

1. Which of the following best describes what is meant by the term sampling variability?

- A. There are many different methods for selecting a sample.
- B. Two different samples from the same population may have different values of a sample statistic.
- C. The sample size can sometimes vary from sample to sample.
- D. Convenience samples may not be representative of the population.
- E. Population characteristics vary from population to population.

2. A random sample of size 2 is to be selected without replacement from the small population shown here:

2 4 6 8

Which of the following is the sampling distribution of the sample mean?

- A.

\bar{x}	2	4	6	8
$p(\bar{x})$	.25	.25	.25	.25
- B.

\bar{x}	3	4	5	6	7
$p(\bar{x})$	1/6	1/6	2/6	1/6	1/6
- C.

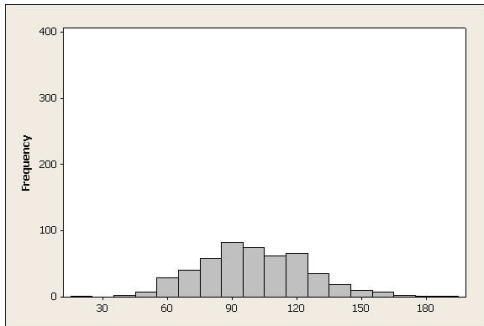
\bar{x}	3	5	7
$p(\bar{x})$	.25	.5	.25
- D.

\bar{x}	2	4	6	8
$p(\bar{x})$	.125	.375	.375	.125
- E.

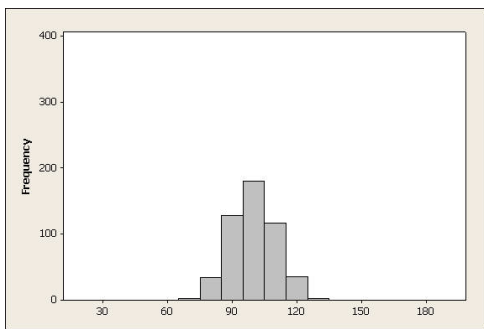
\bar{x}	2	4	5	6	8
$p(\bar{x})$	0	0	1	0	0

3. The histograms shown here are approximate sampling distributions of the sample mean. Each histogram is based on selecting 500 different samples, each of size n . All three histograms were constructed by sampling from the same population, but the sample sizes were different. Which histogram was based on samples with the smallest sample size, n ?

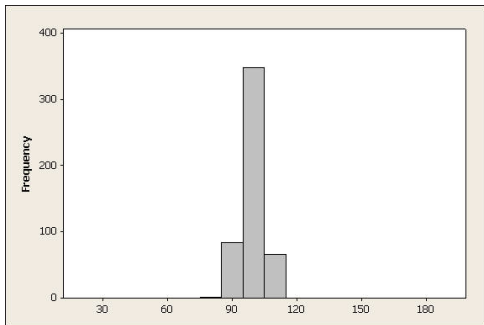
I.



II.



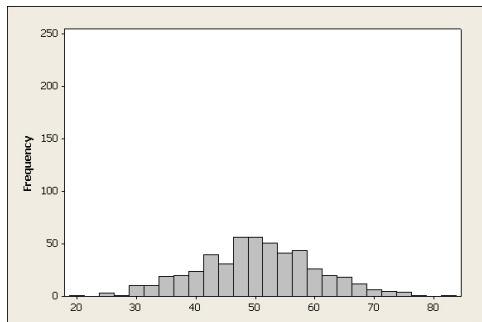
III.



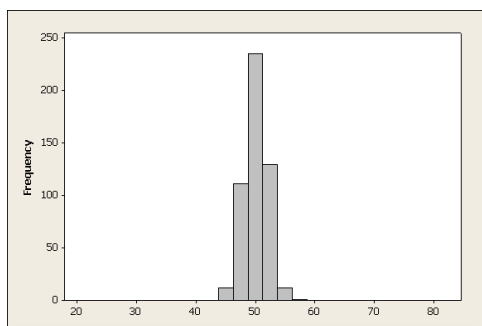
- A. I
- B. II
- C. III
- D. The same sample size was used for all three histograms.
- E. It is not possible to tell by looking at the histograms.

