

There are 50 questions. Tables for the normal and  $t$ -distributions and a formula sheet are attached. A Defective Question Report is available from your instructor.

**Be sure to code your Discussion Section Number into the OPTIONAL CODES in positions JKL**

1. The Central Limit Effect applied to a sample proportion  $p$  from  $n$  trials of a Bernoulli process says that for large  $n$  the distribution of  $p$  is approximately normal with mean  $n\pi$  and standard deviation  $\sqrt{n\pi(1-\pi)}$ .  
A) True    B) False
  
2. A universe consists of 8 elements. How many different samples of size 3 (without replacement) are possible?  
A) 8  
B) 24  
C) 336  
D) 6720  
E) None of the above.
  
3. If a process is in control (that is, stable), the process will produce goods or services that meet the customers' specifications.  
A) True    B) False
  
4. Failing to reject a true null hypothesis is a correct decision.  
A) True    B) False
  
5. Consider a  $t$ -distribution with 13 degrees of freedom. Which of the following is the value we get from the  $t$ -distribution table to construct a 95% confidence interval for  $\mu$ ?  
A) 1.771  
B) 1.782  
C) 1.960  
D) 2.160  
E) 2.179
  
6. In the beer-tasting example, *Consumer Reports* said "Although the 11 correct choices were an improvement over guesswork, we don't consider that to be statistically significant evidence that a beer drinker can tell domestic *Lowenbrau* from *Miller High Life*." True or false: This means ***they did not reject the null hypothesis***.  
A) True    B) False

7. If you are interested in predicting the next value of a *meandering process*, it would be more helpful to look at sequence plot of the data rather than a histogram.
- A) True    B) False
8. Suppose that 30 subgroups (samples) each of size 50 are selected from a Bernoulli process. If there are 150 defectives overall, what is the value of the upper control limit (UCL) for the  $p$ -chart for fraction defective? (Rounded to the nearest hundredth.)
- A) 0.10  
B) 0.13  
C) 0.16  
D) 0.23  
E) 0.26
9. A longitudinal study studies a process variable over time.
- A) True    B) False
10. Which of the following tools would be useful for longitudinal analyses of processes?
- I. Control charts for means  
II.  $p$ -charts  
III. Sequence plots
- A) I only  
B) II only  
C) III only  
D) I, II, and III  
E) None of the above.
11. The standard deviation of the distribution of a sample proportion  $p$  from  $n$  trials of a Bernoulli process is largest when  $\pi = 0.5$ .
- A) True    B) False
12. Which of the following statistics are sensitive to outliers?
- I. the correlation coefficient  
II. the standard deviation  
III. the mean
- A) I only  
B) II only  
C) III only  
D) I, II, and III  
E) None of A, B, C, or D is the correct answer.

13. A *parameter* is a numerical characteristic of a population.  
A) True B) False
14. Suppose that we have two independent estimates,  $\bar{y}_1$  and  $\bar{y}_2$ , of  $\mu_1$  and  $\mu_2$ . Both of these means are based on random samples of 10 observations. The standard error of  $\bar{y}_1$  is 2.4 and of  $\bar{y}_2$  is 2.1. What is the standard error of  $\bar{y}_1 - \bar{y}_2$  ?  
A) 0.30  
B) 1.16  
C) 1.35  
D) 3.19  
E) 10.17
15. In a designed experiment, treatments are randomly assigned to the study units (people or things). The reason for the randomization is to prevent bias due to other factors which are not controlled in the experiment.  
A) True B) False
16. In a simple random sample, increasing the sample size will decrease the margin of sampling error (other things being equal).  
A) True B) False
17. A new marketing strategy is tested against the one in present use. The results reported that the  $p$ -value was 0.04. Which *one* of the following statements is correct? (Here the null hypothesis is that the two strategies are no different.)  
A)  $H_0$  should be rejected at the 1% significance level.  
B)  $H_0$  should be rejected at both the 1% and 5% significance levels.  
C)  $H_0$  should not be rejected at the 5% significance level.  
D)  $H_0$  should not be rejected at the 10% significance level.  
E)  $H_0$  should not be rejected at any significance level less than 4%.
18. In a multiple regression problem, the units (dollars, pounds, inches, etc.) for the residual standard deviation are always the same as the units for the response variable  $y$ .  
A) True B) False
19. A market researcher computed a confidence interval for a population proportion using a 95% confidence level. Her boss decided that she wanted a 99% confidence level instead. True or false: The new interval with 99% confidence level will be **wider** than the original one with a 95% confidence level.  
A) True B) False

20. Suppose  $y$  is a response variable representing the market value of a house,  $x$  is a continuous predictor variable representing the size of the house (in thousands of square feet), and  $z$  is a binary indicator variable indicating whether or not the house is located in a prime location ( $z = 1$  if prime location,  $z = 0$  if not). Consider the regression model with fitted equation:  $\hat{y} = b_0 + b_1x + b_2z$ . Which of the following represents the predicted market value for a three thousand square foot house located in a prime location?

