Mind on Statistics

Chapter 9

Section 9.1

Questions 1 to 6: In each situation, indicate whether the value given in bold print is a statistic or a parameter.

1. Of 10 students sampled from a class of 200, 8 (**80%**) said they would like the school library to have longer hours.
   A. Statistic
   B. Parameter

KEY: A

2. **75%** of all students at a school are in favor of more bicycle parking spaces on campus.
   A. Statistic
   B. Parameter

KEY: B

3. Dyscalculia is a learning disability involving innate difficulty in learning or comprehending mathematics. It is akin to dyslexia and can include confusion about math symbols. Dyscalculia can also occur as the result of some types of brain injury. Dyscalculia occurs in people across the whole IQ range and affects roughly **5%** of all Americans.
   A. Statistic
   B. Parameter

KEY: B

4. A customs inspector sampled 5 boxes among 20 boxes being shipped from out of the country. He found that one of the five boxes (**20%**) contained an illegal food item.
   A. Statistic
   B. Parameter

KEY: A

5. Based on the 2000 Census, **39.5%** of the California population of residents who are over 5 years old speak languages other than English at home.
   A. Statistic
   B. Parameter

KEY: B

6. A 2009 US study found the average age of formal autism diagnosis was **5.7** years, far above the recommended age of 30 months, and that 27% of children remained undiagnosed at age 8 years.
   A. Statistic
   B. Parameter

KEY: A

7. Statistic is to sample as parameter is to
   A. population.
   B. sample size.
   C. mean.
   D. estimate.

KEY: A

Questions 8 to 11: In each situation, indicate whether it would make more sense to find a confidence interval for the population parameter or to conduct a hypothesis test for a specific null value.

8. The school board wishes to find out if the newly adapted teaching method for K-5 math has resulted in higher average grades.
   A. Confidence interval
   B. Hypothesis test

KEY: B

9. A consumer agency wishes to find out how much more private hospitals and medical clinics charge for certain procedures than the large (research) hospitals.
   A. Confidence interval
   B. Hypothesis test

KEY: A

10. A weight-loss clinic wishes to determine if a certain popular diet actually results in weight-loss.
    A. Confidence interval
    B. Hypothesis test

KEY: B

11. A weight-loss clinic wishes to determine how much more weight patients lose when they add both diet and exercise to their daily routines compared to when they just diet.
    A. Confidence interval
    B. Hypothesis test

KEY: A

Questions 12 to 14: In each situation, indicate whether it would make more sense to find a confidence interval for the population parameter or to conduct a hypothesis test for a specific null value. If your answer is "a hypothesis test," specify the null value that you would test.

12. Dyslexia is a broad term defining a learning disability that impairs a person's ability to read, speak, and spell. It is believed that dyslexia can affect between 5 to 10 percent of the population although there have been no studies to indicate an accurate percentage.

KEY: Confidence interval

13. The University of Wisconsin is conducting a study to determine if the average salary of college lecturers in the natural sciences is higher than that of lecturers in the social sciences.

KEY: Hypothesis test; the null value would be a difference in two population means of 0 (zero).

14. A high school teacher is interested to know if students who take a foreign language will get higher grades if their final exam is an oral exam instead of a written exam. The following year he asks all of the Spanish teachers to give their students an oral exam at the end of the course. The average exam score in the previous years was 68 (out of a possible 100 points).

KEY: Hypothesis test; the null value would be a mean score of 68.

15. Explain what the term "statistical significance" means in hypothesis testing.

KEY: A result is statistically significant if it is unlikely that chance alone can explain the observed results.

Questions 16 and 17: According to a recent survey, teenagers who eat with their families at least five times a week are more likely to get better grades in school and much less likely to have substance abuse problems. Two groups of teenagers were studied: those who eat with their families at least five times a week and those who don't. The difference in school grades and the difference in likelihood to have substance abuse problems were both found to be statistically significant.

16. What would have been the null value in this scenario for the difference in school grades between the two groups?

KEY: The null value would be 0 (zero) stating that there is *no difference* between the two groups.

17. When comparing the likelihood to have substance abuse problems between the two groups, what does *statistical significance* mean?

KEY: The null value would be 0 (zero) stating that there is no difference between the two groups. Statistical significance then means that based on the data collected *no difference* does not seem plausible. Based on the observed difference in the sample, it would be hard to believe that no difference exists. The researchers rejected the idea of *no difference*.

Questions 18 and 19: Contradicting some previous research, a new study finds that frequent use of painkillers does not substantially increase a healthy man's risk of developing hypertension.

18. What would have been the null value in this scenario for the difference in proportions of men who developed hypertension (frequently use painkiller – not frequently use painkiller)?

KEY: The null value would be 0 (zero) stating that there is *no difference* in proportions between the two groups.

19. The study finds that the observed difference between the two groups was not statistically significant. Explain in your own words what that means.

KEY: The sample proportions of men that developed hypertension may actually have been (slightly) different between the two groups, but the relative size of this difference was not large enough to convince us that this may indicate a difference in the population. The (small) difference that was observed was a difference that is observed rather often, if indeed there is no difference between the two groups.

Section 9.2

Questions 20 to 27: For each study, decide if the two samples are independent samples or paired samples.

20. A group of 50 students each measured the length of their right arm and the length of their left arm. The average right arm lengths were compared to the average left arm lengths.
    A. Independent samples
    B. Paired samples

KEY: B

21. A study compared the average number of courses taken by a random sample of 100 freshmen at a university with the average number of courses taken by a separate random sample of 50 freshmen at a community college.
    A. Independent samples
    B. Paired samples

KEY: A

22. A group of 100 students were randomly assigned to receive vitamin C (50 students) or a placebo (50 students). The groups were followed for 2 weeks and the proportions of students with colds were compared.
    A. Independent samples
    B. Paired samples

KEY: A

23. A group of 50 students had their blood pressures measured before and after watching a movie containing violence. The mean blood pressure before the movie was compared with the mean pressure after the movie.
    A. Independent samples
    B. Paired samples

KEY: B

24. In a random sample of 100 students (60 women and 40 men), the average hours of sleep during finals week were compared.
    A. Independent samples
    B. Paired samples

KEY: A

25. In a random sample of 100 students, the change in hours of sleep for each student during and after finals week were compared.
    A. Independent samples
    B. Paired samples

KEY: B

26. A random sample of high school seniors is asked how often (times per week) they eat at a fast-food restaurant. A year later, when the students are freshmen in college, they are asked the same question. The frequencies during the senior year of high school and the freshman year in college are compared.
    A. Independent samples
    B. Paired samples

KEY: B

27. In an experiment, students taking French are randomly divided into two groups. Half of the students first take a written exam and a week later an oral exam. The other half of the students take the exams in reverse order. The grades of the oral exam were then compared to the grades of the written exam.
    A. Independent samples
    B. Paired samples

KEY: B

28. Which one of the following ways of collecting data would *not* result in paired data?
    A. Each person is measured twice.
    B. Similar individuals are paired prior to an experiment. Each individual in a pair receives a different treatment.
    C. Two different variables are measured for each person.
    D. Two independent samples are selected and the same response variable is compared between samples.

KEY: D

29. Which of the following is an example of paired data?
    A. A random sample of students is asked how much money they made during the past summer. Results for males and females are compared.
    B. A randomized experiment is done in which volunteers who want to lose weight are randomly assigned to either follow a specified diet or participate in an exercise program for 6 months. At the end of the study the two groups are compared to see which one had a higher proportion of people drop out of the study.
    C. An observational study is conducted on a random sample of married couples to compare the average number of hours worked per week for the husband and the wife.
    D. A random sample of students is asked on the first day of the quarter how many hours they slept the night before. The question is repeated for a new random sample of students on the first day of finals week.

