Sampling Distribution Review

Multiple Choice
Identify the choice that best completes the statement or answers the question.

1. A survey conducted by Black Flag asked whether or not the action of a certain type of roach disk was effective in killing roaches. 79% of the respondents agreed that the roach disk was effective. The number 79% is a
   A. parameter.
   B. population.
   C. statistic.
   D. sample.
   E. sampling distribution.

2. In the 2008 New Hampshire Democratic primary, 30% of voter in a CNN poll said they would vote for Hillary Clinton. Surprisingly, in the primary itself, 39% voted for Clinton. The number 39% is a
   A. parameter.
   B. population.
   C. statistic.
   D. sample.
   E. sampling distribution.

Scenario 7-1
A CBS News/New York Times opinion poll asked 1,190 adults whether they would prefer balancing the Federal budget over cutting taxes; 59% of those asked said "Yes." Suppose that in fact 62% of all adults favor balancing the budget over cutting taxes.

3. Use Scenario 7-1. The number 62%
   A. is evidence of bias.
   B. must be an error, since the actual percentage is 59%.
   C. is a sampling distribution.
   D. is a statistic.
   E. is a parameter.

4. Use Scenario 7-1. If you take a large number of SRSs of size 1,190, the sample proportions who favor balancing the budget will vary. Some will be lower than 62% and some will be higher, but the average sample result will be very close to 62%. This fact is called
   A. low bias.
   B. small margin of error.
   C. high variability.
   D. large bias.
   E. low variability.

5. Which of the following is correct?
   A. parameters describe population characteristics
   B. parameters describe sample characteristics
   C. the population is a subset of the sample
   D. statistics must be based on a simple random sample
   E. both (A) and (D) are correct.
6. I flip a coin ten times and record the proportion of heads I obtain. I then repeat this process of flipping the coin ten times and record the proportion of heads obtained many, many times. When done, I make a histogram of my results. This histogram approximates
A. the bias, if any, that is present.
B. the true sample statistic.
C. the distribution of sample data.
D. the sampling distribution of the proportion of heads in ten flips of the coin.
E. the population distribution.

7. The variability of a statistic is described by
A. the spread of its sampling distribution.
B. the amount of bias present.
C. the vagueness in the wording of the question used to collect the sample data.
D. probability calculations.
E. the stability of the population it describes.

8. If we take many simple random samples from the same population, we expect
A. the same values of the statistic for each sample
B. the values of the statistic will vary from sample to sample
C. a different value of the parameter for each sample
D. a problem with voluntary response
E. a problem with bias

9. The distribution of the value of a variable for all members of a population is
A. the distribution of sample data.
B. random allocation.
C. the population distribution of the variable.
D. the parameter.
E. the sampling distribution.

10. The distribution of values from a single sample of size \( n \) from a population is
A. the distribution of sample data.
B. random allocation.
C. the population distribution of the variable.
D. the parameter.
E. the sampling distribution.

**Scenario 7-2**
Below are dot plots of the values taken by three different statistics in 30 samples from the same population. The true value of the population parameter is marked with an arrow.

---

**Statistic A**

---

**Statistic B**

---

**Statistic C**

---

The true value of the population parameter is marked with an arrow.
11. Use Scenario 7-2. The statistic that has the largest bias among these three is
   A. statistic A.
   B. statistic B.
   C. statistic C.
   D. A and B have similar bias, and it is larger than the bias of C.
   E. B and C have similar bias, and it is larger than the bias of A.

12. Use Scenario 7-2. The statistic that has the lowest variability among these three is
   A. statistic A.
   B. statistic B.
   C. statistic C.
   D. A and B have similar variability, and it is less than the variability of C.
   E. B and C have similar variability, and it is less than the variability of A.

13. Use Scenario 7-2. Based on the performance of the three statistics in many samples, which is preferred as an estimate of the parameter?
   A. statistic A.
   B. statistic B.
   C. statistic C.
   D. either A or B would be equally good.
   E. either B or C would be equally good.

14. A shocking fact: 66% of all teenagers have a TV set in their room. If an opinion poll chooses an SRS of 1000 teens and asks if they have a TV set in their room, the percent who say "Yes" will vary if the sampling procedure is repeated. But the distribution of the percent who say “Yes” in all the samples is centered at the truth about the population (66%). We call this desirable characteristic of sample proportions
   A. absence of bias.
   B. low variability.
   C. symmetry.
   D. sample repeatability.
   E. statistical significance.

15. To reduce the variability of estimates from a simple random sample, you should
   A. use a smaller sample.
   B. increase the bias.
   C. use a count, not a percent.
   D. use a larger sample.
   E. use a percent, not a count.

