Chapter 7: Sampling Distributions

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

1) Sampling distributions describe the distribution of
   A) parameters.
   B) neither parameters nor statistics.
   C) statistics.
   D) both parameters and statistics.

2) True or False: A sampling distribution is defined as the probability distribution of possible sample sizes that can be observed from a given population.
   A) True
   B) False

3) True or False: The amount of time it takes to complete an examination has a left skewed distribution with a mean of 65 minutes and a standard deviation of 8 minutes. If 64 students were randomly sampled, the probability that the sample mean of the sampled students exceeds 71 minutes is approximately 0.
   A) True
   B) False

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

4) The distribution of the number of loaves of bread sold per week by a large bakery over the past 5 years has a mean of 7,750 and a standard deviation of 145 loaves. Suppose a random sample of \( n = 40 \) weeks has been selected. What is the approximate probability that the mean number of loaves sold in the sampled weeks exceeds 7,895 loaves?

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

5) Major league baseball salaries averaged $3.26 million with a standard deviation of $1.2 million in a certain year in the past. Suppose a sample of 100 major league players was taken. Find the approximate probability that the mean salary of the 100 players exceeded $4.0 million.
   A) Approximately 1
   B) 0.9772
   C) 0.0228
   D) Approximately 0
6) Major league baseball salaries averaged $3.26 million with a standard deviation of $1.2 million in a certain year in the past. Suppose a sample of 100 major league players was taken. Find the approximate probability that the mean salary of the 100 players was less than $2.5 million.

A) 0.9849  B) Approximately 1
C) Approximately 0  D) 0.0151

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

7) At a computer manufacturing company, the actual size of computer chips is normally distributed with a mean of 1 centimeter and a standard deviation of 0.1 centimeter. A random sample of 12 computer chips is taken. What is the probability that the sample mean will be below 0.95 centimeters?

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

8) The owner of a fish market has an assistant who has determined that the weights of catfish are normally distributed, with mean of 3.2 pounds and standard deviation of 0.8 pound. If a sample of 64 fish yields a mean of 3.4 pounds, what is probability of obtaining a sample mean this large or larger?

A) 0.0001  B) 0.0228  C) 0.0013  D) 0.4987

9) True or False: If the amount of gasoline purchased per car at a large service station has a population mean of 15 gallons and a population standard deviation of 4 gallons, then 99.73% of all cars will purchase between 3 and 27 gallons.

A) True  B) False

10) True or False: If the amount of gasoline purchased per car at a large service station has a population mean of 15 gallons and a population standard deviation of 4 gallons and it is assumed that the amount of gasoline purchased per car is symmetric, there is approximately a 68.26% chance that a random sample of 16 cars will have a sample mean between 14 and 16 gallons.

A) True  B) False
11) True or False: Suppose $\mu = 50$ and $\sigma = 10$ for a population. In a sample where $n = 100$ is randomly taken, 95% of all possible sample means will fall between 48.04 and 51.96.
   A) True   B) False

12) True or False: Suppose $\mu = 50$ and $\sigma = 10$ for a population. In a sample where $n = 100$ is randomly taken, 90% of all possible sample means will fall between 49 and 51.
   A) True   B) False

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

13) The amount of tea leaves in a can from a particular production line is normally distributed with $\mu = 110$ grams and $\sigma = 25$ grams. A sample of 25 cans is to be selected. What is the probability that the sample mean will be less than 100 grams?

14) The amount of tea leaves in a can from a particular production line is normally distributed with $\mu = 110$ grams and $\sigma = 25$ grams. A sample of 25 cans is to be selected. So, 95% of all sample means will be greater than how many grams?

15) The amount of time required for an oil and filter change on an automobile is normally distributed with a mean of 45 minutes and a standard deviation of 10 minutes. A random sample of 16 cars is selected. What is the probability that the sample mean is between 45 and 52 minutes?

16) The amount of time required for an oil and filter change on an automobile is normally distributed with a mean of 45 minutes and a standard deviation of 10 minutes. A random sample of 16 cars is selected. 95% of all sample means will fall between what two values?

