

**May 17, 2012**

Name: \_\_\_\_\_ Date: \_\_\_\_\_

Use the following to answer questions 1-2:

A researcher is studying the relationship between sugar consumption and weight gain. Twelve volunteers were randomly assigned to one of two groups. The first group of five participants was put on a diet low in sugar and the second group of the remaining seven participants received 10% of their calories from sugar. After 8 weeks, weight gain was recorded from each participant.

1. Each of the 12 volunteers receives a label: 01 through 12. Use the list of random digits below to determine the labels of the first five participants selected who were put on a low-sugar diet. Start at the beginning of the list and use double-digit labels.

81507 2710 56027 5589 33063 41842 8186 71035 09001 23367 49497  
          2                  2                          8

- A) 2, 6, 10, 9, 12.  
B) 2, 2, 6, 10, 9.  
C) 8, 1, 5, 0, 7.  
D) 8, 1, 5, 7, 2.
2. Which of the following basic principles of statistical design was not used in this experiment?
- A) blinding  
B) control  
C) repetition  
D) randomization

Use the following to answer question 3:

The head of the quality control department at a publishing company is studying the effect of type of glue and type of binding on the strength of the bookbinding. The company has three possible glues to choose from and the book can either be bound as a paperback or a hardback.

3. What is/are the factor(s) in this study?
- A) The strength of the bookbinding.  
B) Type of glue and type of binding.  
C) Three possible glues.  
D) Paperback vs. hardback.

4. The three basic principles of statistical design of experiments are

- A) randomization, control, pairing.
- B) blocking, blinding, bias avoidance.
- C) control, randomization, repetition.
- D) control, comparison, confounding.
- E) comparison, blocking, pairing.

Use the following to answer question 5:

Researchers wish to determine if a new experimental medication will reduce the symptoms of allergy sufferers without the side effect of drowsiness. To investigate this question, the researchers gave the new medication to 50 adult volunteers who suffer from allergies. Forty-four of these volunteers reported a significant reduction in their allergy symptoms without any drowsiness.

5. What are the experimental units in this study?

- A) The 50 adult volunteers.
- B) The researchers.
- C) The six volunteers who did not report a significant reduction in their allergy symptoms without any drowsiness.
- D) The 44 volunteers who reported a significant reduction in their allergy symptoms without any drowsiness.

6. The six people listed below are enrolled in an online statistics course.

- |              |          |            |
|--------------|----------|------------|
| 1. Caltellan | 3. Jones | 5. Moore   |
| 2. Gael      | 4. Klein | 6. Saunter |

This class list is to be randomly divided into two groups of three students each for a group project. Use the list of random digits below to randomly select the names of the three students who will form the first group. The remaining students will comprise Group 2. Start at the beginning of the list and use the numerical labels attached to the names.

27102 56027 55892 33063 41842 81868 71035 09001 43367 49497 54580 81507

How are the two groups made up?

- A) Group 1: Gael, Castellan, Moore. Group 2: Jones, Klein, Saunter.
- B) Group 1: Gael, Moore, Saunter. Group 2: Castellan, Jones, Klein.
- C) Group 1: Gael, Castellan, Gael. Group 2: Moore, Jones, Klein.
- D) Group 1: 2, 7, 1. Group 2: 5, 6, 8.

Use the following to answer question 7:

The number of undergraduates at Johns Hopkins University is approximately 2000, while the number at Ohio State University is approximately 40,000.

7. Suppose the actual proportion of undergraduates at Johns Hopkins University who feel drinking is a problem among college students is 67%. A simple random sample of 50 undergraduates at Johns Hopkins University found that 60% of those sampled felt that drinking was a problem among college students. Which value(s) can be labeled as parameter(s)?

- A) 67%
- B) 60%
- C) 50
- D) 60% and 67%

Use the following to answer question 8:

The proportion of supermarket customers who do not buy store-brand products is to be estimated.