16. If we took a SRS of 1700 people from California (population 34 million) and a SRS of 1000 people from Detroit (population 1 million) which sampling distribution would have the smaller standard deviation?
   A. Detroit, because 1000/1,000,000 is more than 1700/32,000,000.
   B. Detroit, because it has the smaller population.
   C. California, because the sample size (1700) is larger than for Detroit (1000).
   D. California, because it has the larger population.
   E. Both would be the same, because simple random samples (SRS) are taken in both places.

17. "Congress passed a ban on the sale of assault weapons. Now there is a move to repeal that ban. Do you agree that the ban on sale of assault weapons should be repealed?" You ask that question to an SRS of 1000 adults in Texas (population 21 million people) and to a separate SRS of 1000 adults in Indiana (population 6 million people). The standard deviation of the sampling distribution for proportions in Indiana is
   A. approximately the same as in Texas, because the two SRS's are approximately the same
size.
B. larger than in Texas, because there are fewer people in Indiana.
C. smaller than in Texas, because there are fewer people in Indiana.
D. smaller than in Texas, because the sample is a larger proportion of the population.
E. may be either smaller or larger than in Texas, because the sample result varies due to chance.

**Scenario 7-3**
A 2010 study of 240 randomly-selected residents of a subtropical resort city with 82,000 residents found that 5.4% of them had been exposed to the mosquito-borne virus that causes Dengue fever. Suppose the actual percentage of people in the city who have been exposed to the virus is 3%. Let \( p \) = the proportion of residents who have been exposed in a random sample of 240,

18. Use Scenario 7-3. The mean \( \mu_p \) of \( p \) is
A. 0.03.
B. 0.054.
C. 7.2.
D. 13.
E. 240.

19. Use Scenario 7-3. The standard deviation \( \sigma_p \) of \( p \) is approximately
A. 0.000121.
B. 0.00187.
C. 0.0110.
D. 2.643.
E. 2.683.

20. Use Scenario 7-3. Which of the following conditions had to be met in order for us to use the formula for \( \sigma_p \) that we used in the previous question?
A. \( n \geq 30 \)
B. \( \sqrt{np(1-p)} \geq 10 \)
C. \( np \geq 10 \) and \( n(1-p) \geq 10 \)
D. \( n < 0.10N \)
E. The population distribution is approximately Normal.

21. Use Scenario 7-3. If the true proportion is actually 0.03, the probability that \( \hat{p} \) is more than 0.054 is closest to
A. 0.
B. 0.0222.
C. 0.0207.
D. 0.0146.
E. We can’t calculate this probability because we haven’t satisfied the Normality condition.

22. Suppose you are going to roll a 10-sided die 50 times and record \( p \), the proportion of times that the roll is 3 or lower. Which of the following describes the sampling distribution of \( p \)?
A. Mean = 15; Standard deviation = 0.0648; non-Normal.
B. Mean = 15; Standard deviation = 3.24; approximately Normal
C. Mean = 0.3; Standard deviation = 3.24; approximately Normal
D. Mean = 0.3; Standard deviation = 0.0648; non-Normal
E. Mean = 0.3; Standard deviation = 0.0648; approximately Normal

Scenario 7-4
According to a recent poll, 27% of Americans get 30 minutes of exercise at least five days each week. Let’s assume this is the parameter value for the population.

___ 23. Use Scenario 7-4. If you take a simple random sample of 25 Americans and let \( \hat{p} \) = the proportion in the sample who get 30 minutes of exercise at least five days per week, what are the mean and standard deviation of the sampling distribution of \( \hat{p} \)?

A. \( \mu_\hat{p} = 0.30; \sigma_{\hat{p}} = 0.1039 \)
B. \( \mu_\hat{p} = 0.30; \sigma_{\hat{p}} = 0.0888 \)
C. \( \mu_\hat{p} = 0.27; \sigma_{\hat{p}} = 0.0079 \)
D. \( \mu_\hat{p} = 0.27; \sigma_{\hat{p}} = 0.0888 \)
E. \( \mu_\hat{p} = 0.27; \sigma_{\hat{p}} = 0.1039 \)

___ 24. Use Scenario 7-4. If you take a simple random sample of 25 Americans and let \( \hat{p} \) = the proportion in the sample who get 30 minutes of exercise at least five days per week, is the shape of the sampling distribution of \( \hat{p} \) approximately Normal?

A. No, because \( n < 30 \).
B. No, because \( np < 10 \)
C. Yes, because we can reasonably assume that there are more than \( (10)(25) = 250 \) individuals in the population.
D. Yes, because we took a simple random sample.
E. Yes, because \( n(1-p) \geq 10 \).