17) The amount of bleach a machine pours into bottles has a mean of 36 oz. with a standard deviation of 0.15 oz. Suppose we take a random sample of 36 bottles filled by this machine. The probability that the mean of the sample exceeds 36.01 oz. is ________. 
18) The amount of bleach a machine pours into bottles has a mean of 36 oz. with a standard deviation of 0.15 oz. Suppose we take a random sample of 36 bottles filled by this machine. The probability that the mean of the sample is between 35.94 and 36.06 oz. is ________.

19) The amount of bleach a machine pours into bottles has a mean of 36 oz. with a standard deviation of 0.15 oz. Suppose we take a random sample of 36 bottles filled by this machine. So, the middle 95% of the sample means based on samples of size 36 will be between ________ and ________.

20) A manufacturer of power tools claims that the mean amount of time required to assemble their top-of-the-line table saw is 80 minutes with a standard deviation of 40 minutes. Suppose a random sample of 64 purchasers of this table saw is taken. The probability that the sample mean will be between 77 and 89 minutes is ________.

21) A manufacturer of power tools claims that the mean amount of time required to assemble their top-of-the-line table saw is 80 minutes with a standard deviation of 40 minutes. Suppose a random sample of 64 purchasers of this table saw is taken. So, the middle 95% of the sample means based on samples of size 64 will be between ________ and ________.

SCENARIO 7-1

The time spent studying by students in the week before final exams follows a normal distribution with a standard deviation of 8 hours. A random sample of 4 students was taken in order to estimate the mean study time for the population of all students.

22) Referring to Scenario 7-1, what is the probability that the sample mean exceeds the population mean by more than 2 hours? ________

23) Referring to Scenario 7-1, what is the probability that the sample mean is more than 3 hours below the population mean? ________

24) Referring to Scenario 7-1, what is the probability that the sample mean differs from the population mean by less than 2 hours? ________
25) Referring to Scenario 7-1, what is the probability that the sample mean differs from the population mean by more than 3 hours?

SCENARIO 7-3

The lifetimes of a certain brand of light bulbs are known to be normally distributed with a mean of 1,600 hours and a standard deviation of 400 hours. A random sample of 64 of these light bulbs is taken.

26) Referring to Scenario 7-3, what is the probability that the sample mean lifetime is more than 1,550 hours?

27) Referring to Scenario 7-3, the probability is 0.15 that the sample mean lifetime is more than how many hours?

28) Referring to Scenario 7-3, the probability is 0.20 that the sample mean lifetime differs from the population mean lifetime by at least how many hours?

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

29) The standard error of the mean
   A) decreases as the sample size increases.
   B) is never larger than the standard deviation of the population.
   C) measures the variability of the mean from sample to sample.
   D) All of the above.

30) If the expected value of a sample statistic is equal to the parameter it is estimating, then we call that sample statistic
   A) biased.
   B) random.
   C) minimum variance.
   D) unbiased.
31) Which of the following statements about the sampling distribution of the sample mean is incorrect?
   A) The sampling distribution of the sample mean is approximately normal whenever the sample size is sufficiently large (n ≥ 30).
   B) The mean of the sampling distribution of the sample mean is equal to μ.
   C) The standard deviation of the sampling distribution of the sample mean is equal to σ.
   D) The sampling distribution of the sample mean is generated by repeatedly taking samples of size n and computing the sample means.

32) Suppose the ages of students in Statistics 101 follow a right skewed distribution with a mean of 23 years and a standard deviation of 3 years. If we randomly sampled 100 students, which of the following statements about the sampling distribution of the sample mean age is incorrect?
   A) The standard deviation of the sampling distribution is equal to 3 years.
   B) The standard error of the sampling distribution is equal to 0.3 years.
   C) The shape of the sampling distribution is approximately normal.
   D) The mean of the sampling distribution is equal to 23 years.