4. The histograms shown below are approximate sampling distributions of the sample mean. Each one is based on 500 samples of size 25, but each of the three histograms is the result of sampling from a different population. Which of the three populations sampled had the largest standard deviation?

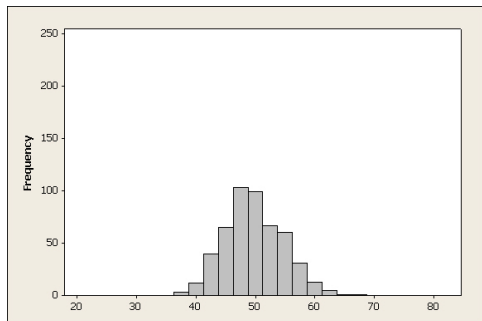
I.



II.



III.



- A. I
- B. II
- C. III
- D. All three populations have the same standard deviation.
- E. It is not possible to tell by looking at the histograms.

5. For a random sample from a skewed population, for which of the following sample sizes would the sampling distribution of \bar{x} be closest to normal in shape?
- A. $n = 4$
 - B. $n = 10$
 - C. $n = 40$
 - D. $n = 60$
 - E. The \bar{x} distribution will be normal for any sample size.
6. What is the standard deviation of \bar{x} for random samples of size 100 from a population with a mean of 100 and a standard deviation of 80?
- A. .8
 - B. 8
 - C. 10
 - D. 80
 - E. 100
7. For which of the following will the sample mean tend to differ least from sample to sample?
- A. random samples of size 10
 - B. random samples of size 20
 - C. random samples of size 30
 - D. random samples of size 50
 - E. random samples of size 100
8. Commute distances for employees of a large company have a distribution that is quite skewed. Suppose the mean commute distance is 20 miles and that the standard deviation is 10 miles. What can be said about the mean commute distance for a random sample of size 4 employees from this plant?
- A. The distribution of \bar{x} will be approximately normal with mean 20 and standard deviation 10.
 - B. The distribution of \bar{x} will be approximately normal with mean 20 and standard deviation 5.
 - C. The mean and standard deviation of \bar{x} will be 20 and 10, but the sampling distribution of \bar{x} will not be approximately normal.
 - D. The mean and standard deviation of \bar{x} will be 20 and 5, but the sampling distribution of \bar{x} will not be approximately normal.
 - E. \bar{x} will have a standard normal distribution.
9. A random sample is to be selected from a population. For which combination of n and p is it reasonable to assume that the sampling distribution of the sample proportion \hat{p} will be approximately normal?
- A. $n = 10$ and $p = .4$
 - B. $n = 25$ and $p = .5$
 - C. $n = 30$ and $p = .2$
 - D. $n = 40$ and $p = .1$
 - E. $n = 100$ and $p = .05$

10. Suppose that 50% of those taking a national licensing exam pass the exam on the first attempt. A random sample of $n = 100$ people taking the exam for the first time will be selected. If \hat{p} is the proportion in the sample that pass the exam on the first attempt, what are the mean and standard deviation of the sampling distribution of \hat{p} ?

- A. The mean is .5 and the standard deviation is .25.
- B. The mean is .5 and the standard deviation is .025.
- C. The mean is .5 and the standard deviation is $\sqrt{.0025}$
- D. The mean is .25 and the standard deviation is .25.
- E. The mean is .25 and the standard deviation is $\sqrt{.0025}$

11. For which of the following will the sample proportion tend to differ least from sample to sample?

- A. random samples of size 30 from a population with $p = .1$
- B. random samples of size 40 from a population with $p = .1$
- C. random samples of size 40 from a population with $p = .4$
- D. random samples of size 50 from a population with $p = .5$
- E. random samples of size 60 from a population with $p = .5$

12. Which of the following is true:

- I. The sampling distribution of \hat{p} has a mean equal to p .
- II. The sampling distribution of \hat{p} has a standard deviation equal to $\sqrt{np(1-p)}$
- III. The sampling distribution of p is always symmetric

- A. I only
- B. II only
- C. III only
- D. I and II only
- E. I and III only

13. As the sample size increases, how does the sampling distribution of \bar{x} change?

- A. The mean of the sampling distribution decreases in value.
- B. The standard deviation of the sampling distribution decreases in value.
- C. The mean of the sampling distribution increases in value.
- D. The standard deviation of the sampling distribution increases in value.
- E. The mean and standard deviation of the sampling distribution will not change.