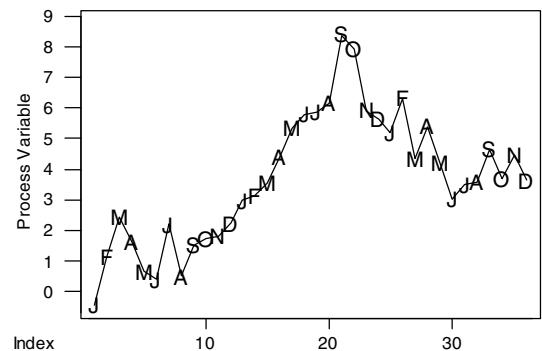
- A)  $3b_1$
- B)  $b_0 + 3b_1$
- C)  $3b_1 + b_2$
- D)  $b_0 + b_1 + b_2$
- E)  $b_0 + 3b_1 + b_2$

21. Consider 18 Bernoulli trials with success probability  $\pi = 0.2$ . Which of the following give the chance of observing **at most one** success?

- A)  $18(0.2)^1(0.8)^{17}$
- B)  $(0.8)^{18}$
- C)  $1 - (0.8)^{18}$
- D)  $1 - 18(0.2)^1(0.8)^{17}$
- E)  $(0.8)^{18} + 18(0.2)^1(0.8)^{17}$

22. A monthly process is observed for three years. The sequence plot is displayed at the right. In the plot J=January, F=February, etc. This series is best described as:

- A) seasonal
- B) meandering
- C) random
- D) cross-sectional
- E) trending

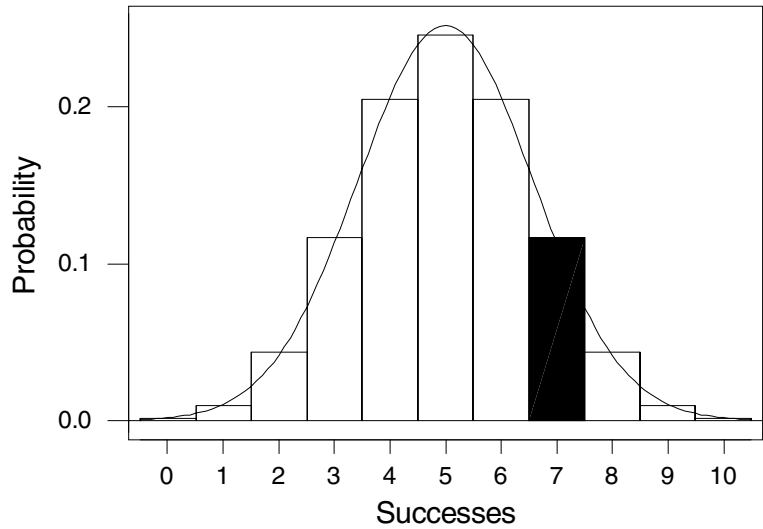


23. A class has asked their instructor to “grade on the curve.” With this system the instructor is required to give preselected percentages of the various possible grades. In particular, the lowest 10% of the class **must receive** F’s. If exam scores are normally distributed with mean 81.4 and standard deviation 5, what exam score corresponds to the highest F grade?

- A) 55
- B) 60
- C) 65
- D) 70
- E) 75

24. The time it takes for an automatic car wash to wash a car varies according to a number of factors—is it a basic wash, a deluxe wash and wax, and so forth. Suppose that the distribution of individual wash times has a mean of 5 minutes and a standard deviation of 20 seconds. You are in line behind 9 cars waiting for a car wash. The first car begins its wash. What are the chances that you will have to wait 40 minutes or more before starting your car wash? (Round to the nearest whole percent.)
- A) 0%
  - B) 47%
  - C) 53%
  - D) 95%
  - E) 100%

25. The graph to the right displays the Binomial distribution with 10 trials and success probability .5. A normal curve with the same mean and same standard deviation is also shown. The *shaded area* gives the



- A) normal approximation for the chance of exactly 7 successes *using* the continuity correction.
- B) normal approximation for the chance of 7 or more successes *using* the continuity correction.
- C) normal approximation for the chance of exactly 7 successes *without* using the continuity correction.
- D) normal approximation for the chance of 7 or more successes *without* using the continuity correction.
- E) chance of exactly 7 successes with no approximation.