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

33) A sample that does not provide a good representation of the population from which it was collected is referred to as a(n) ________ sample.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

34) Suppose a sample of n = 50 items is selected from a population of manufactured products and the weight, X, of each item is recorded. Prior experience has shown that the weight has a probability distribution with μ = 6 ounces and σ = 2.5 ounces. Which of the following is true about the sampling distribution of the sample mean if a sample of size 15 is selected?
   A) The mean of the sampling distribution is 6 ounces.
   B) The shape of the sampling distribution is approximately normal.
   C) The standard deviation of the sampling distribution is 2.5 ounces.
   D) All of the above are correct.
35) Major league baseball salaries averaged $3.26 million with a standard deviation of $1.2 million in a certain year in the past. Suppose a sample of 100 major league players was taken. What was the standard error for the sample mean salary?

A) $1,200.0 million  
B) $0.12 million  
C) $12 million  
D) $0.012 million

36) The owner of a fish market has an assistant who has determined that the weights of catfish are normally distributed, with mean of 3.2 pounds and standard deviation of 0.8 pound. If a sample of 16 fish is taken, what would the standard error of the mean weight equal?

A) 0.800  
B) 0.003  
C) 0.200  
D) 0.050

37) For sample size 16, the sampling distribution of the mean will be approximately normally distributed

A) if the sample is normally distributed.  
B) if the sample standard deviation is known.  
C) if the shape of the population is symmetrical.  
D) regardless of the shape of the population.

38) Which of the following is true regarding the sampling distribution of the mean for a large sample size?

A) It has the same shape and mean as the population, but has a smaller standard deviation.  
B) It has a normal distribution with the same mean as the population but with a smaller standard deviation.  
C) It has the same shape, mean, and standard deviation as the population.  
D) It has a normal distribution with the same mean and standard deviation as the population.

39) For sample size 1, the sampling distribution of the mean will be normally distributed

A) only if the population values are positive.  
B) only if the shape of the population is symmetrical.  
C) only if the population is normally distributed.  
D) regardless of the shape of the population.
40) True or False: If the population distribution is symmetric, the sampling distribution of the mean can be approximated by the normal distribution if the samples contain 15 observations.
   A) True  
   B) False

41) True or False: As the sample size increases, the effect of an extreme value on the sample mean becomes smaller.
   A) True  
   B) False

42) True or False: The Central Limit Theorem ensures that the sampling distribution of the sample mean approaches a normal distribution as the sample size increases.
   A) True  
   B) False

43) True or False: As the size of the sample is increased, the standard deviation of the sampling distribution of the sample mean for a normally distributed population will stay the same.
   A) True  
   B) False

44) True or False: The fact that the sample means are less variable than the population data can be observed from the standard error of the mean.
   A) True  
   B) False

45) True or False: The amount of bleach a machine pours into bottles has a mean of 36 oz. with a standard deviation of 0.15 oz. Suppose we take a random sample of 36 bottles filled by this machine. The sampling distribution of the sample mean has a mean of 36 oz.
   A) True  
   B) False

46) True or False: The amount of bleach a machine pours into bottles has a mean of 36 oz. with a standard deviation of 0.15 oz. Suppose we take a random sample of 36 bottles filled by this machine. The sampling distribution of the sample mean will be approximately normal only if the population sampled is normal.
   A) True  
   B) False
SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

47) A manufacturer of power tools claims that the mean amount of time required to assemble their top-of-the-line table saw is 80 minutes with a standard deviation of 40 minutes. Suppose a random sample of 64 purchasers of this table saw is taken. The standard deviation of the sampling distribution of the sample mean is ________ minutes.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

48) True or False: A sample of size 25 provides a sample variance of 400. The standard error, in this case equal to 4, is best described as the estimate of the standard deviation of means calculated from samples of size 25.
   A) True               B) False

49) True or False: In inferential statistics, the standard error of the sample mean assesses the uncertainty or error of estimation.
   A) True               B) False

50) The standard error of the population proportion will become larger
   A) as population proportion approaches 0.50.
   B) as population proportion approaches 1.00.
   C) as population proportion approaches 0.
   D) as the sample size increases.

51) True or False: The sample proportion is an unbiased estimate of the population proportion.
   A) True               B) False

52) True or False: The standard error of the sampling distribution of a sample proportion is \( \sqrt{\frac{\rho(1 - \rho)}{n}} \) where \( \rho \) is the sample proportion.
   A) True               B) False

53) True or False: The sample proportion is an unbiased estimator for the population proportion.
   A) True               B) False
SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

SCENARIO 7-5

According to an article, 19% of the entire population in a developing country have high-speed access to the Internet. Random samples of size 200 are selected from the country’s population.