14. if a population distribution is substantially skewed and the sample size is small, which of the following is true about the sampling distribution of \bar{x} ?

- A. $\mu_{\bar{x}} \neq \mu$ and $\sigma_{\bar{x}} \neq \frac{\sigma}{\sqrt{n}}$
- B. $\mu_{\bar{x}} \neq \mu$ and the shape is not approximately normal
- C. $\sigma_{\bar{x}} \neq \frac{\sigma}{\sqrt{n}}$ and the shape is not approximately normal
- D. $\mu_{\bar{x}} = \mu$ and the shape is not approximately normal
- E. $\sigma_{\bar{x}} \neq \frac{\sigma}{\sqrt{n}}$ and the shape is approximately normal

15. The mean of a population is 83 with a standard deviation of 5. A sample of size 40 is taken. What are the mean and the standard deviation for this sample expected to be?

- A. 83 and 5 respectively
- B. 83 and $\frac{5}{40}$ respectively
- C. 83 and $\frac{5}{\sqrt{40}}$ respectively
- D. 83 and $\sqrt{\frac{5}{40}}$ respectively
- E. 40 and $\sqrt{\frac{5}{40}}$ respectively

16. As a result of the recent recession in the United States, home values also dropped. A survey of 50 recent house sales in a large urban community found the average home sale price had dropped by \$72,000. \$72,000 is called a

- A. proportion
- B. population
- C. parameter
- D. statistic
- E. sample

17. A population has $\mu = 78$ and a standard deviation $\sigma = 4.8$. What would be the mean and standard deviation of the sampling distribution \bar{x} if a sample of 100 were taken?

- A. $\mu_{\bar{x}} = 78$, $\sigma_{\bar{x}} = 0.048$
- B. $\mu_{\bar{x}} = 78$, $\sigma_{\bar{x}} = 0.48$
- C. $\mu_{\bar{x}} = 78$, $\sigma_{\bar{x}} = 4.8$
- D. $\mu_{\bar{x}} = 78$, $\sigma_{\bar{x}} = 48$
- E. $\mu_{\bar{x}} = 78$, $\sigma_{\bar{x}} = 0.0048$

18. Which of the following statements is true?

- I. The mean of any sample always equals the mean for the population it came from
- II. The sampling distribution of means has a roughly normal shape about the population mean when the sample size is sufficiently large.
- III. As the sample size increases, the variation of the sampling distribution of the means decreases.

A. I only B. II only C. I and II D. I and III E. II and III

19. A certain population of seven numbers has a mean of 8.5 and a standard deviation of 2.29. If samples of size 3 are pulled out with replacement, what can be said about the sampling mean and standard deviation?

- A. $\mu_{\bar{x}} = 8.5, \sigma_{\bar{x}} = 2.29$ B. $\mu_{\bar{x}} = 8.5, \sigma_{\bar{x}} > 2.29$ C. $\mu_{\bar{x}} = 8.5, \sigma_{\bar{x}} < 2.29$
D. $\mu_{\bar{x}} > 8.5, \sigma_{\bar{x}} = 2.29$ E. $\mu_{\bar{x}} < 8.5, \sigma_{\bar{x}} < 2.29$

20. The Central Limit Theorem states

- A. when n is sufficiently large, the sampling distribution \bar{x} is roughly approximated by the normal curve
- B. if the population distribution is normal, then the sampling distribution \bar{x} will also be normal for all sample sizes n
- C. $\mu_{\bar{x}} = \mu$
- D. $\sigma_{\bar{x}} = \frac{\sigma}{\sqrt{n}}$
- E. All the above properties make up the Central Limit Theorem

21. A sample of 36 kindergarten children has their heights measured. They are found to have an average height of 37.2 inches. What can be said about the population of kindergarten children's heights?

