AP Statistics - Sampling Distributions

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. 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.

4. 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.

5. 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
6. 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.

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7. 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.

8. 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.

9. 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.

10. 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.
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.

11. 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. \( \mu_p = 0.30; \sigma_p = 0.1039 \)
   B. \( \mu_p = 0.30; \sigma_p = 0.0888 \)
   C. \( \mu_p = 0.27; \sigma_p = 0.0079 \)
   D. \( \mu_p = 0.27; \sigma_p = 0.0888 \)
   E. \( \mu_p = 0.27; \sigma_p = 0.1039 \)

12. 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 \( n(1-p) \geq 10 \).

13. 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.

14. 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
   E. 0.3164
15. 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.

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.

16. 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.

17. 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.

![Histogram of three-point shots per game](image)

18. 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.

19. 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.

20. 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.
21. 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.

22. 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 $\sigma^2/n$.
E. $\mu$ and $\sigma^2/n^2$.

23. 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

24. 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.

25. 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.
AP Statistics - Sampling Distributions
Answer Section

MULTIPLE CHOICE

1. ANS: C PTS: 1 TOP: Parameter vs. Statistic
2. ANS: A PTS: 1 TOP: Parameter vs. Statistic
3. ANS: A PTS: 1 TOP: Bias and variability
4. ANS: A PTS: 1 TOP: Idea of a sampling distribution
5. ANS: B PTS: 1 TOP: Idea of a sampling distribution
6. ANS: A PTS: 1 TOP: Idea of a sampling distribution
7. ANS: C PTS: 1 TOP: Bias and variability
8. ANS: E PTS: 1 TOP: Bias and variability
9. ANS: B PTS: 1 TOP: Bias and variability
10. ANS: D PTS: 1 TOP: Variability and sample size
11. ANS: D PTS: 1 TOP: Mean and Std. Dev. of sampling distribution of proportions
12. ANS: B PTS: 1 TOP: Normality condition
13. ANS: D PTS: 1 TOP: Normal probability calculation for p-hat
14. ANS: E PTS: 1 TOP: Normal probability calculation for p-hat
15. ANS: C PTS: 1 TOP: Normal probability calculation for p-hat
16. ANS: B PTS: 1 TOP: Central limit theorem
17. ANS: A PTS: 1 TOP: Normal probability calculation for sampl. distrib. of x-bar
18. ANS: D PTS: 1 TOP: Central limit theorem
19. ANS: C PTS: 1 TOP: 10% condition and central limit theorem
20. ANS: A PTS: 1 TOP: Mean and Std. Dev. of sampling distribution of means
21. ANS: C PTS: 1 TOP: Normal probability calculation for sampl. distrib. of x-bar
22. ANS: D PTS: 1 TOP: Mean and Std. Dev. of sampling distribution of means
23. ANS: A PTS: 1 TOP: Normal probability calculation for sampl. distrib. of x-bar
24. ANS: B PTS: 1 TOP: Mean, Std. Dev., shape of sampling distribution of means
25. ANS: B PTS: 1 TOP: Standard deviation of sampling distribution of means