54) Referring to Scenario 7-5, the population mean of all the sample proportions is ________.

55) Referring to Scenario 7-5, the standard error of all the sample proportions is ________.

56) Referring to Scenario 7-5, among all the random samples of size 200, ________ % will have between 14% and 24% who have high-speed access to the Internet.

57) Referring to Scenario 7-5, among all the random samples of size 200, ________ % will have between 9% and 29% who have high-speed access to the Internet.

58) Referring to Scenario 7-5, among all the random samples of size 200, ________ % will have more than 30% who have high-speed access to the Internet.

59) Referring to Scenario 7-5, among all the random samples of size 200, ________ % will have less than 20% who have high-speed access to the Internet.

60) Referring to Scenario 7-5, among all the random samples of size 200, 90 % will have less than ________ % who have high-speed access to the Internet.

61) Referring to Scenario 7-5, among all the random samples of size 200, 90 % will have more than ________ % who have high-speed access to the Internet.
According to a survey, only 15% of customers who visited the website of a major retail store made a purchase. Random samples of size 50 are selected.

62) Referring to Scenario 7-4, what proportion of the samples will have between 20% and 30% of customers who will make a purchase after visiting the website?

63) Referring to Scenario 7-4, what proportion of the samples will have less than 15% of customers who will make a purchase after visiting the website?

64) Referring to Scenario 7-4, what is the probability that a random sample of 50 will have at least 30% of customers who will make a purchase after visiting the website?

65) Referring to Scenario 7-4, 90% of the samples will have less than what percentage of customers who will make a purchase after visiting the website?

66) Referring to Scenario 7-4, 90% of the samples will have more than what percentage of customers who will make a purchase after visiting the website?

67) A study at a college in the west coast reveals that, historically, 45% of the students are minority students. If a random sample of size 75 is selected, the probability is ______ that between 30% and 50% of the students in the sample will be minority students.

68) A study at a college in the west coast reveals that, historically, 45% of the students are minority students. If a random sample of size 75 is selected, the probability is ______ that more than half of the students in the sample will be minority students.
69) A study at a college in the west coast reveals that, historically, 45% of the students are minority students. If random samples of size 75 are selected, 80% of the samples will have less than ______ % of minority students.

70) A study at a college in the west coast reveals that, historically, 45% of the students are minority students. If random samples of size 75 are selected, 95% of the samples will have more than ______ % of minority students.
1) C
2) B
3) A
4) Approximately 0
5) D
6) C
7) 0.0416 using Excel or 0.0418 using Table E.2
8) B
9) B
10) A
11) A
12) B
13) 0.0228
14) 101.7757
15) 0.4974
16) 40.1 and 49.9 minutes
17) 0.3446
18) 0.9836
19) 35.951 and 36.049 ounces
20) 0.6898
21) 70.2 and 89.8 minutes
22) 0.3085
23) 0.2266
24) 0.3829 using Excel or 0.3830 using Table E.2
25) 0.4533 using Excel or 0.4532 using Table E.2
26) 0.8413
27) 1,651.82 hours using Excel or 1,652 hours using Table E.2
28) 64.08 hours using Excel or 64 hours using Table E.2
29) D
30) D
31) C
32) A
33) biased
34) A
35) B
36) C
37) C
38) B
39) C
40) A
41) A
42) A
43) B
44) A
45) A
46) B
47) 5
48) A
49) A
50) A
51) A
52) B
53) A
54) 19% or 0.19
55) 0.0277
56) 92.85 using Excel or 92.82 using Table E.2
57) 99.97
58) 0.0000 or virtually zero
59) 64.08 using Excel or 64.06 using Table E.2
60) 22.56 using Excel or 22.55 using Table E.2
61) 15.45
62) 0.1596
63) 0.5
64) 0.0015
65) 21.47%
66) 8.528% using Excel or 8.536% using Table E.2
67) 0.8034 using Excel or 0.8033 using Table E.2
68) 0.1920 using Excel or 0.1922 using Table E.2
69) 49.83
70) 35.55