- A. The average height of kindergarten children would be 37.2 inches with a standard deviation six times smaller than the sample's deviation.
- B. The average height of kindergarten children would be 37.2 inches with a standard deviation six times larger than the sample's deviation.
- C. The average height of kindergarten children would be 37.2 inches with a standard deviation six times larger than the sample's deviation. The population will also be normally distributed.
- D. The average height of kindergarten children would be smaller than 37.2 inches with a standard deviation six times smaller than the sample's deviation.
- E. The average height of kindergarten children would be larger than 37.2 inches with a standard deviation six times larger than the sample's deviation.

22. A simple random sample of 1,000 Americans found that 61% were satisfied with the service provided by the dealer from which they bought their car. A simple random sample of 1,000 Canadians found that 58% were satisfied with the service provided by the dealer from which they bought their car. The sampling variability associated with these statistics.

- A. is about the same
- B. is much smaller for the Canadians since the population of Canada is smaller than that of the United States, hence the sample is a larger proportion of the population.
- C. is much larger for the Canadians since Canada has a lower population density than the United States. Hence, Canadians tend to live further apart, which always increases sampling variability.
- D. is exactly the same.
- E. cannot be determined because these are two different populations.

23. It is believed that currently 37% of Americans have at least one flat screen television in their homes. A sample of 150 Americans is surveyed. What is true about that sample?

- A. $\mu_{\hat{p}} = 0.37$ and $\sigma_{\hat{p}} = \sqrt{0.37(0.63)}$
- B. $\mu_{\hat{p}} = 0.37$ and $\sigma_{\hat{p}} = \frac{\sqrt{0.37(0.63)}}{150}$
- C. $\mu_{\hat{p}} < 0.37$ and $\sigma_{\hat{p}} = \sqrt{0.37(0.63)}$
- D. $\mu_{\hat{p}} < 0.37$ and $\sigma_{\hat{p}} = \sqrt{\frac{0.37(0.63)}{150}}$
- E. $\mu_{\hat{p}} = 0.37$ and $\sigma_{\hat{p}} = \sqrt{\frac{0.37(0.63)}{150}}$

24. Forty-three percent of the people in a particular county are Democrats. A sample of 200 people is collected at random. The approximate probability that more than 100 of the people selected are Democrats is

- A. 0.463
- B. 0.388
- C. 0.038
- D. 0.023
- E. 0.012

25. A university states that 14% of their students most likely have a full-time job. If a graduate student wants to do a study to see if this percentage has changed, what would be the minimum sample size she should gather to be sure that her data could be well approximated by a normal curve?

- A. 10 students
- B. 11 students
- C. 12 students
- D. 71 students
- E. 72 students

26. 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 a random sample of 200 New York City police officers are weighed. Fifty-two, or 26%, of the surveyed officers turn out to be overweight. Which of the following statements is true?

- A. This must be wrong because we should always get the claim of 30% from our sample.
- B. The sample was not large enough to compare since it violates the rules of thumb.
- C. 26% is just one of the sample proportions that can be obtained out of all the possible samples of 200 officers.
- D. The normal curve is not a good approximation here as the distribution is right skewed.
- E. The standard deviation of the sample would be $\sqrt{\frac{0.26(0.74)}{200}}$.

27. A sample of 100 individuals yields a mean of 27.3 and a standard deviation of 20. What is the probability of the sample mean being in the interval of 28.2-29.7?

- A. 0.2113 B. 0.05 C. 0.000 D. 0.7887 E. 0.95

28. 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 packet of crackers after tasting the free sample is 0.20. Different shoppers can be regarded as independent trials. Let \hat{p} be the proportion of the next 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. 16 B. 64 C. 256 D. 1600 E. 4000

29. A study of voting chose 663 registered voters at random shortly after an election. Of these, **72%** said they had voted in the election. Election records show that only **56%** of registered voters voted in the election. Which of the following statements is true about the boldface numbers?