KEY: C

30. Which of the following is an example of a difference in two proportions based on independent samples?
    A. A random sample of 1000 voters is asked who they plan to vote for in the upcoming election. The difference is found between the proportion of voters who plan to vote for the Republican candidate and the proportion of voters who plan to vote for the Democratic candidate.
    B. Each student in a random sample of 500 sophomores and a random sample of 500 seniors is asked what proportion of classes he or she skips in a typical quarter. The difference in the average responses for the two groups is found.
    C. A random sample of 800 adults in the US in 1999 was asked if they support the legalization of marijuana, and another random sample of 800 adults was asked the same question is 2009. The difference in the proportions of adults who supported it in 1999 and 2009 is found.
    D. None of the above is an example of a difference in two proportions based on independent samples.

KEY: C

Questions 31 and 32: Many undergraduate students are thinking about getting a graduate degree. Do male and female students have equal opinions about this? A survey of undergraduate students at public universities in the state of California revealed the following results: Out of 265 female students, 131 were seriously thinking about applying to graduate school. Out of 233 male students, 130 were seriously thinking about applying to graduate school. We wish to compare the proportions of male and female students who are thinking about getting a graduate degree by calculating a confidence interval for the difference between males and females.

31. What is the correct notation for the parameter that is estimated by the confidence interval?
    A. $\mu_1 - \mu_2$
    B. $\bar{x}_1 - \bar{x}_2$
    C. $p_1 - p_2$
    D. $\hat{p}_1 - \hat{p}_2$

KEY: C

32. What is the correct notation for the difference $\frac{130}{233} - \frac{131}{265}$?
    A. $\mu_1 - \mu_2$
    B. $\bar{x}_1 - \bar{x}_2$
    C. $p_1 - p_2$
    D. $\hat{p}_1 - \hat{p}_2$

KEY: D

Questions 33 and 34: A Statistics instructor asked a random sample of female and male students how many hours they exercise each week. Minitab output for a comparison of females and males is shown below.

```
Gender      N   Mean      StDev   SE Mean
female    129   6.16       4.18      0.37
male       73   6.42       4.39      0.51

Difference = mu (female) - mu (male )
Estimate for difference: -0.262
95% CI for difference: (-1.511, 0.988)
```

33. This is an example of data collected using
    A. paired data.
    B. independent samples.
    C. a binomial experiment.
    D. matched pairs.

KEY: B

34. What is the correct notation for the parameter that is estimated by the confidence interval given in the output?
    A. p
    B. $p_1 - p_2$
    C. μ
    D. $\mu_1 - \mu_2$

KEY: D

35. Which statement is true about p and $\hat{p}$?
    A. They are both parameters.
    B. They are both statistics.
    C. p is a parameter and $\hat{p}$ is a statistic.
    D. $\hat{p}$ is a parameter and p is a statistic.

KEY: C

36. Which statement is true about $\bar{x}$ and $\hat{p}$?
    A. They are both parameters.
    B. They are both statistics.
    C. $\bar{x}$ is a parameter and $\hat{p}$ is a statistic.
    D. $\hat{p}$ is a parameter and $\bar{x}$ is a statistic.

KEY: B

37. Suppose that a polling organization surveys n = 400 people about whether they think the federal government should give financial aid to the airlines to help them avoid bankruptcy. In the poll, 300 people say that the government should provide aid to the airlines. Which choice gives the correct notation and value for the sample proportion in this survey?
    A. $\hat{p}$ = 0.30
    B. p = 0.30
    C. $\hat{p}$ = 0.75
    D. p =0.75

KEY: C

38. Suppose we select a random sample of n = 100 students and find that the proportion of students who said they believe in love at first sight is 0.43. Which statement is *not* necessarily true?
   A. There were 43 students in the sample who said they believe in love at first sight.
   B. Based on the information provided by the sample, we cannot determine exactly what proportion of the population would say they believe in love at first sight.
   C. $\hat{p}$ = 0.43
   D. p = 0.43

KEY: D

39. Explain what the difference between a parameter and a statistic is. Give an example of each.

KEY: A parameter is a characteristic of a population; a statistic is a characteristic of a sample. An example of a parameter would be the proportion of all students who will vote for a particular candidate for student body president. An example of a statistic is the proportion of students in a sample who will vote for the candidate.

40. Suppose you decide to use the 40 students in your Introduction to Philosophy course as a (convenience) sample. You wish to find out more about students' attitudes toward female priests. You decide to compare the proportion of girls who support the idea of a female priest with the proportion of boys. Define the parameter of interest and give the correct notation.

KEY: The parameter of interest is the difference between the proportion girls who support the idea of a female priest and he proportion boys who support the idea of a female priest. The correct notation for this difference is $p_{\text{girl}} - p_{\text{boy}}$ or $p_1 - p_2$.

Section 9.3

41. Which of the following statements is correct about a parameter and a statistic associated with repeated random samples of the same size from the same population?
    A. Values of a parameter will vary from sample to sample but values of a statistic will not.
    B. Values of both a parameter and a statistic may vary from sample to sample.
    C. Values of a parameter will vary according to the sampling distribution for that parameter.
    D. Values of a statistic will vary according to the sampling distribution for that statistic.

KEY: D

42. When a random sample is to be taken from a population and a statistic is to be computed, the statistic can also be thought of as
    A. a parameter.
    B. a random variable.
    C. a standard error.
    D. a sample.

KEY: B

43. Which of the following statements best describes the relationship between a parameter and a statistic?
    A. A parameter has a sampling distribution with the statistic as its mean.
    B. A parameter has a sampling distribution that can be used to determine what values the statistic is likely to have in repeated samples.
    C. A parameter is used to estimate a statistic.
    D. A statistic is used to estimate a parameter.

KEY: D

44. Which one of the following statements is *false*?
    A. The standard error measures the variability of a population parameter.
    B. The standard error of a sample statistic measures, roughly, the average difference between the values of the statistic and the population parameter.
    C. Assuming a fixed value of s = sample standard deviation, the standard error of the mean decreases as the sample size increases.
    D. The standard error of a sample proportion decreases as the sample size increases.

KEY: A

45. Which one of the following statements is *false*?
    A. A sampling distribution is the probability distribution of a sample statistic. It describes how values of a sample statistic vary across all possible random samples of a specific size that can be taken from a population.
    B. For all five scenarios considered, the sampling distribution is approximately normal as long as the sample size(s) are large enough.
    C. The mean value of a sampling distribution is the mean value of a sample statistic over all possible random samples. For the five scenarios, this mean equals the value of the statistic.
    D. The standard deviation of a sampling distribution measures the variation between all possible values of the sample statistic and their mean over all possible random samples. For the five scenarios, this mean equals the value of the parameter.

KEY: C

Questions 46 and 47: A comparison is to be made between the proportion of second graders that cannot read at second grade level and the proportion of third graders that cannot read at second grade level. School records from schools across the state are collected and records for 123 second graders and 146 third graders are randomly selected. Of the sampled second graders, 25 seem to be not reading at second grade level. Of the sample third graders, 26 do not read at second grade level.

46. What is the correct notation for the difference $\frac{25}{123} - \frac{26}{146}$?
    - A. $\mu_1 - \mu_2$
    - B. $\bar{x}_1 - \bar{x}_2$
    - C. $p_1 - p_2$
    - D. $\hat{p}_1 - \hat{p}_2$

KEY: D

47. We know that if the sampling procedure were repeated, we would probably not observe 25/123 and 26/146 students who cannot read at second grade level again. What is the mean of the sampling distribution of the difference between the two proportions based on 123 second graders and 146 third graders?
    - A. $p_1 - p_2$
    - B. $\hat{p}_1 - \hat{p}_2$
    - C. 146 – 123
    - D. 0

KEY: A

Questions 48 and 49: We wish to conduct a hypothesis test to determine if, on average, the mother in a family spends more time doing house work per week than the father, for families where both parents have a full time job.

48. What is the correct notation for the parameter of interest?
    - A. $\mu_1 - \mu_2$
    - B. μ_d
    - C. $\bar{x}_1 - \bar{x}_2$
    - D. $\bar{d}$

KEY: B

49. Suppose that in reality, mothers and fathers spend an equal amount of time, on average, doing housework each week. What would be the mean of the sampling distribution of the sample mean difference in time, based on random samples taken from the population under study (mothers and fathers from families where both parents have a full time job)?
    - A. $\mu_1 - \mu_2$
    - B. μ_d
    - C. $\bar{d}$
    - D. 0

KEY: D

50. Explain what the “sampling distribution of a statistic” means (or give an example).

KEY: The sampling distribution of a statistic is the distribution of possible values of a statistic for repeated samples of the same size from a population.