8. Which of the following scenarios would lead to a sampling distribution of the sample proportion with the lowest variability?
- A) Sample 300 customers from the roughly 20,000 customers who shop at the stores citywide.
  - B) Sample 100 customers from the roughly 2000 customers who shop at one store location.
  - C) Sample 200 customers from the roughly 2000 customers who shop at one store location.
  - D) Sample 100 customers from the roughly 20,000 customers who shop at the stores citywide.
9. Suppose a fair coin is flipped twice and the number of heads is counted. Which of the following is a valid probability model for the number of heads observed in two flips?
- A)

Number of Heads	0	1	2
Probability	$\frac{1}{4}$	$\frac{1}{4}$	$\frac{1}{4}$

B)

Number of Heads	0	1	2
Probability	$\frac{1}{3}$	$\frac{1}{2}$	$\frac{1}{3}$

C)

Number of Heads	0	1	2
Probability	$\frac{1}{4}$	$\frac{1}{2}$	$\frac{1}{2}$

D) None of the above.

Use the following to answer question 10:

Ignoring twins and other multiple births, assume babies born at a hospital are independent events with the probability that a baby is a boy and the probability that a baby is a girl both equal to 0.5.

10. What is the probability that at least one of the next three babies is a boy?
- A) 0.750
  - B) 0.875
  - C) 0.125
  - D) 0.333

11. Andy has a (toy) garage that is supposed to have four cars in it. According to Andy,  $X$  = the number of cars that are actually in the garage at any given time follows the following distribution:

Value of $X$	4	3	2	1	0
Probability	0.90	0.05	0.03	0.02	0

According to this model, what is the average number of cars that are in the garage at any given time?

- A) 3.83 cars
- B) 3 cars
- C) 4 cars
- D) 3.92 cars

Use the following to answer question 12:

Suppose that a college determines the following distribution for  $X$  = number of courses taken by a full-time student this semester:

Value of $X$	3	4	5	6
Probability	0.07		0.25	0.28

12. What is  $P(X > 4.74)$ ?

- A) 0.53
- B) 0.28
- C) Impossible to calculate, because  $X$  cannot be 4.74.
- D) 0.25

Use the following to answer question 13:

A small store keeps track of  $X$  = the number of customers who make a purchase during the first hour that the store is open each day. Based on the records,  $X$  has the following probability distribution:

Value of $X$	0	1	2	3	4
Probability	0.1	0.1	0.1	0.1	0.6

13. What is the standard deviation of the number of customers who make a purchase during the first hour that the store is open?
- A) 1.4  
B) 2.0  
C) 3.0  
D) 4.0

Use the following to answer question 14:

When figure skaters need to find a partner for "pair figure skating," it is important to find a partner who is compatible in weight. The weight of figure skaters can be modeled by a Normal distribution. For male skaters, the mean is 170 lbs with a standard deviation of 10 lbs. For female skaters, the mean is 110 lbs with a standard deviation of 5 lbs. Let the random variable  $X$  = the weight of female skaters and the random variable  $Y$  = the weight of male skaters.

14. What is  $P(X < 100)$ ?

- A) 0.0228  
B) 0.1587  
C) 0  
D) 0.9772

15. The following is the probability distribution for a discrete random variable  $X$  for which the mean  $\mu = 2.5$ :

$X$	1	2	3	4
$P(X = x)$	0.2	0.3	0.3	0.2

- A) 1.58  
B) 0.98  
C) 10.25  
D) 0.96  
E) 1.05

16. Suppose we have two independent random variables  $X$  and  $Y$ . Which of the following statements about  $X$  and  $Y$  is FALSE?

- A) The variance of the difference  $X - Y$  is the difference of their variances.  
B) The mean of  $X + Y$  is the sum of their means.  
C) The correlation between  $X$  and  $Y$  is zero.  
D) The variance of  $X + Y$  is the sum of their variances.  
E) The mean of the difference  $X - Y$  is the difference of their means.



17. An airplane has a front and a rear door, both of which are opened to allow passengers to exit when the plane lands. The plane has 100 passengers aboard. Let  $X$  = the number of passengers exiting through the front door. What is the appropriate distribution for the random variable  $X$ ?
- A) A binomial distribution with  $n = 100$  trials but success probability not equal to 0.5.
  - B) A Normal distribution with a standard deviation of 5.
  - C) A binomial distribution with mean 50.
  - D) None of the above.
18. A fair die is rolled 12 times. Let  $X$  = the number of times an even number occurs on the 12 rolls. What is the appropriate distribution for the random variable  $X$ ?
- A) A binomial distribution with a mean of 2.
  - B) A binomial distribution with a standard deviation of 3.
  - C) A binomial distribution with a mean of 0.5.
  - D) A binomial distribution with a mean of 6.