- A. 72% is a sample; 56% is a population
B. 72% and 56% are both statistics
C. 72% is a statistic and 56% is a parameter
D. 72% is a parameter and 56% is a statistic
E. 72% and 56% are both parameters

30. The Gallup Poll has decided to increase the size of its random sample of voters from about 1500 people to about 4000 people right before an election. The poll is designed to estimate the proportion of voters who favor a new law banning smoking in public buildings. The effect of this increase is to

- A. reduce the bias of the estimate
B. increase the bias of the estimate
C. reduce the variability of the estimate
D. increase the variability of the estimate
E. have no effect since the population size is the same.

31. Suppose we select an SRS of size $n = 100$ from a large population having proportion p of successes. Let \hat{p} be the proportion of successes in the sample. For which value of p would it be safe to use the Normal approximation to the sampling distribution of \hat{p} ?

- A. 0.01 B. 0.09 C. 0.85 D. 0.975 E. 0.999

32. The central limit theorem is important in statistics because it allows us to use the Normal distribution to make inferences concerning the population mean

- A. if the sample size is reasonable large (for any population)
B. if the population is Normally distributed and the sample size is reasonably large
C. if the population is Normally distributed (for any sample size).
D. if the population is Normally distributed and the population variance is known (for any sample size)
E. if the population size is reasonably large (whether the population distribution is known or not).

33. The number of undergraduates of Johns Hopkins University is approximately 2000, while the number at Ohio State University is approximately 40,000. At both schools, a simple random sample of about 3% of the undergraduates is taken. Each sample is used to estimate the proportion p of all students at that university who own an iPod. Suppose that, in fact, $p = 0.80$ at both schools. Which of the following is the best conclusion?

- A. The estimate from Johns Hopkins has less sampling variability than that from Ohio State.
- B. The estimate from Johns Hopkins has more sampling variability than that from Ohio State.
- C. The two estimates have about the same amount of sampling variability
- D. It is impossible to make any statement about the sampling variability of the two estimates since the students surveyed were different.
- E. None of the above

34. A researcher initially plans to take an SRS of size n from a population that has a mean 80 and standard deviation 20. If she were to double her sample size (to $2n$), the standard deviation of the sampling distribution of the sample mean would be multiplied by

- A. $\sqrt{2}$ B. $\frac{1}{\sqrt{2}}$ C. 2 D. $\frac{1}{2}$ E. $\frac{1}{\sqrt{2n}}$

35. The student newspaper at a large university asks an SRS of 250 undergraduates, "Do you favor eliminating the carnival from the term-end celebration?" All in all, 150 of the 250 are in favor. Suppose that (unknown to you) 55% of all undergraduates favor eliminating the carnival. If you took a very large number of SRSs of size $n = 250$ from this population, the sampling distribution of the sample proportion \hat{p} would be

- A. exactly Normal with mean 0.55 and standard deviation 0.03.
- B. approximately Normal with mean 0.55 and standard deviation 0.03.
- C. exactly Normal with mean 0.60 and standard deviation 0.03.
- D. approximately Normal with mean 0.60 and standard deviation 0.03.
- E. heavily skewed with mean 0.55 and standard deviation 0.03

36. Which of the following statements about the sampling distribution of the sample mean is *incorrect*?

- A. The standard deviation of the sampling distribution will decrease as sample size increases.
- B. The standard deviation of the sampling distribution is a measure of the variability of the sample mean among repeated samples.
- C. The sample mean is an unbiased estimator of the true population mean.
- D. The sampling distribution shows how the sample mean will vary in repeated samples.
- E. The sampling distribution shows how the sample was distributed around the sample mean.

37. A machine is designed to fill 16-ounce bottles of shampoo. When the machine is working properly, the mean amount poured into the bottles is 16.05 ounces with a standard deviation of 0.1 ounce. Assume that the machine is working properly. If four bottles are randomly selected each hour and the number of ounces in each bottle is measured, then 95% of the observations should occur in which interval?