Section 9.4

51. If the sample size (n) is large, and the sample is a random sample, then the distribution of the sample proportion $\hat{p}$ is approximately a
    A. binomial distribution.
    B. uniform distribution.
    C. normal distribution.
    D. none of the above.

KEY: C

52. For which of the following situations would the Rule for Sample Proportions *not* apply?
    A. A random sample of 100 is taken from a population in which the proportion with the trait of interest is 0.98.
    B. A random sample of 50 is taken from a population in which the proportion with the trait of interest is 0.50.
    C. A binomial experiment is done with n = 500 and p = 0.9.
    D. The Rule for Sample Proportions would apply in all of the situations in A, B and C.

KEY: A

53. If the size of a sample randomly selected sample from a population is increased from n = 100 to n = 400, then the standard deviation of $\hat{p}$ will
    A. remain the same.
    B. increase by a factor of 4.
    C. decrease by a factor of 4.
    D. decrease by a factor of 2.

KEY: D

54. The mean of the sampling distribution for a sample proportion depends on the value(s) of
    A. the true population proportion but not the sample size.
    B. the sample size but not the true population proportion.
    C. the sample size and the true population proportion.
    D. neither the sample size nor the true population proportion.

KEY: A

55. Which of the following statements is true about the standard deviation of $\hat{p}$?
    A. It increases as the sample size n increases.
    B. It decreases as the sample size n increases.
    C. It does not change as the sample size n increases.
    D. It changes each time a new sample is drawn.

KEY: B

56. Sleep apnea is a condition involving irregular breathing during sleep. Suppose that 20% of a population of men experience sleep apnea. A random sample of n = 64 men is to be drawn from this population. What is the mean of the sampling distribution for the sample proportion of men who experience sleep apnea?
    A. 20/64
    B. 0.20
    C. 0.80
    D. It depends on the value of the sample proportion.

KEY: B

57. Suppose that 20% of a random sample of n = 64 men are currently single. What is the standard error of the proportion of single men in the sample?
    A. 0.125
    B. 0.05
    C. 0.10
    D. 0.20

KEY: B

58. In a random sample of 1000 students, 80% were in favor of longer hours at the school library. What is the standard error of the sample proportion?
    A. 0.013
    B. 0.160
    C. 0.640.
    D. 0.800

KEY: A

Questions 59 to 61: A television station plans to ask a random sample of 400 city residents if they can name the news anchor on the evening news at their station. They plan to fire the news anchor if fewer than 10% of the residents in the sample can do so. Suppose that in fact 12% of city residents could name the anchor if asked.

59. What is the mean of the sampling distribution for the sample proportion of city residents who can name the news anchor on the evening news at their station?
    A. 400
    B. 0.10
    C. 0.12
    D. 48

KEY: C

60. What is the standard deviation of the sampling distribution for the sample proportion of city residents who can name the news anchor on the evening news at their station?
    A. 0.015
    B. 0.0162
    C. 0.1056
    D. 0.12

KEY: B

61. What is the approximate probability that the anchor will be fired?
    A. 0.02
    B. 1.23
    C. 0.11
    D. 0.89

KEY: C

Questions 62 to 64: Based on the 2000 Census, 31.8% of grandparents in California are the primary caregivers for their grandchildren. Suppose n = 1000 grandparents are to be sampled from this population and the sample proportion of grandparents as primary caregivers ($\hat{p}$) is to be calculated.

62. What is the mean of the sampling distribution of $\hat{p}$?
    A. 0.0002
    B. 0.0147
    C. 0.2169
    D. 0.3180
KEY: D

63. What is the standard deviation of the sampling distribution of $\hat{p}$?
    A. 0.0002
    B. 0.0147
    C. 0.2169
    D. 0.3180
KEY: B

64. What is the approximate probability that they find less than 30% primary caregivers in the sample?
    A. 0.1112
    B. 0.1075
    C. 0.8888
    D. 0.0147
KEY: A

Questions 65 to 67: Based on the 2000 Census, the proportion of the California population aged 15 years old or older who are married is p = 0.524. Suppose n = 1000 persons are to be sampled from this population and the sample proportion of married persons ($\hat{p}$) is to be calculated.

65. What is the mean of the sampling distribution of $\hat{p}$?
    A. 0.0158
    B. 0.0166
    C. 0.2494
    D. 0.5240
KEY: D

66. What is the standard deviation of the sampling distribution of $\hat{p}$?
    A. 0.0158
    B. 0.0166
    C. 0.2494
    D. 0.5240
KEY: A

67. What is the approximate probability that less than 50% of the people in the sample are married?
    A. 0.0158
    B. 0.0645
    C. 0.5240
    D. 0.9355
KEY: B

Questions 68 to 70: Every student taking elementary statistics at a large university (1,100 students) participated in a class project by rolling a 6-sided die 100 times. Each individual student determined the *proportion* of his or her 100 rolls for which the result was a "1". The instructor plans to draw a histogram of the 1,100 sample proportions.

68. What will be the approximate shape of this histogram?
    A. Skewed
    B. Uniform
    C. Normal (bell-shaped)
    D. Chi-square

KEY: C

69. What will be the approximate mean for the 1,100 sample proportions?
    A. 1/100
    B. 1/6
    C. 6/100
    D. 6

KEY: B

70. What will be the approximate standard deviation for the 1,100 sample proportions?
    A. $\sqrt{\dfrac{(1/6)(5/6)}{1{,}100}}$
    B. $\sqrt{\dfrac{(1/6)(5/6)}{100}}$
    C. $\sqrt{\dfrac{(1/100)(99/100)}{1{,}100}}$
    D. $\sqrt{\dfrac{(1/100)(99/100)}{100}}$

KEY: B

71. Five hundred (500) random samples of size $n = 900$ are taken from a large population in which 10% of the subjects are left-handed. The proportion of subjects in the sample that is left-handed is found for each sample and a histogram of these 500 proportions is drawn. Which interval covers the range into which about 68% of the values in the histogram will fall?
    A. 0.1 ± 0.010
    B. 0.1 ± 0.0134
    C. 0.1 ± 0.0167
    D. 0.1 ± 0.020

KEY: A

Questions 72 to 74: Let p denote the proportion of adults in major minority groups in the US who read an ethnic newspaper at least several times per week. According to the nonprofit organization New California Media the true value of p is 45 percent. We decide to take SRS of 200 adults in major minority groups and calculate $\hat{p}$, the sample proportion of adults who read an ethnic newspaper at least several times per week.

72. What is the mean of the sampling distribution of $\hat{p}$?
KEY: 45% (= 0.45)

73. What is the standard deviation of the sampling distribution of $\hat{p}$?
KEY: 0.0352

74. What is the approximate probability that more than half the adults in the sample read an ethnic newspaper at least several times per week?
KEY: 0.0777

Questions 75 to 80: In a pond with a large population of turtles, the percent of three different types of turtles are presented in the table below.

Type of Turtle	Percentage
Chicken Turtle	30%
Spotted Turtle	50%
Snapping Turtle	20%

A random sample of 100 turtles is taken from the pond.

75. What is the standard deviation for the sample proportion of chicken turtles?
KEY: 0.0458

76. What is the standard deviation for the sample proportion of spotted turtles?
KEY: 0.050

77. What is the standard deviation for the sample proportion of snapping turtles?
KEY: 0.040

78. What is the approximate probability that the sample proportion of chicken turtles is lower than 0.25?
KEY: 0.1376

79. What is the approximate probability that the sample proportion of spotted turtles falls between 45% and 55%?
KEY: 0.8413 − 0.1587 = 0.6826 or about 68% by the empirical rule

80. What is the approximate probability that the sample proportion of snapping turtles is higher than 0.25?
KEY: 0.1056

Questions 81 to 83: Data is to be gathered to estimate the proportion of residents who will vote for Mr. Treehouse in the coming city elections. A random sample of 650 voters is interviewed and 306 of them say that they will support Mr. Treehouse.