Use the following to answer question 19:

The scores of individual students on the American College Testing (ACT) Program Composite College Entrance Examination have a Normal distribution with mean 18.6 and standard deviation 6.0. At Northside High, 36 seniors take the test. Assume the scores at this school have the same distribution as national scores.

19. What is the standard deviation of the sampling distribution of the sample mean score for a random sample of 36 students?
- A) 18.6
  - B) 3.1
  - C) 1.0
  - D) 6.0

Use the following to answer question 20:

The weights of extra-large eggs have a Normal distribution with a mean of 1 oz and a standard deviation of 0.1 oz.

20. What is the probability that a carton of a dozen eggs weighs more than 13 oz?
- A) 0.2033
  - B) 0.1814
  - C) 0.0019
  - D) 0.0000

Use the following to answer question 21:

A population variable has a distribution with mean  $\mu = 50$  and variance  $\sigma^2 = 225$ . From this population a simple random sample of  $n$  observations is to be selected and the mean  $\bar{x}$  of the sample values calculated.

21. If the population variable is known to be Normally distributed and the sample size used is to be  $n = 16$ , what is the probability that the sample mean will be between 48.35 and 55.74, i.e.,  $\Pr\{48.35 \leq \bar{x} \leq 55.74\}$ ?
- A) 0.330
  - B) Not within  $\pm 0.010$  of any of the above.
  - C) 0.937
  - D) 0.393
  - E) 0.607

Use the following to answer question 22:

The distribution of the amount of money undergraduate students spend on books for a term is slightly right-skewed, with a mean of \$400 and a standard deviation of \$80.

22. If a student is selected at random, what is the probability that this student spends more than \$425 on books?
- A) 0.1125
  - B) 0.6227
  - C) This cannot be determined from the information given.
  - D) 0.3773

Use the following to answer question 23:

Let  $X$  represent the SAT score of an entering freshman at University X. The random variable  $X$  is known to have a  $N(1200, 90)$  distribution. Let  $Y$  represent the SAT score of an entering freshman at University Y. The random variable  $Y$  is known to have a  $N(1215, 110)$  distribution. A random sample of 100 freshmen is obtained from each university. Let  $\bar{X}$  = the sample mean of the 100 scores from University X, and  $\bar{Y}$  = the sample mean of the 100 scores from University Y.



23. What is the probability that  $\bar{X}$  will be less than 1190?

- A) 0.0116
- B) 0.1335
- C) 0.4090
- D) 0.4562

Use the following to answer question 24:

A gasoline tank for a certain car is designed to hold 15 gallons of gas. Suppose that the actual capacity of a randomly selected tank has a distribution that is approximately Normal with a mean of 15.0 gallons and a standard deviation of 0.15 gallons.

24. What proportion of tanks will hold between 14.75 and 15.10 gallons of gas?

- A) 0.9833
- B) 0.35
- C) 0.6997
- D) 0.6563

Use the following to answer question 25:

The distribution of GPA scores is known to be left-skewed. At a large university, an English professor is interested in learning about the average GPA score of the English majors and minors. A simple random sample of 75 junior and senior English majors and minors results in an average GPA score of 2.97. Assume that the distribution of GPA scores for all English majors and minors at this university is also left-skewed with a standard deviation of 0.62.

25. Calculate a 95% confidence interval for the mean GPA of the junior and senior English majors and minors.

- A) (2.852, 3.088)
- B) (2.786, 3.154)
- C) (2.830, 3.110)
- D) (2.954, 2.986)

26. Is the mean height for all adult American males between the ages of 18 and 21 now over 6 feet? Let  $\mu$  represent the population mean height of all adult American males between the ages of 18 and 21. What are the appropriate null and alternative hypotheses to answer this question?

- A)  $H_0: \mu = 6$  vs.  $H_a: \mu \neq 6$
- B)  $H_0: \mu = 6$  vs.  $H_a: \mu > 6$
- C)  $H_0: \mu = 6$  vs.  $H_a: \mu < 6$

Use the following to answer question 27:

The level of calcium in the blood of healthy young adults follows a Normal distribution with mean  $\mu = 10$  milligrams per deciliter and standard deviation  $\sigma = 0.4$ . A clinic measures the blood calcium of 100 healthy pregnant young women at their first visit for prenatal care. The mean of these 100 measurements is  $\bar{x} = 9.8$ . Is this evidence that the mean calcium level in the population of healthy pregnant young women is less than 10? To answer this, test the hypotheses  $H_0: \mu = 10$  versus  $H_a: \mu < 10$  at the 5% significance level.