- A. 16.05 to 16.15 ounces B. -0.30 to +0.30 ounces C. 15.95 to 16.15 ounces
D. 15.90 to 16.20 ounces E. None of these

Free Response

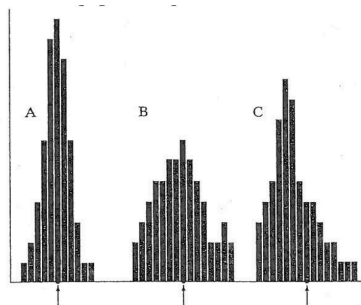
38. The amount of sugar used in a gallon of high-quality southern sweet tea is approximately normally distributed with a mean of 1.8 cups with a standard deviation 0.4 cups.

- What is the probability that a randomly selected gallon of tea will have at least 2.3 cups of sugar in it?
- What is the probability that the total amount of sugar in 10 gallons of tea will be at least 23 cups?

39. A well-known food chain believes that 36% of their customers prefer to have the buns used on their sandwiches toasted. Suppose a random sample of 400 people is gathered.

- What is the mean and standard deviation of the sampling distribution \hat{p} , the proportion of customers preferring toasted sandwich buns?
- Check to see if a normal curve is a reasonable approximation for this study.
- What is the probability that fewer than 32% of the customers prefer to have their sandwiches on toasted buns.

40. Below are histograms of values taken by three sample statistics in several hundred samples from the same population. The true value of the population parameter is marked with an arrow on each histogram.



Which statistic would provide the best estimate of the parameter? Justify your answer.

41. The amount that households pay service providers for access to the Internet varies quite a bit, but the mean monthly fee is \$28 and the standard deviation is \$10. The distribution is not Normal; many households pay about \$10 for limited dial-up access or about \$30 for unlimited dial-up access, but some pay much more for faster connections. A sample survey asks an SRS of 500 households with Internet access how much they pay. Let \bar{x} be the mean amount paid.

- Explain why you can't determine the probability that the amount a randomly selected household pays for access to the Internet exceeds \$29.
- What are the mean and standard deviation of the sampling distribution of \bar{x} ?
- What is the shape of the sampling distribution of \bar{x} ? Justify your answer.
- Find the probability that the average fee paid by the sample of households exceeds \$29. Show your work.

42. According to government data, 22% of American children under the age of six live in households with incomes less than the official poverty level. A study of learning in early childhood chooses an SRS of 300 children. Find the probability that more than 20% of the sample are from poverty households.

43. Researchers are studying populations of two squirrels, the eastern gray and the western gray. For the eastern gray squirrel, about 22 percent of the population weighs over 0.5 kilogram (kg). For the western gray squirrel, about 36 percent of the population weighs over 0.5 kg. A random sample of 60 squirrels will be selected from the population of eastern gray squirrels, and a random sample of 120 squirrels will be selected from the population of western gray squirrels. What is the mean of the sampling distribution of the difference in sample proportions (eastern minus western)?

a. $\sqrt{\frac{0.22(0.78)}{120} + \frac{0.36(0.64)}{60}}$

b. $\sqrt{\frac{0.22(0.78)}{60} + \frac{0.36(0.64)}{120}}$

c. $60(.22) - 120(0.36)$

d. $0.36 - 0.22$

e. $0.22 - 0.36$

44. City R is a large city with 4 million residents, and City S is a smaller city with 0.25 million residents. Researchers believe that the proportion of City S residents who regularly ride bicycles is between 10 percent and 25 percent and the proportion of City R residents who regularly ride bicycles is between 20 percent and 50 percent. Suppose two independent random samples of residents from each city will be taken and the proportion of residents who ride bicycles is recorded. Based on the population proportions of residents who regularly ride bicycles, which of the following sample sizes is large enough to guarantee that the sampling distribution of the difference in sample proportions will be approximately normal?