81. What is the sample proportion of residents who will vote for Mr. Treehouse in the coming city elections?
KEY: 0.4708

82. What is the standard error of the sample proportion?
KEY: 0.0196

83. Use the Empirical Rule to find values that fill in the blanks in the following sentence: In about 95% of all randomly selected samples of n = 650 voters, we would estimate the population proportion of all residents who will vote for Mr. Treehouse in the coming city elections to be between _____ and _____.
KEY: 0.4316 and 0.5100

Questions 84 to 86: Data collected over several years shows that of all patients that come to the doctor's office with a sore throat, 6% of them have a contagious virus. The next 188 patients with a sore throat are tested for this virus.

84. What is the mean of the sampling distribution of $\hat{p}$, the sample proportion of patients with a sore throat who have the virus?
KEY: 0.06

85. What is the standard deviation of the sampling distribution of $\hat{p}$?
KEY: 0.0173

86. What is the probability that more than 11% of these 188 patients have the virus?
KEY: 0.0019

Section 9.5

87. Suppose that the mean of the sampling distribution for the difference in two sample proportions is 0. This tells us that
    A. The two sample proportions are both 0.
    B. The two sample proportions are equal to each other.
    C. The two population proportions are both 0.
    D. The two population proportions are equal to each other.

KEY: D

Questions 88 and 89: In a random sample of 50 men, 40% said they preferred to walk up stairs rather than take the elevator. In a random sample of 40 women, 50% said they preferred the stairs. The difference between the two sample proportions (men – women) is to be calculated.

88. Which of the following choices correctly denotes the difference between the two sample proportions that is to be calculated?
    A. $p_1 - p_2 = 0.10$
    B. $\hat{p}_1 - \hat{p}_2 = 0.10$
    C. $p_1 - p_2 = -0.10$
    D. $\hat{p}_1 - \hat{p}_2 = -0.10$

KEY: D

89. What is the standard error for the difference between the two sample proportions?
    A. 0.0111
    B. 0.0972
    C. 0.1051
    D. 0.1160

KEY: C

Questions 90 and 91: In a random sample of 250 full time students, 80% preferred to have three one-hour lectures per week rather than two 90-minute lectures. In a random sample of 500 part-time students, 50% said they preferred the three one-hour lectures schedule. The difference between the two sample proportions (full-time – part-time) is to be calculated.

90. Which of the following choices correctly denotes the difference between the two sample proportions that is to be calculated?
    A. $p_1 - p_2 = 0.30$
    B. $p_1 - p_2 = -0.30$
    C. $\hat{p}_1 - \hat{p}_2 = 0.30$
    D. $\hat{p}_1 - \hat{p}_2 = -0.30$

KEY: C

91. What is the standard error for the difference between the two sample proportions?
    A. 0.0011
    B. 0.0338
    C. 0.0553
    D. 0.6000

KEY: B

Questions 92 to 94: A new study finds that frequent use of painkillers does not substantially increase a healthy man's risk of developing hypertension (high blood pressure). In other words, the proportion of healthy men with hypertension is the same for those who use painkillers frequently and those who don't. According to the American Heart Association, 1 in 3 American adults have hypertension.

92. Which of the following choices correctly denotes the difference between the proportions of men with hypertension (frequent use of painkillers – not frequent use of painkillers)?
    A. $p_1 - p_2 = 1/3$
    B. $p_1 - p_2 = 0$
    C. $\hat{p}_1 - \hat{p}_2 = 1/3$
    D. None of the above.

KEY: B

93. Suppose random samples of 200 men who use painkillers frequently and 200 men who don't are to be selected. What is the standard deviation for the difference between the two sample proportions?
    A. 0
    B. 0.0333
    C. 0.0471
    D. 0.5773

KEY: C

94. Suppose random samples of 200 men who use painkillers frequently and 200 men who don't are to be selected. What is probability that the difference between the two sample proportions (frequent use of painkillers – not frequent use of painkillers) is greater than 10 percentage points (0.10)?
    A. 0.0013
    B. 0.0169
    C. 0.0337
    D. 0.9999

KEY: B

Questions 95 to 97: At a small college somewhere on the East coast, 20% of the girls and 30% of the boys smoke at least once a week. Independent random samples of 75 girls and 100 boys are to be selected and the proportions of smokers in the samples are to be calculated.

95. What is the mean of the sampling distribution of the difference in the sample proportion of girl smokers and the sample proportion of boy smokers?

KEY: –0.10

96. What is the standard deviation of the sampling distribution of the difference in the sample proportion of girl smokers and the sample proportion of boy smokers?

KEY: 0.0651

97. What is probability that the sample proportion of girl smokers is greater than the sample proportion of boy smokers?

KEY: 0.0623

Questions 98 and 99: In the Youth Risk Behavior Survey (a study of public high school students), a random sample showed that 45 of 675 girls and 103 of 621 boys had been in a physical fight on school property one or more times during the past 12 months.

98. What is the difference in sample proportions of students who had been in a fight (boys – girls)?

KEY: 0.0992.

99. What is the standard error of the difference in sample proportions?

KEY: 0.0177

Questions 100 to 102: Suppose that 60% of all teenagers — both boys and girls — are classified as having good grades. Independent random samples of 537 boys and 689 girls who go to school in the Washington, DC, area are to be selected and surveyed and the proportions of teenagers with good grades are to be calculated.

100. What is the mean of the sampling distribution of the difference between the two sample proportions (boys – girls)?

KEY: 0

101. What is the standard deviation of the sampling distribution of the difference between the two sample proportions (boys – girls)?

KEY: 0.0282

102. What is the probability that the difference between the two sample proportions (boys – girls) is greater than 5 percentage points (0.05)?

KEY: 0.0381

Questions 103 to 105: Suppose that 80% of all English majors and 85% of all engineering majors at a Minnesota college wear winter boots when there is snow on the ground. Two independent random samples of 40 English majors and 60 engineering majors are to be selected during a day with snow on the ground and the proportions of students with winter boots are to be calculated.

103. What is the mean of the sampling distribution of the difference between the two sample proportions (English majors – engineering majors)?

KEY: −0.05

104. What is the standard deviation of the sampling distribution of the difference between the two sample proportions (English majors – engineering majors)?

KEY: 0.0783

105. What is the probability that more English majors than engineering majors in the sample wear winter boots?

KEY: 0.2616

Section 9.6

106. For which of the following situations would the Rule for Sample Means *not* apply?
   A. A random sample of size 20 is drawn from a skewed population.
   B. A random sample of size 50 is drawn from a skewed population.
   C. A random sample of size 20 is drawn from a bell-shaped population.
   D. A random sample of size 50 is drawn from a bell-shaped population.

KEY: A

107. Which one of the following statements is *false*?
   A. The sampling distribution of any statistic becomes approximately normal for large sample sizes.
   B. The sampling distribution of the sample mean becomes approximately normal for large sample sizes.
   C. The sampling distribution of the sample mean is exactly normal if the observations are normally distributed.
   D. The standard deviation of the sample mean decreases as the sample size increases.

KEY: A

108. Which of the following statements is true about the standard deviation of $\bar{x}$?
   A. It decreases as the sample size *n* increases.
   B. It increases as the sample size *n* increases.
   C. It does not change as the sample size *n* increases.
   D. It changes each time a new sample is drawn.

KEY: A

109. The standard deviation of the sampling distribution for a sample mean depends on the value(s) of
   A. the sample size and the population standard deviation.
   B. the sample size but not the population standard deviation.
   C. the population standard deviation but not the sample size
   D. neither the sample size nor the population standard deviation.

KEY: A

110. For results based on a small random sample from a bell-shaped distribution, the distribution of the sample mean is
   A. not a bell-shaped distribution.
   B. approximately a normal distribution.
   C. approximately a standard normal (*z*-score) distribution.
   D. a uniform distribution.

KEY: B

111. Heights for women are bell-shaped with a mean of 65 inches and standard deviation of 2.5 inches. If a random sample of 25 women is taken, what is the mean of the sampling distribution of $\bar{x}$?
   A. 2.5 inches
   B. 2.5/5 = 0.5 inches
   C. 65 inches
   D. It depends on the value of the sample mean.