27. What is the value of the  $P$ -value?

- A) 0.6170
- B) greater than 0.99
- C) less than 0.0002
- D) 0.3085

Use the following to answer question 28:

The time needed for college students to complete a certain paper-and-pencil maze follows a Normal distribution with a mean of 30 seconds and a standard deviation of 3 seconds. You wish to see if the mean time  $\mu$  is changed by vigorous exercise, so you have a group of nine college students exercise vigorously for 30 minutes and then complete the maze. Assume that  $\sigma$  remains unchanged at 3 seconds. The hypotheses you decide to test are  $H_0: \mu = 30$  versus  $H_a: \mu \neq 30$ .

28. Suppose you compute the average time  $\bar{x}$  that it takes these students to complete the maze and you find that the results are significant at the 5% level. What can you conclude?

- A) The test would also be significant at the 10% level.
- B) The test would also be significant at the 1% level.
- C) Both of the above.
- D) None of the above.

Use the following to answer question 29:

A major car manufacturer wants to test a new engine to determine if it meets new air pollution standards. The mean emission  $\mu$  of all engines of this type must be approximately 20 parts per million of carbon. If it is higher than that, they will have to redesign parts of the engine. Ten engines are manufactured for testing purposes and the emission level of each is determined. Based on data collected over the years from a variety of engines, it seems reasonable to assume that emission levels are roughly Normally distributed with  $\sigma = 3$ .



29. What are the appropriate null and alternative hypotheses?

- A)  $H_0: \mu = 20$  vs.  $H_a: \mu < 20$
- B)  $H_0: \mu = 20$  vs.  $H_a: \mu \neq 20$
- C)  $H_0: \mu = 20$  vs.  $H_a: \mu > 20$

Use the following to answer questions 30-31:

It is known that driving can be difficult in regions where winter conditions involve snow-covered roads. For cars equipped with all-season tires traveling at 90 km/hr, the mean stopping time in loose snow is known to be 215 meters with a standard deviation of  $\sigma = 2.5$  meters. It is often advocated that automobiles in such areas should be equipped with special tires to compensate for such conditions, especially with respect to stopping distance. A manufacturer of tires made for driving in loose snow claims that vehicles equipped with their tires have a decreased stopping distance. A study was done using a random sample of 9 snow tires from the manufacturer on a snow-covered test track. The tests resulted in a mean stopping distance of  $\bar{x} = 212.9$  meters.

30. What are the appropriate null and alternative hypotheses to test the manufacturer's claim?

- A)  $H_0: \mu = 215$  against  $H_a: \mu < 215$
- B)  $H_0: \mu = 215$  against  $H_a: \mu \neq 215$
- C)  $H_0: \mu = 215$  against  $H_a: \mu > 215$
- D) Snow tires decrease the stopping distance in loose snow.
- E)  $H_0: \bar{X} = 215$  against  $H_a: \bar{X} < 215$

31. Using the sample results and assuming that stopping distance is a Normally distributed random variable, what is the value of the test statistic?

- A) -1.96
- B) 0.05
- C) -9.36
- D) -1.04
- E) -2.52



Use the following to answer question 32:

	True Situation	
	$H_0$ is True	$H_0$ is False
Decision	Do not reject $H_0$	(2)
	Reject $H_0$	(4)

32. Which of the following best describes the entry designated by (2) in the table?

- A) The entry refers to an error of Type II.
- B) The probability of the entry is called Power.
- C) The entry refers to a Type I error.
- D) The entry is a correct decision.
- E) None of the above describe the entry.

Use the following to answer questions 33-34:

A study was to be undertaken to determine if a particular training program would improve physical fitness. An SRS of 31 university students was selected to be enrolled in the fitness program. One important measure of fitness is maximum oxygen uptake. Measurements of oxygen uptake in untrained individuals are known to follow a Normal distribution with a mean of  $\mu = 45$  ml/kg/min. The researchers wished to determine if there was evidence that their sample of students differed from the general population of untrained subjects. The measurements made on the subjects coming into this study produced a mean of  $\bar{x} = 47.4$  with a standard deviation of  $s = 5.3$ .

33. Based on these data, what is the 98% confidence interval estimate for the mean oxygen uptake for the population from which the sample of students was selected?

