statements regarding the two histograms of $\hat{p}$-values is true?
 A. The first class's histogram is more biased since it is derived from a smaller number of tosses per student.
 B. The first class's histogram has greater spread (variability) since it is derived from a smaller number of tosses per student.
 C. The first class's histogram has less spread (variability) since it is derived from a larger number of students.

4. As part of a promotion for a new type of cracker, free samples are offered to shoppers in a local supermarket. The probability that a shopper will buy a package of crackers after tasting the free sample is 0.2. Different shoppers can be regarded as independent trials. Let $\hat{p}$ be the sample proportion of the next n shoppers that buy a packet of crackers after tasting a free sample. How large should n be so that the standard deviation of $\hat{p}$ is no more than 0.01?
A. 4   B. 16   C. 1600

5. As part of a promotion for a new type of cracker, free samples are offered to shoppers in a local supermarket. The probability that a shopper will buy a package of crackers after tasting the free sample is 0.2. Different shoppers can be regarded as independent trials. Let $\hat{p}$ be the sample proportion of the next 100 shoppers that buy a package of crackers after tasting a free sample. Which of the following best describes the sampling distribution of the statistic $\hat{p}$?
A. It is approximately normal with mean μ = 0.2 and standard deviation σ = 0.0016.
B. It is approximately normal with mean μ = 0.2 and standard deviation σ = 0.04.
C. It cannot be approximated by a normal distribution.

6. As part of a promotion for a new type of cracker, free samples are offered to shoppers in a local supermarket. The probability that a shopper will buy a package of crackers after tasting the free sample is 0.2. Different shoppers can be regarded as independent trials. Let $\hat{p}$ be the sample proportion of the next 100 shoppers that buy a package of crackers after tasting a free sample. The probability that fewer than 30% of these individuals buy a package of crackers after tasting a sample is approximately (without using the continuity correction)
A. 0.3.   B. 0.9938.   C. 0.0062.

7. Suppose that you are a student worker in the statistics department and agree to be paid according to the "random pay" system. Each week, the chair of the department flips a coin. If the coin comes up heads, your pay for the week is $80; if it comes up tails, your pay for the week is $40. You work for the department for 100 weeks (at which point you have learned enough probability to know that the "random pay" system is not to your advantage). The probability that $\overline{X}$, your average earnings in the first two weeks, is greater than $65 is
A. 0.2500.   B. 0.3333.   C. 0.5000.

8. The sampling distribution of the sample mean $\overline{x}$ is formed from random samples of size 16 taken from a population with mean μ = 64 and standard deviation σ = 10. What are the mean and standard deviation of the sampling distribution of $\overline{x}$?
A. mean = 64, standard deviation = 0.625
B. mean = 8, standard deviation = 2.5
C. mean = 64, standard deviation = 2.5

9. The scores of individual students on the American College Testing (ACT) program composite college entrance examination have a normal distribution with mean 18.6 and standard deviation 6.0. At Northside High, 36 seniors take the ACT test. If the scores at this school have the same distribution as the national scores, then the sampling distribution of the average (sample mean) score $\overline{X}$ for these 36 students is
A. approximately normal, but the approximation is poor.
B. approximately normal, but the approximation is good.
C. exactly normal.

10. The duration of Alzheimer's disease, from the onset of symptoms until death, ranges from 3 to 20 years, with a mean of 8 years and a standard deviation of 4 years. The administrator of a large medical center randomly selects the medical records of 30 deceased Alzheimer's patients and records the duration of the disease for each one. Find the probability that the average duration of the disease for the 30 patients will exceed 8.25 years.
A. 0.6331   B. 0.3669   C. 0.4761

11. The duration of Alzheimer's disease, from the onset of symptoms until death, ranges from 3 to 20 years, with a mean of 8 years and a standard deviation of 4 years. The administrator of a large medical center randomly selects the medical records of 30 deceased Alzheimer's patients and records the duration of the disease for each one. Find the probability that the average duration of the disease for the 30 patients will lie within 1 year of the overall mean of 8 years.
A. 0.8294   B. 0.1706   C. 0.4147

12. The duration of Alzheimer's disease, from the onset of symptoms until death, ranges from 3 to 20 years, with a mean of 8 years and a standard deviation of 4 years. The administrator of a large medical center randomly selects the medical records of 30 deceased Alzheimer's patients and records the duration of the disease for each one. Find the value L such that there is a probability of 0.99 that the average duration of the disease for the 30 patients lies less than L years above the overall mean of 8 years.
A. 0.72   B. 1.70   C. 2.33