KEY: C

112. Heights for women are bell-shaped with a mean of 65 inches and standard deviation of 2.5 inches. If a random sample of 25 women is taken, what is the standard deviation of the sampling distribution of $\bar{x}$?
   A. 2.5 inches
   B. 2.5/5 = 0.5 inches
   C. It depends on the value of the sample mean.
   D. It depends on the value of the sample standard deviation.

KEY: B

113. Heights for a sample of n = 4 women are measured. For the sample, the mean is 64 inches and the standard deviation is 3 inches. What is the standard error of the mean?
   A. 3/8
   B. 0.75
   C. 1.5
   D. 3

KEY: C

114. For a random sample of 10 men, the mean head circumference is $\bar{x}$ = 57.3 cm and the sample standard deviation is s = 2 cm. What is the standard error of the mean?
   A. 0.200
   B. 0.447
   C. 0.500
   D. 0.632

KEY: D

115. For a random sample of 9 women, the average resting pulse rate is $\bar{x}$ = 76 beats per minute, and the sample standard deviation is s = 5. What is the standard error of the mean?
   A. 0.557
   B. 0.745
   C. 1.667
   D. 2.778

KEY: C

116. For a random sample of 40 students, the average statistics midterm score is 73 point (out of a possible 100 points). The standard deviation in the sample was 7.3. What is the standard error of the mean?
   A. 0.183
   B. 1.154
   C. 1.332
   D. 0.100

KEY: B

117. For n = 203 students, the output below gives a summary of responses to “How long did you sleep last night?” Based on the output, what value estimates roughly, for samples of this size, the average difference between the sample mean and the population mean?

Variable	N	Mean	StDev	SE Mean
Sleep	203	6.42	1.56	0.11

A. 6.42
B. 1.56
C. 0.11
D. $\frac{1}{\sqrt{203}}$

KEY: C

118. Consider a random sample with sample mean $\bar{x}$. If the sample size is increased from n = 40 to n = 360, then the standard deviation of $\bar{x}$ will

A. remain the same.
B. increase by a factor of 9 (will be multiplied by 9).
C. decrease by a factor of 9 (will be multiplied by 1/9).
D. decrease by a factor of 3 (will be multiplied by 1/3).

KEY: D

119. A store manager is trying to decide whether to price oranges by weight, with a fixed cost per pound, or by the piece, with a fixed cost per orange. He is concerned that customers will choose the largest ones if there is a fixed price per orange. For one week the oranges are priced by the piece rather than by weight, and during this time the mean weight of the oranges purchased is recorded for all customers who buy 4 of them. The manager knows the population of weights of individual oranges is bell-shaped with mean of 8 ounces and a standard deviation of 1.6 ounces. If the 4 oranges each customer chooses are equivalent to a random sample, what should be the approximate mean and standard deviation of the distribution of the mean weight of 4 oranges?

A. mean = 32 ounces, standard deviation = 6.2 ounces
B. mean = 8 ounces, standard deviation = 1.6 ounces
C. mean = 8 ounces, standard deviation = 0.8 ounces
D. mean = 2 ounces, standard deviation = 0.4 ounces

KEY: C

120. Test scores for a standardized math test follow a normal distribution with a mean of 73 and a standard deviation of 8. A random sample of 23 students took this math test. What is the probability that the average score of the 23 students falls above 75?

A. < 0.0001
B. 0.1151
C. 0.4013
D. 0.8849

KEY: B

121. In the population of male students, motivation scores follow a normal distribution with an average of 32.4 and a standard deviation of 7. A random sample of 16 male students is to be taken. They are all asked to answer the motivation questionnaire so that their motivation scores can be determined. What is the probability that the sample mean score will exceed 35?

A. < 0.0001
B. 0.0681
C. 0.1977
D. 0.3557

KEY: B

Questions 122 to 124: Exam scores for a large introductory statistics class follow an approximate normal distribution with an average score of 56 and a standard deviation of 5. The average exam score in your lab was 59.5. The 20 students in your lab sections will be considered a random sample of all students who take this class.

122. What is the expected value of the average exam score of the 20 students in your lab section?
   A. 5
   B. 20
   C. 56
   D. 59.5

KEY: C

123. What is the standard deviation of the distribution of the average exam score of the 20 students in your lab section?
   A. 0.25
   B. 1.12
   C. 1.25
   D. 5

KEY: B

124. What is the probability that the average score of a random sample of 20 students exceeds 59.5?
   A. < 0.0001
   B. 0.0009
   C. 0.0026
   D. 0.2420

KEY: B

Questions 125 and 126: In the population of female students, motivation scores follow a normal distribution with an average of 29 and a standard deviation of 4.3. A random sample of female students is to be taken. They are all asked to answer the motivation questionnaire so that their motivation scores can be determined.

125. If the sample size is 20, what is the probability that the mean score of the female students in the sample will fall below 27?
   A. < 0.0001
   B. 0.0005
   C. 0.0188
   D. 0.3192

KEY: C

126. If the sample size is 50, what is the probability that the mean score of the female students in the sample will fall below 27?
   A. < 0.0001
   B. 0.0005
   C. 0.0188
   D. 0.3192

KEY: B

Questions 127 to 129: Management of an airline uses a normal distribution to model the value claimed for a lost piece of luggage on domestic flights. The mean of the distribution is $600 and the standard deviation is $85. Suppose a random sample of 65 pieces of luggage is to be selected.

127. What is the expected value of the average claimed value of the 65 pieces of lost luggage?
KEY: $600

128. What is the standard deviation of the sampling distribution of the sample mean claimed value of the 65 pieces of lost luggage?
KEY: $10.54

129. What is the probability that the average claimed value of the 65 pieces is over $625?
KEY: 0.0088

Questions 130 to 132: The level of nitrogen oxides (NOX) in the exhaust of a particular car model can be modeled by the normal distribution with mean 0.9 grams per mile and standard deviation of 0.16 grams per mile. A random sample of 4 of these NOX levels is to be selected.

130. What is the probability that the NOX level of the first car in the sample is greater than 1 gram per mile?
KEY: 0.2660

131. What is the probability that the NOX level of all 4 cars in the sample is greater than 1 gram per mile?
KEY: 0.005

132. What is the probability that the average NOX level of the 4 selected cars is greater than 1 gram per mile?
KEY: 0.1056

Questions 133 to 135: Items produced by a certain process are supposed to weigh 90 grams. However, the process is such that there is variability in the items produced and they do not all weigh exactly 90 grams. The distribution of weights is normal with a mean of 89.8 grams and a standard deviation of 1.1 gram.

133. Suppose we sample one of these items. What is the probability that it weighs more than 91 grams?
KEY: 0.1377

134. Suppose we have a random sample of 2 of these items. What is the probability that both these items weigh more than 91 grams?
KEY: 0.0190

135. If we have a random sample of 10 of these items, what is the probability that their average weight exceeds 91 grams?
KEY: 0.00028

Questions 136 to 141: Suppose on a highway with a speed limit of 65 mph, the speed of cars are independent and normally distributed with an average speed = 65 mph and standard deviation = 5 mph.

136. What is the expected value of the sample mean speed in a random sample of n = 10 cars?
KEY: 65 mph

137. What is the standard deviation for the sample mean speed in a random sample of n = 10 cars?
KEY: 1.58 mph

138. What is the probability that the sample mean speed in a random sample of n = 10 cars exceeds 68 mph?
KEY: 0.0288

139. What is the expected value of the sample mean speed in a random sample of n = 100 cars?
KEY: 65 mph

140. What is the standard deviation for the sample mean speed in a random sample of n = 100 cars?
KEY: 0.50 mph

141. What is the probability that the sample mean speed in a random sample of n = 100 cars exceeds 68 mph?
KEY: 9.9×10^{-10}

Questions 142 to 145: A large company is making all of its employees take a stress test. Test scores on this stress test follow a normal distribution with a mean score of 3 and a standard deviation of 0.9. A random sample of 35 employees is to be taken.