- a. 30 in City R and 30 in City S
- b. 30 in City R and 60 in City S
- c. 60 in City R and 30 in City S
- d. 50 in City R and 100 in City S
- e. 100 in City R and 50 in City S

45. At a large university, the division of computing services surveyed a random sample of 45 biology majors and 55 business majors from populations of over 1,000 biology and 1,000 business majors. The sampled students were asked how many hours they spend per week using any university computer lab. Let \bar{x}_1 represent the average hours per week spent in any university computer lab by the 45 biology majors, and let \bar{x}_2 represent the average hours per week spent in any university computer lab by the 55 business majors.

Which of the following is the best explanation for why the sampling distribution of $\bar{x}_1 - \bar{x}_2$ can be modeled with a normal distribution?

- a. The two sample standard deviations are assumed to be equal.
- b. The sample sizes are both sufficiently large.
- c. The distributions of the population are normal.
- d. The population standard deviations are assumed equal.
- e. There are at least 30 students in each of the two populations.

46. A large school district held a district-wide track meet for all high school students. For the 2-mile run, the population of female students participating had a mean running time of 8.8 minutes with standard deviation of 3.3 minutes, and the population of male students participating had a mean running time 7.3 minutes with standard deviation of 2.9 minutes. Suppose 8 female students and 8 male students who participated in the 2-mile run are selected at random from each population. Let \bar{x}_F represent the sample mean running time for the female students, and let \bar{x}_M represent the sample mean running time for the male students. What are the mean and standard deviation of the sampling distribution of the difference in sample means $\bar{x}_F - \bar{x}_M$?

- The mean is 0.4, and the standard deviation is 1.42
- The mean is 0.4, and the standard deviation is 4.04
- The mean is 1.5, and the standard deviation is 0.56
- The mean is 1.5, and the standard deviation is 0.88
- The mean is 1.5, and the standard deviation is 1.55

47. Cheryl practices hitting a softball in an indoor stadium by using both an aluminum bat and a composite bat made of carbon fiber and graphite. She records the distance traveled by the ball for each hit. Let \bar{x}_1 represent the average distance traveled by balls hit with the aluminum bat, and let \bar{x}_2 represent the average distance traveled by balls hit with the composite bat. Assume Cheryl's batting practice hits are independent.

Which of the following conditions are sufficient to model the sampling distribution of $\bar{x}_1 - \bar{x}_2$ with a normal distribution?

- There are at least 30 recorded distances traveled for each type of bat.
 - The distribution of distance traveled by the ball is approximately normal for each bat.
 - The total number of distances traveled is at least 60 for the two bats combined.
- a. I only b. II only c. III only d. I and II only e. II and III only

48. A polling agency is investigating the voter support for a ballot measure in an upcoming city election. The agency will select a random sample of 500 voters from one region, Region A, of the city. Assume that the population proportion of voters who would support the ballot measure in Region A is 0.47.

(a) What is the probability that the proportion of voters in the sample of Region A who support the ballot measure is greater than 0.50?

The polling agency will take another sample from a different region, Region B, of the city. The agency plans to select a random sample of 400 voters. Assume that the population proportion of voters who would support the ballot measure in Region B is 0.51.

(b) Describe the sampling distribution of the difference in sample proportions (Region B minus Region A).

(c) What is the probability that the two sample proportions will differ by more than 0.05?

Answer Key:

- | | | |
|-------|-------|-------|
| 1. B | 15. C | 29. C |
| 2. B | 16. D | 30. C |
| 3. A | 17. B | 31. C |
| 4. A | 18. E | 32. A |
| 5. D | 19. C | 33. B |
| 6. B | 20. A | 34. B |
| 7. E | 21. B | 35. B |
| 8. D | 22. A | 36. E |
| 9. B | 23. E | 37. E |
| 10. C | 24. D | |
| 11. B | 25. E | |
| 12. A | 26. C | |
| 13. B | 27. A | |
| 14. D | 28. D | |

38. a. Since this is just one gallon, calculate this first part as a normal distribution with the mean and standard deviation given. $\text{normalcdf}(2.3, 1000, 1.8, 0.4) = .1056$

b. Here, a sample of 10 gallons is taken so the standard deviation will be smaller.