___ 25. Use Scenario 7-4. Suppose you increased the sample size in the previous question to \( n = 50 \). How would the sampling distribution of \( \hat{p} \) compare to the sampling distribution for \( n = 25 \)?

A. Center and spread would be the same, both distributions would be approximately Normal.
B. Center and spread would be the same, but only the shape for the larger sample would be approximately Normal.
C. Center would be the same, spread would be smaller for \( n = 50 \), both distributions would be approximately Normal.
D. Center would be the same, spread would be smaller for \( n = 50 \), and only the shape for the larger sample would be approximately Normal.
E. Center would be the same, spread would be larger for \( n = 50 \), and only the shape for the larger sample would be approximately Normal.

___ 26. Use Scenario 7-4. If an SRS of size \( n = 50 \) were taken, what is the approximate probability that \( \hat{p} \), the proportion who exercise at least five days per week, is higher than 0.30?

A. nearly 0.
B. 0.1081
C. 0.1163
D. 0.1227
27. A fair coin (one for which both the probability of heads and the probability of tails are 0.5) is tossed 60 times. The probability that less than 1/3 of the tosses are heads is closest to
A. 0.9951.
B. 0.33.
C. 0.109.
D. 0.09.
E. 0.0049.

28. In a test of ESP (extrasensory perception), the experimenter looks at cards that are hidden from the subject. Each card contains one of four figures—a star, a circle, a wavy line, or a square. An experimenter looks at each of 100 cards in turn, and the subject tries to read the experimenter’s mind and name the shape on each card. What is the approximate probability that the subject gets more than 30 correct if the subject does not have ESP and is just guessing?
A. 0.3121.
B. 0.2483.
C. 0.1251.
D. 0.0427.
E. <0.001.

29. A college basketball player makes 80% of his free throws. Over the course of the season she will attempt 100 free throws. Assuming free throw attempts are independent, the probability that the number of free throws she makes exceeds 80 is approximately
A. 0.2000.
B. 0.2266.
C. 0.5000.
D. 0.7734.
E. 0.8000.

30. Suppose we select an SRS of size \( n = 100 \) from a large population having proportion \( p \) of successes. Let \( X \) be the number of successes in the sample. For which value of \( p \) would it be safe to assume the sampling distribution of \( X \) is approximately normal?
A. 0.01.
B. 0.099.
C. 1/9.
D. 0.975.
E. 0.9999.

Scenario 7-5
A factory produces plate glass with a mean thickness of 4 mm and a standard deviation of 1.1 mm. A simple random sample of 100 sheets of glass is to be measured, and the sample mean thickness of the 100 sheets \( \bar{X} \) is to be computed.

31. Use Scenario 7-5. We know the random variable \( \bar{X} \) has approximately a normal distribution because of the
A. law of large numbers.
B. central limit theorem.
C. law of proportions.
D. fact that probability is the long run proportion of times an event occurs.
E. normality of the population distribution.
32. Use Scenario 7-5. The probability that the average thickness $\bar{x}$ of the 100 sheets of glass is less than 4.1 mm is closest to
A. 0.8183.
B. 0.5361.
C. 0.1814.
D. 0.6817.
E. 0.8413.

Scenario 7-6
The histogram below was obtained from data on 750 high school basketball games in a regional athletic conference. It represents the number of three-point baskets made in each game.

33. Use Scenario 7-6. A researcher takes a simple random sample of size $n = 40$ from this population and calculates the mean number of 3-point baskets. Which of the following best describes the shape of the sampling distribution of means?
A. Skewed left
B. Skewed right
C. Approximately uniform
D. Approximately Normal
E. Symmetric, but distinctly non-Normal.

34. Use Scenario 7-6. What is the range of sample sizes the research could take from this population without violating conditions required for the application of the formula $\sigma_x = \frac{\sigma}{\sqrt{n}}$ and the central limit theorem?
A. $n \geq 30$
B. $30 \leq n \leq 50$
C. $30 \leq n \leq 75$
D. $50 \leq n \leq 75$
E. $n \leq 75$

Scenario 7-7
An automobile insurer has found that repair claims have a mean of $920 and a standard deviation of $870. Suppose that the next 100 claims can be regarded as a random sample from the long-run claims process.

35. Use Scenario 7-7. The mean and standard deviation of the mean of the next 100 claims is
A. mean = $920 and standard deviation = $87.
B. mean = $920 and standard deviation = $8.70.
C. mean = $92 and standard deviation = $87.
D. mean = $92 and standard deviation = $870.
E. none of these.

36. Use Scenario 7-7. The probability that the mean of the next 100 claims is larger than $1000 is approximately
A. 0.9200.
B. 0.8212.
C. 0.1788.
D. 0.0800.
E. close to 0.