142. What is the expected value of the sample mean stress score in the sample of 35 employees?
KEY: 3

143. What is the standard deviation of the sampling distribution of the sample mean stress score?
KEY: 0.152

144. What is the probability that the sample mean stress score exceeds 3.5?
KEY: 0.0005

145. What is the probability that the sample mean stress score is lower than 2.75?
KEY: 0.0505

Section 9.7

146. In which of the following scenarios is a paired design *not* appropriate?
   A. Comparison of the wear pattern on one's left shoe and one's right shoe.
   B. Comparison of a cream and an ointment in the treatment of a rash, where the ointment is applied to half the rash and the cream to the other half.
   C. Comparison of the average energy use of two brands of dishwashers.
   D. Comparison of the accuracy of taking a person's temperature orally and in the ear, where each person's temperature is taken using both methods.

KEY: C

Questions 147 to 150: When people get married for the first time, the husband is, on average, 2 years older than the wife. The standard deviation of the difference in age is roughly 2.5 years. Suppose it is reasonable to assume that the distribution of the difference in age between the husband and the wife is normal. Twelve recently married couples (all first marriages) are to be selected and the average difference in age is to be calculated.

147. What is the correct notation for the statistic of interest?
   A. $\bar{x}_{\mathrm{M}} - \bar{x}_{\mathrm{F}}$
   B. $\bar{x}$
   C. $\bar{d}$
   D. μ_d

KEY: C

148. What is the mean of the sampling distribution of the sample mean difference in age between the husband and the wife?
   A. 0.72
   B. 2
   C. 2.5
   D. 20

KEY: B

149. What is the standard deviation of the sampling distribution of the sample mean difference in age between the husband and the wife?
   A. 0.208
   B. 0.72
   C. 2
   D. 2.5

KEY: B

150. What is the probability that the average age of the wives in the sample is older than the average age of the husbands?
   A. < 0.0001
   B. 0.0027
   C. 0.2119
   D. 0.9973

KEY: B

151. A random sample of 20 mixed gender twins is selected and their resting pulse rate is taken after a 5 minute period of relaxing on a sofa. The average resting pulse rate for the male twins was 67 betas per minute and for the female twins it was 73 beats per minute, resulting in $\bar{d} = -6$. The standard deviation of the differences in pulse rates between the male and female twins was 3.4 beats per minute. What is the standard error of $\bar{d}$?
A. 0.17
B. 0.76
C. 3.4
D. 5
KEY: B

152. A random sample of 15 high school students is selected for a small experiment in which they will be tested in two ways: a written test and an oral exam. To avoid order effects, eight students are randomly selected to first take the written test and then the oral exam. The remaining 7 students take the tests in reverse order. Summary statistics for the two tests are provided below.

	n	Mean	Std. Deviation
Oral	15	1.523	1.530
Written	15	4.166	2.047
Difference	15	-2.643	2.182

What is the standard error of $\bar{d}$?
A. 0.145
B. 0.517
C. 0.563
D. 0.660
KEY: C

Questions 153 to 155: Scores on an English spelling test are determined for a sample of 16 5^{th} graders both before and after they learn some new vocabulary “tricks of the trade”. In the population of difference scores it is know that students improve with an average of 3 points, with a standard deviation of 4 points, and that the distribution of the differences is approximately normal.

153. What is the expected value of the sample mean difference in spelling scores?
A. 16
B. 5
C. 3
D. 4
KEY: C

154. What is the standard deviation of the sampling distribution of the sample mean difference in spelling scores?
A. 4
B. 0.25
C. 1
D. 0.75
KEY: C

155. What is the probability that the 16 students in the sample do *not* improve, on average? a
A. < 0.0001
B. 0.0013
C. 0.2266
D. 0.7500
KEY: B

Questions 156 to 158: A group of 50 students had their blood pressures measured before and after watching a movie containing violence. The mean blood pressure before the movie is to be compared with the mean pressure after the movie. In general, blood pressure increases by 5 points after watching something violent happening with a standard deviation of 7 points.

156. What is the mean of the sampling distribution of the sample mean difference in blood pressure before and after watching a movie containing violence?
KEY: 5

157. What is the standard deviation of the sampling distribution of the sample mean difference in blood pressure before and after watching a movie containing violence?
KEY: 0.9899

158. If we can assume that the differences are normally distributed, what is probability that the difference (in either direction) in average blood pressure is no more than 3 points?
KEY: 0.0217

Questions 159 to 161: A group of 50 students each measured the length of their right arm and the length of their left arm. The right arm lengths were compared to the left arm lengths. The average difference between right and left arm lengths was 0.3 cm with a standard deviation of 1 cm.

159. What is the correct notation for the value 0.3 cm?
KEY: $\bar{d}$

160. What is the standard error of the sample mean difference?
KEY: 0.141

161. (Optional) Why do you think is the average difference between right and left arm lengths positive?
KEY: The arm you use most tends to be slightly longer and more people are right handed.

Questions 162 to 165: People who go on a (leisure) vacation tend to gain weight. It is thought that the average difference between weight before the vacation and after the vacation is roughly 2 pounds with a standard deviation of 2.5 pounds. Ten vacationing people are to be randomly selected and their weights measured, both upon departure and return of their vacation.

162. What is the expected value of the sample mean difference between after and before vacation weight?
KEY: 2 pounds

163. What is the standard deviation of the sampling distribution of the sample mean difference between after and before vacation weight?
KEY: 0.7906

164. If we can assume that the differences are normally distributed, what is probability that the ten vacationing people gain an average between 1 and 2 pounds?
KEY: 0.3962

165. If we can assume that the differences are normally distributed, what is probability that the ten vacationing people actually lost weight, on average?
KEY: 0.0057

Section 9.8

166. Suppose that the mean of the sampling distribution for the difference in two sample means is 0. This tells us that
   A. the two sample means are both 0.
   B. the two sample means are equal to each other.
   C. the two population means are both 0.
   D. the two population means are equal to each other.

KEY: D

167. The sample mean number of accidents is to be calculated for both a sample of male and a sample of female drivers and we wish to determine the difference in sample means. Which statistic is being studied?
   A. $\bar{x}$
   B. $\bar{d}$
   C. $\bar{x}_1 - \bar{x}_2$
   D. $\mu_1 - \mu_2$

KEY: C

168. The sample mean number of accidents is to be calculated for a sample of husbands and wives and we wish to determine the difference in mean number of accidents for these husband-wife couples. Which statistic is being studied?
   A. $\bar{x}$
   B. $\bar{d}$
   C. $\bar{x}_1 - \bar{x}_2$
   D. $\mu_1 - \mu_2$

KEY: B

169. A fourth grade class of 28 students is given a standardized math test. The mean score of the boys is compared to the mean score of the girls. Which statistic is being studied?
   A. $\bar{x}$
   B. $\bar{d}$
   C. $\bar{x}_1 - \bar{x}_2$
   D. $\mu_1 - \mu_2$

KEY: C

170. A fourth grade class of 28 students is given a standardized math test, both at the beginning of the semester and again at the end of the semester. The mean scores from the beginning and the end are compared. Which statistic is being studied?
   A. $\bar{x}$
   B. $\bar{d}$
   C. $\bar{x}_1 - \bar{x}_2$
   D. $\mu_1 - \mu_2$

KEY: B

171. A fourth grade class of 28 students is given a standardized math test. The mean score of the 12 boys is 25 with a standard deviation of 3. The mean score of the 16 girls is 24 with a standard deviation of 4. What is the standard error for the sampling distribution of $\bar{x}_{\text{boys}} - \bar{x}_{\text{girls}}$?

A. 1
B. 1.87
C. 1.75
D. 1.32

KEY: D

172. A researcher wishes to determine if female students and male students differ in the size of their network of friends. She selects random samples of 10 female and 15 male students. Descriptive statistics are given below:

$n_{\text{female}} = 10$ $\bar{x}_{\text{female}} = 23$ $s_{\text{female}} = 7.8$

$n_{\text{male}} = 15$ $\bar{x}_{\text{male}} = 16$ $s_{\text{male}} = 6.4$

What is the standard error for the sampling distribution of $\bar{x}_{\text{female}} - \bar{x}_{\text{male}}$?