$$\text{normalcdf}(2.3, 1000, 1.8, 0.126) = .00004$$

39. a. $\mu_{\hat{p}} = 0.36$, $\sigma_{\hat{p}} = \sqrt{\frac{0.36(0.64)}{400}} = 0.024$ b. $400(0.36) \geq 10$, $400(0.64) \geq 10$

c. $\text{normalcdf}(0, 0.32, 0.36, 0.024) = 0.048$

40. Sample statistic A provides the best estimate of the parameter. Both statistics A and B appear unbiased, while statistic C appears to be biased (low). In addition, statistic A has lower variability than statistic B. In this situation, we want low bias and low variability, so statistic A is the best choice

41. a. We cannot calculate this probability because we do not know the shape of the distribution of the amount that individual households pay for Internet service.

$\mu_{\bar{x}} = \$28$ and $\sigma_{\bar{x}} = 0.4472$, because there are at least $10(500) = 5000$ households with Internet access.

b.

c. Since the sample size is large (much more than 30), the central limit theorem tells that the sampling distribution of the sample mean is approximately Normal.

d. $\text{Normalcdf}(29, 10000, 28, .4472) = 0.0125$. There is about a 1.25% chance of getting a sample of 500 in which the average amount paid for the Internet is more than \$29.

42. We know that $\mu_{\hat{p}} = p = 0.22$. Since the population size (all children under 6 years old) is much more than

10 times the sample size (300), we know and $\sigma_{\hat{p}} = \sqrt{\frac{0.22(0.78)}{300}} = 0.0239$

Finally, since $np = 300(.22) = 66$ and $n(1-p) = 300(.78) = 234$ are both at least 10, the sampling distribution is approximately Normal. This leads to the probability of more than 20% of the sample being poverty households is 0.7995. ($\text{normalcdf}(.20, 100, .22, 0.0239)$)

43. e 44. d 45. b 46. e 47. D

48.

Part (a)

Normal Approximation approach:

Since $np = 500(0.47) = 235$ and $n(1-p) = 500(0.53) = 265$ are both greater than or equal to 10, the sample size is large enough to ensure that the sampling distribution of the sample proportion, \hat{p} will be approximately normal with mean $\mu_{\hat{p}} = 0.47$ and standard deviation $\sigma_{\hat{p}} = \sqrt{\frac{(0.47)(0.53)}{500}} \approx 0.0223$. Therefore,
 $P(\hat{p} > 0.5) = P\left(z > \frac{0.5-0.47}{0.0223}\right) = P(z > 1.35) \approx 0.089$

The probability that the proportion of voters who support the ballot measure is greater than 0.50 is approximately equal to 0.089.

Binomial approach:

Let the random variable X be the number of voters out of 500 who support the ballot measure in the upcoming election. Random variable X is modeled by a binomial distribution with $n = 500$ and $p = 0.47$

The probability that more than 250 voters (proportion of 0.5) in the sample of Region A who support the ballot measure is $P(X > 250) \approx 0.0825$

Part (b):

Because the samples are independent (selected from different regions) with large sample sizes*, the sampling distribution of $\hat{p}_B - \hat{p}_A$ is approximately normal with mean $\mu_{\hat{p}_B - \hat{p}_A} = 0.51 - 0.47 = 0.04$ and standard deviation $\sigma_{\hat{p}_B - \hat{p}_A} = \sqrt{\frac{(0.47)(0.53)}{500} + \frac{(0.51)(0.49)}{400}} \approx 0.0335$

*Check for large sample size of Region B

$n_B p_B = 400(0.51) = 204$ and $n_B(1-p_B) = 400(0.49) = 196$ are greater than 10.

Part (c):

$$P(|\hat{p}_B - \hat{p}_A| > 0.05) = P\left(z < \frac{-0.05-0.04}{0.0335}\right) + P\left(z > \frac{0.05-0.04}{0.0335}\right) = P(z < -2.69) + P(z > 0.30) \approx 0.0038 + 0.3821 \approx 0.3859$$