37. The central limit theorem says that when a simple random sample of size \( n \) is drawn from any population with mean \( \mu \) and standard deviation \( \sigma \), then when \( n \) is sufficiently large, the
A. standard deviation of the sample mean is \( \sigma/\sqrt{n} \).
B. distribution of the population is exactly normal.
C. distribution of the sample mean is approximately normal.
D. distribution of the sample mean is exactly normal.
E. mean of the sampling distribution of \( \bar{X} \) is \( \mu \).

38. The number of column inches of classified advertisements appearing on Mondays in a certain daily newspaper has mean 320 inches and standard deviation 30 inches. Suppose that the results for 100 consecutive Mondays can be regarded as a simple random sample and let \( \bar{X} \) denote the mean number of column inches of classified advertisements in the sample. Assuming a sample of 100 is sufficiently large, the random variable \( \bar{X} \) has a
A. distribution that is exactly normal by the central limit theorem.
B. distribution that is approximately normal by the central limit theorem.
C. mean of 3.2 inches by the law of large numbers.
D. standard deviation of 3.2 inches by the law of large numbers.
E. More than one is true.

39. Suppose a large population has mean \( \mu \) and standard deviation \( \sigma \), and a simple random sample of size \( n \) is taken. The sampling distribution of the sample mean has mean and variance respectively equal to
A. \( \mu/n \) and \( \sigma^2/n \).
B. \( \mu \) and \( \sigma/n \).
C. \( \mu/n \) and \( \sigma^2/n^2 \).
D. \( \mu \) and \( \sigma^2/n^2 \).
E. \( \mu \) and \( \sigma^2/n^2 \).

40. The incomes in a certain large population of college teachers have a normal distribution with mean $60,000 and standard deviation $5000. Four teachers are selected at random from this population to serve on a salary review committee. What is the probability that their average salary exceeds $65,000?
A. 0.0228
B. 0.1587
C. 0.8413
D. 0.9772
E. essentially 0

41. A random sample of size 25 is to be taken from a population that is Normally distributed with mean 60 and standard deviation 10. The mean \( \bar{X} \) of the observations in our sample is to be computed. The sampling distribution of \( \bar{X} \)
A. is approximately Normal with mean 60 and standard deviation 10.
B. is approximately Normal with mean 60 and standard deviation 2.
C. is approximately Normal with mean 60 and standard deviation 1.414.
D. has an unknown shape with mean 60 and standard deviation 1.414.
E. has an unknown shape with mean 60 and standard deviation 2.

**Scenario 7-8**
The scores of individual students on the American College Testing (ACT) Program composite college entrance examination have an approximately Normal distribution with mean 18.6 and standard deviation 6.0.

At Northside High, 36 seniors take the test. Assume that the scores at this school have the same distribution as national scores.

___ 42. Use Scenario 7-8. What is the mean of the sampling distribution of mean scores for the 36 students?
A. 1.0.
B. 3.1.
C. 6.0.
D. 18.6.
E. This value cannot be determined without the actual data.

___ 43. Use Scenario 7-8. What is the standard deviation of the sampling distribution of mean scores for the 36 students?
A. 0.41.
B. 1.0.
C. 3.1.
D. 6.0.
E. 18.6.

___ 44. Use Scenario 7-8. The shape of the sampling distribution of mean scores for the 36 students is
A. approximately Normal.
B. symmetry and mound-shaped, but non-Normal
C. skewed right.
D. neither Normal nor non-normal. It depends on the particular 36 students selected.
E. exactly Normal.

___ 45. Use Scenario 7-8. If, after answering the previous three questions, you discover that Northside High has only 200 seniors, which of your three answers would no longer be correct?
A. The mean and the standard deviation
B. The standard deviation and the shape of the distribution.
C. Only the shape of the distribution.
D. Only the standard deviation.
E. All three would be incorrect.

___ 46. The distribution of prices for home sales in a certain New Jersey county is skewed to the right with a mean of $290,000 and a standard deviation of $145,000. Suppose you take a simple random sample of 100 home sales from this (very large) population. What is the probability that the mean of our sample is above $325,000?
A. 0.0015
B. 0.0027
C. 0.0079
D. 0.4046
E. 0.4921
Answer Section

MULTIPLE CHOICE

1. C
2. A
3. E
4. A
5. A
6. D
7. A
8. B
9. C
10. A
11. C
12. E
13. B
14. A
15. D
16. C
17. A
18. A
19. C
20. D
21. D
22. E
23. D
24. B
25. D
26. E
27. E
28. C
29. C
30. C
31. B
32. A
33. D
34. C
35. A
36. C
37. C
38. B
39. D
40. A
41. B
42. D
43. B
44. A
45. D
46. C