A. 1.10
B. 8.81
C. 2.97
D. 7.10

KEY: C

Questions 173 to 175: A large car insurance company is conducting a study on behavior behind the wheel to explain the fact that male drivers (who tend to be thought of as more aggressive drivers) have more accidents, on average, per year, than female drivers. The average number of accidents per year for male drivers is 2.3 with a standard deviation of 0.8 and for female drivers the mean is 1.7 with a standard deviation of 0.6. Independent random samples of 25 male and 20 female drivers are to be selected to take part in the behavior study.

173. If the sample mean number of accidents is to be calculated for both the male and female drivers and we calculate the difference as male – female, what is the expected value for the difference in sample means?

A. 1.7
B. 2.3
C. 0.6
D. 0.8

KEY: C

174. If the sample mean number of accidents is to be calculated for both the male and female drivers and we calculate the difference as male – female, what is the standard deviation of the sampling distribution of the difference in sample means?

A. 0.0436
B. 0.2088
C. 0.2942
D. 0.7

KEY: B

175. Suppose we can assume that the number of accidents per year is normally distributed, both for males and for females. What is the probability that the average number of accidents in the sample of 25 male drivers is *less* than the average number of accidents in the sample of 20 female drivers?

A. < 0.0001
B. 0.0020
C. 0.0207
D. 0.2266

KEY: B

Questions 176 to 179: High school students can be categorized into two groups by the amount of activities they are involved in. Let group 1 consist of all high school students who are very involved in sports and other activities and group 2 consist of all high school students who aren't. The distributions of GPAs in both groups are approximately normal. The mean and standard deviation for group 1 are 2.9 and 0.4, respectively. The mean and standard deviation for group 2 are 2.7 and 0.5, respectively. Independent random samples of 50 high school students are to be selected from both groups (for a total of 100 students).

176. If the sample mean GPA is to be calculated for both groups and we calculate the difference as involved in activities – not so involved in activities, what is the expected value for the difference in sample means?
   A. 0
   B. 0.2
   C. 0.4
   D. 0.6

KEY: B

177. If the sample mean GPA is to be calculated for both groups and we calculate the difference as involved in activities – not so involved in activities, what is the standard deviation of the sampling distribution of the difference in sample means?
   A. 0.0082
   B. 0.0905
   C. 0.18
   D. 0.45

KEY: B

178. What is the probability that the average GPA in the sample of students who are not so involved is *higher* than the average GPA in the sample of students who are very involved?
   A. < 0.0001
   B. 0.0136
   C. 0.0582
   D. 0.9864

KEY: B

179. What is the probability that the average GPAs in the two samples differ by no more than 0.1?
   A. 0.1341
   B. 0.2266
   C. 0.2415
   D. 0.8659

KEY: A

Questions 180 to 183: College students spend a lot of their money, not on things they would like to buy, but on text books. College text books have increased in price significantly over the past few years. The amount students spend on text books is approximately normally distributed with a standard deviation of \$50. The average amount spent on books each semester is \$340 for undergraduate students and \$250 for graduate students. Independent random samples of 100 undergraduate students and 80 graduate students are to be selected and the average amount they spent on text books last semester is to be compared (undergraduate – graduate).

180. What is the expected value for the difference in sample means?
KEY: \$90

181. What is the standard deviation of the sampling distribution of the difference in sample means?
KEY: \$7.50

182. What is the probability that the difference between the sample means is greater than \$100?
KEY: 0.0912

183. What is the probability that the undergraduate students in the sample spent more on books, on average, than the graduate students in the sample?
KEY: < 0.0001

Questions 184 to 186: Many adults complain they do not get enough sleep at night. What happens when these adults have children? Independent random samples of 150 adults who do *not* have children in the house and 130 adults who do have children in the house are selected. The average amount of sleep the adults *without* children had was 7.1 hours with a standard deviation of 0.7 hours. The average amount of sleep the adults *with* children had was 6.5 hours with a standard deviation of 0.8 hours.

184. What is the estimate for the difference in mean hours slept at night between adults with and adults without children?
KEY: –0.6 hours (–36 minutes)

185. What is the estimate for the standard deviation of the sampling distribution of the difference in sample means?
KEY: 0.0905 hours (roughly 5 minutes)

186. What do we call the estimate in question 124?
KEY: standard error or standard error of $\bar{x}_1 - \bar{x}_2$

Questions 187 to 189: Grade school students, especially the ones in higher grades, tend to spend a lot of time on the computer already. The average amount of time 4th grade boys spend on the computer is 5 hours per week, with a standard deviation of 1 hour. For 5th grade boys the average increases to 7 hours per week with a standard deviation of 1.5 hours. Random sample of 20 4th grade students and 25 5th grade students are to be selected.

187. What is the expected value for the difference in sample means (5th − 4th grade)?
KEY: 2 hours

188. What is the standard deviation of the sampling distribution of the difference in sample means?
KEY: 0.374

189. What is the probability that the difference between the sample means is greater than 1 hour?
KEY: 0.9962

Section 9.9

190. Which of the following is *not* a *z*-score?

A. $\frac{\bar{x}-\mu}{\sigma/\sqrt{n}}$ B. $\frac{\bar{x}-\mu}{s/\sqrt{n}}$ C. $\frac{\bar{d}-\mu_d}{\sigma_d/\sqrt{n}}$ D. $\frac{\hat{p}-p}{\sqrt{\frac{p(1-p)}{n}}}$

KEY: B

191. The t-distribution is the sampling distribution for which of the following?

A. $\frac{\hat{p}-p}{\sqrt{\frac{p(1-p)}{n}}}$ B. $\frac{(\hat{p}_1-\hat{p}_2)}{s.e.(\hat{p}_1-\hat{p}_2)}$ C. $\frac{\bar{x}-\mu}{s/\sqrt{n}}$ D. $\frac{\bar{x}-\mu}{\sigma/\sqrt{n}}$

KEY: C

Questions 192 to 194: A candy factory makes 20% (p = 0.20) of all its candies with chocolate liquor. A random sample of n =100 candies is taken, and $\hat{p}$ = proportion of candies in the sample made with chocolate liquor is calculated.

192. What is the *z*-score for $\hat{p}$ = 0.35?

A. –2.50
B. –1.50
C. 1.25
D. 3.75

KEY: D

193. What is the *z*-score for $\hat{p}$ = 0.10?

A. –2.50
B. –1.50
C. 1.25
D. 3.75

KEY: A

194. What is the *z*-score for $\hat{p}$ = 0.25?

A. –2.50
B. –1.50
C. 1.25
D. 3.75

KEY: C

Questions 195 to 197: Assume the cholesterol level in a certain population has mean $\mu = 200$ and standard deviation $\sigma = 24$. The cholesterol levels for a random sample of $n = 9$ individuals are measured and the sample mean $\bar{x}$ is determined.

195. What is the z-score for a sample mean $\bar{x} = 212$?
   A. –3.75
   B. 0.375
   C. 1.50
   D. 2.50

KEY: C

196. What is the z-score for a sample mean $\bar{x} = 220$?
   A. –3.75
   B. –2.50
   C. 0.833
   D. 2.50

KEY: D

197. What is the z-score for a sample mean $\bar{x} = 180$?
   A. –3.75
   B. –2.50
   C. –0.83
   D. 2.50

KEY: B

Questions 198 to 200: Scores on an English spelling test are determined for a sample of $n = 25$ fifth graders both before and after they learn some new vocabulary "tricks of the trade". In the population of all differences in scores it is known that students improve with an average of 3 points, with a standard deviation of 4 points, and that the distribution of the differences is approximately normal.

198. What is the z-score if the mean difference in the sample was $\bar{d} = 2$?
   A. –2
   B. –1
   C. –0.25
   D. –1.25

KEY: D

199. What is the z-score if the mean difference in the sample was $\bar{d} = 0$?
   A. 0
   B. –3.75
   C. –0.75
   D. –6.67

KEY: B

200. What is the z-score if the mean difference in the sample was $\bar{d} = 4.5$?
   A. 0.625
   B. 0.375
   C. 1.875
   D. 9.375

KEY: C

Questions 201 to 205: Suppose that the weight of apples eaten by individual Americans each year can be described by a normal distribution with mean μ = 15 pounds and standard deviation σ = 5 pounds per year.