- A)  $47.4 \pm 2.054 \left( 5.3 / \sqrt{31} \right)$
- B)  $47.4 \pm 2.147 \left( 5.3 / \sqrt{30} \right)$
- C)  $47.4 \pm 2.457 \left( 5.3 / \sqrt{30} \right)$
- D)  $47.4 \pm 2.147 \left( 5.3 / \sqrt{31} \right)$
- E)  $47.4 \pm 2.457 \left( 5.3 / \sqrt{31} \right)$

34. What is the appropriate alternative hypothesis in this situation?

- A)  $H_a: \mu > 45$
- B)  $H_a: \mu < 45$
- C)  $H_a: \bar{x} > 45$
- D)  $H_a: \bar{x} \neq 45$
- E)  $H_a: \mu \neq 45$

35. The hypotheses  $H_0: \mu = 350$  versus  $H_a: \mu < 350$  are examined using a sample of size  $n = 20$ . The one-sample  $t$  statistic has the value  $t = -1.68$ . What do we know about the  $P$ -value of this test?

- A)  $0.01 < P\text{-value} < 0.025$
- B)  $0.025 < P\text{-value} < 0.05$
- C)  $P\text{-value} < 0.01$
- D)  $P\text{-value} > 0.05$

Use the following to answer questions 36-37:

Bags of a certain brand of tortilla chips claim to have a net weight of 14 oz. Net weights actually vary slightly from bag to bag. Assume net weights are Normally distributed. A representative of a consumer advocate group wishes to see if there is any evidence that the mean net weight is less than advertised and so intends to test the hypotheses  $H_0: \mu = 14$ ,  $H_a: \mu < 14$ . To do this, he selects 16 bags of tortilla chips of this brand at random and determines the net weight of each. He finds a sample mean of 13.88 oz with a standard deviation of  $s = 0.24$  oz.

36. Determine which of the following statements regarding the decision the representative would make is true.

- A) He would reject  $H_0$  at a significance level 0.025, but not at 0.01.
- B) He would reject  $H_0$  at a significance level 0.01.
- C) He would not reject  $H_0$  at a significance level of 0.05.
- D) He would reject  $H_0$  at a significance level 0.05, but not at 0.025.

37. What is the value of the test statistic?

- A)  $t = -2.00$
- B)  $t = -8.00$
- C)  $t = -0.50$
- D)  $t = -8.33$



38. A simple random sample of six male patients over the age of 65 is being used in a blood pressure study. The standard error of the mean blood pressure of these six men was 22.8. What is the standard deviation of these six blood pressure measurements?
- A) 50.98
  - B) 55.85
  - C) 9.31
  - D) 136.8

Use the following to answer question 39:

You wish to compare the prices of apartments in two neighboring towns. You take a simple random sample of 12 apartments in town A and calculate the average price of these apartments. You repeat this for 15 apartments in town B. Let  $\mu_1$  represent the true average price of apartments in town A and  $\mu_2$  the average price in town B.

39. What would be the hypotheses for this problem?

- A)  $H_0: \mu_1 = \mu_2$  versus  $H_a: \mu_1 < \mu_2$
- B)  $H_0: \mu_1 = \mu_2$  versus  $H_a: \mu_1 > \mu_2$
- C)  $H_0: \mu_1 = \mu_2$  versus  $H_a: \mu_1 \neq \mu_2$

Use the following to answer question 40:

Some researchers have conjectured that stem-pitting disease in peach-tree seedlings might be controlled with weed and soil treatment. An experiment is conducted to compare peach-tree seedling growth when the soil and weeds are treated with one of two herbicides. In a field containing 20 seedlings, 10 are randomly selected throughout the field and assigned to receive Herbicide A. The remainder of the seedlings is assigned to receive Herbicide B. Soil and weeds for each seedling are treated with the appropriate herbicide, and at the end of the study period the height in centimeters is recorded for each seedling. The following results are obtained:

Herbicide A	$\bar{x}_1 = 94.5$ cm	$s_1 = 10$ cm
Herbicide B	$\bar{x}_2 = 109.1$ cm	$s_2 = 9$ cm

40. What is a 90% confidence interval (use the conservative value for the degrees of freedom) for  $\mu_2 - \mu_1$ ?
- A)  $14.6 \pm 7.38$
  - B)  $14.6 \pm 7.80$
  - C)  $14.6 \pm 7.00$
  - D)  $14.6 \pm 9.62$