201. For a random sample of n = 16 people, what is the mean of the sampling distribution of the sample mean $\bar{x}$?
KEY: 15 pounds.

202. For a random sample of n = 16 people, what is the standard deviation of the sampling distribution of the sample mean $\bar{x}$?
KEY: 1.25 pounds.

203. For a random sample of n = 16 people, what is the z-score for a sample mean $\bar{x}$ = 10 pounds?
KEY: –4.00

204. For a random sample of n = 9 people, what is the z-score for a sample mean $\bar{x}$ = 10 pounds?
KEY: −3.00

205. For a random sample of n = 9 people, what is the z-score for a sample mean $\bar{x}$ = 18 pounds?
KEY: 1.80

206. In a creek, the proportion of turtles that are snake-necked turtles is 35%. In a random sample of n = 50 turtles, the sample proportion of snake-necked turtles is 50%. What is the z-score associated with $\hat{p} = 0.50$?
KEY: 2.22

207. In a pond with a large population of turtles, the proportion of turtles that are snapping turtles is 20%. In a random sample of n = 80 turtles from this pond, 20 are snapping turtles. What is the z-score associated with the observed sample proportion of snapping turtles?
KEY: 1.12

208. In a city with a large population of cats, 1 of every 7 cats is a stray cat. In a random sample of n = 25 cats from this city, 5 are strays. What is the z-score associated with the observed sample proportion of stray cats?
KEY: 0.816

209. It is estimated that only about 10% of 3-year olds already know how to write their (first) name. Out of 85 random sampled 3-year olds, 11 are able to write their name. What is the z-score associated with the observed sample proportion of 3-year olds already know how to write their name?
KEY: 0.904

210. Based on the 2000 Census, 31.8% of grandparents in California are the primary caregivers for their grandchildren. In a random sample of 1000 grandparents, 296 are the primary caregivers for their grandchildren. What is the z-score associated with the observed sample proportion of grandparents who are the primary caregivers for their grandchildren?
KEY: –1.49

Questions 211 to 213: Suppose height of college students can be modeled by the normal distribution. We believe the mean of the normal distribution is 1.72 m. We randomly sample 18 students and find an average of 1.69 m and a standard deviation of 5 cm (= 0.05 m).

211. What is the standard error of $\bar{x}$?
KEY: 0.0118

212. What is the value of the *t*-statistic?
KEY: –2.54

213. What are the degrees of freedom for the *t*-distribution?
KEY: 17

Questions 214 to 216: A gasoline tank for a certain car is designed to hold 15 gallons of gas. The manufacturer of this gasoline tank claims that the actual capacity of a randomly selected tank has a distribution that is approximately normal with a mean of 15.0 gallons. A random sample of 25 tanks results in an average of 14.8 gallons with a standard deviation of 0.42 gallons.

214. What is the standard error of the sample mean?
KEY: 0.084

215. What is the value of the *t*-statistic when comparing the sample mean to the average claimed by the manufacturer?
KEY: –2.381

216. What are the degrees of freedom for the *t*-distribution?
KEY: 24

Questions 217 to 219: Ms. Jackson of the Employment Agency believes that the agency receives an average of 16 complaints per week. Mr. Vermeer, the boss, thinks it is less. A sample of 10 weeks yields an average of 14 complaints per week with a standard deviation of 3 complaints.

217. What is the standard error of the sample mean?
KEY: 0.95

218. What is the value of the observed *t*-statistic when comparing the sample mean to the average perceived by Ms. Jackson?
KEY: –2.11

219. What are the degrees of freedom for the *t*-distribution?
KEY: 9

Section 9.10

220. Which of the following describes the relationship between the Central Limit Theorem and the Rule for Sample Proportions?
    A. The Rule for Sample Proportions follows from the Central Limit Theorem by defining each observation in the sample to be either 1 or 0.
    B. The Central Limit Theorem is a special case of the Rule for Sample Proportions.
    C. There is no relationship because the Central Limit Theorem is about means and the Rule for Sample Proportions is about proportions.
    D. The Central Limit Theorem is just a restatement of the Rule for Sample Proportions.

KEY: A

221. Which of the following describes the relationship between the Central Limit Theorem and the Rule for Sample Means?
    A. The Rule for Sample Means follows from the Central Limit Theorem by dividing each observation in the sample by *n*.
    B. The Central Limit Theorem is a special case of the Rule for Sample Means.
    C. There is no relationship because the Central Limit Theorem is about population means and the Rule for Sample Means is about sample means.
    D. The Central Limit Theorem is just a restatement of the Rule for Sample Means.

KEY: D

222. Imagine taking many different samples of $n = 30$ values from a population of resting pulse rate values. Which one of these statistics is most likely to have a sampling distribution that is approximately a normal distribution?
    A. The maximum pulse rate in a sample.
    B. The minimum pulse rate in a sample.
    C. The mean pulse rate in a sample.
    D. The mean pulse rate in the population.

KEY: C

Questions 223 to 225: Based on the current rate of savings, the average American household will live on 59 percent of pre-retirement income once they retire, a recent report says. The report also says that Americans are behind in funding their retirement years. The report recommended saving enough to be able to live on 85 percent of income in retirement. However, the typical household has put aside only $18,750 for retirement. Suppose we can assume that the true average amount a typical household has put aside for retirement is $18,750. Also assume that these amounts vary with a standard deviation of $12,500. The distribution of these amounts is known to be right-skewed.

223. Suppose one household is to be randomly selected. Is the probability that this household has set aside more than $30,000 for retirement equal to 0.1841?
    A. Yes
    B. No
    C. Cannot be determined

KEY: C

224. Suppose 100 households are to be randomly selected and the average amount these 100 households have set aside for retirement calculated. What is the expected value of the average amount set aside for retirement in the sample of 100 households?
    A. $1,250
    B. $18,750
    C. 85 percent
    D. 59 percent

KEY: B

225. Suppose 100 households are to be randomly selected. Is the probability that the average amount these 100 households have set aside for retirement is more than \$20,000 (roughly) equal to 0.1587?
   A. Yes
   B. No
   C. Cannot be determined

KEY: A

226. In a lottery, a real number from 0 to 100 is picked at random. If X is the number picked, then the mean of X is 50 and the standard deviation of X is 28.9. For a random sample of 60 numbers, use the Empirical Rule to find a range that will include the sample mean, $\overline{X}$, approximately 95% of the time.

KEY: 42.5 to 57.5

227. The household income in a certain community is known to have a right skewed distribution with a mean of \$42,000 and a standard deviation of \$5,000. Without knowing the exact distribution we cannot find the probability that a randomly selected household has a yearly income less than \$41,000. Suppose we randomly sample 80 incomes from this population, what is the (approximate) probability that the average income in the sample is less than \$41,000?

KEY: 0.0368

Questions 228 to 232: The distribution of quiz, exam, and course grades is known to be left-skewed. The course grades (measured as percentage scores) in upper level statistics classes have a mean of 68 with a standard deviation of 15.

228. Suppose one course grade is to be randomly selected. Can we calculate the probability that this grade is higher than 75? If yes, calculate it. If no, explain why not.

KEY: No, we do not know the exact distribution of the scores. We just know it is left-skewed.

229. Suppose 50 course grades are to be randomly selected and the average score in the sample calculated. What is the expected value of the average percentage score in the sample of 50 course grades?

KEY: 68

230. Suppose 50 course grades are to be randomly selected and the average score in the sample calculated. What is the standard deviation of the sampling distribution of the average percentage score in the sample of 50 course grades?

KEY: 2.12

231. Suppose 50 course grades are to be randomly selected and the average score in the sample calculated. What is the (approximate) probability that the average score in the sample is higher than 75?

KEY: 0.0005

232. Suppose 50 course grades are to be randomly selected and the average score in the sample calculated. What is the (approximate) probability that the average score in the sample is more than 5 points removed from the true average of 68?

KEY: 0.0184