26. The mean of the sampling distribution of a statistic is also called the *standard error* of the statistic.

- A) True
- B) False

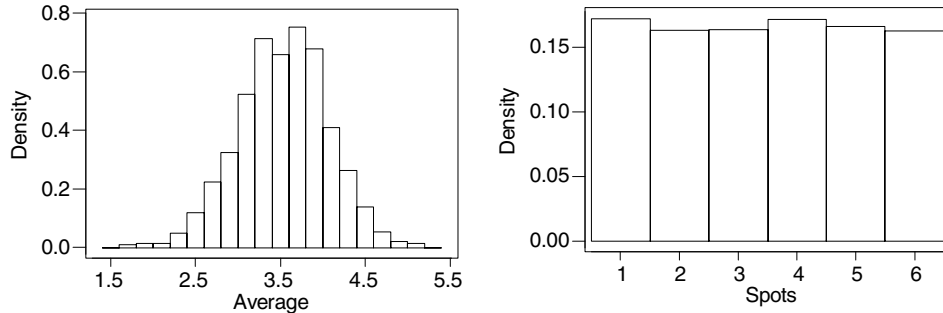
27. A survey organization would like to estimate a population percentage in a large population to an accuracy of 10 percentage points with 95% confidence. They have no current knowledge of the size of the population percentage. How large should a random sample be selected to achieve their goal for the margin of sampling error?

- A) 10
- B) 100
- C) 1000
- D) 10,000
- E) None of the above.

28. If data have a very strong downward relationship, it is possible to get a correlation coefficient that is smaller than  $-1$ .

- A) True    B) False

29. Ten dice were rolled and the average (mean) number of spots on the ten dice calculated. This process was repeated 1000 times. The density histograms for the 1000 Averages and for the 10,000 individual dice rolls are shown below. Which of the following statements are illustrated in the plots?



- A) The approximate normality of the sampling distribution of the sample mean.  
B) The fact that the mean of the sampling distribution of the sample mean is the mean of the process.  
C) The fact that the standard deviation of the sampling distribution of the sample mean is  $\sigma/(\sqrt{n})$ .  
D) The uniform distribution of the individual spots on the dice.  
E) All of the above.

30. The  $t$  distribution with 13 degrees of freedom has a smaller standard deviation than the standard deviation of the standard normal distribution.

- A) True    B) False

31. If any set of data is standardized, the mean of the standardized data will be zero.

- A) True    B) False

32. A **Type I error** is rejecting a true null hypothesis.

- A) True    B) False

33. An auditor must audit the costs of an inventory of 90,000 items. Unfortunately time and budget does not allow a census so he must base his conclusions on a simple random sample of 100 items. After selecting the sample data he finds a sample mean of \$134 and sample standard deviation of \$80. What is his **margin of error** in estimating the mean value of the 90,000 items in the inventory if he uses a 95% confidence level?

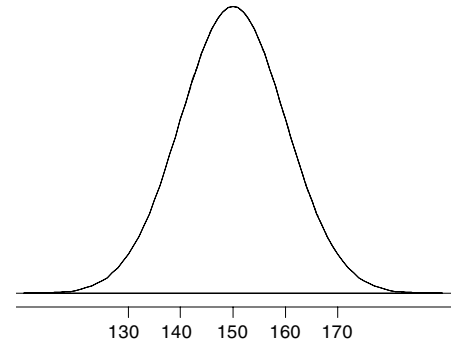
- A) \$16  
B) \$80  
C) \$134  
D) \$160  
E) Cannot be determined from the information given.

34. If Nancy flips a fair coin 5 times, what is the chance she gets at least one head?

- A) 0.03125
- B) 0.15625
- C) 0.50000
- D) 0.84375
- E) 0.96875

35. The graph at the right is the sampling distribution of  $\bar{y}$  based on random samples of size 49. Which of the following is the value of  $\sigma$  for the distribution of *individual values*?

- A) 10
- B) 30
- C) 50
- D) 70
- E) 90



36. A machine that caps Pepsi bottles has a chance 0.01 of not sealing an individual bottle properly. Each bottle is sealed independently of all the other bottles. Which one of the following is true?

- A) The number of unsealed caps in the next 100 bottles has a Bernoulli distribution.
- B) The number of bottles processed before the first unsealed cap occurs has a Bernoulli distribution.
- C) The number of properly sealed caps in a case of 24 bottles has a Binomial distribution.
- D) The proportion of bottles with properly sealed caps in a case of 24 bottles has a Binomial distribution.
- E) The amount of Pepsi in a bottle has Binomial distribution.

37. A temporary employee would be considered a special cause of variation.

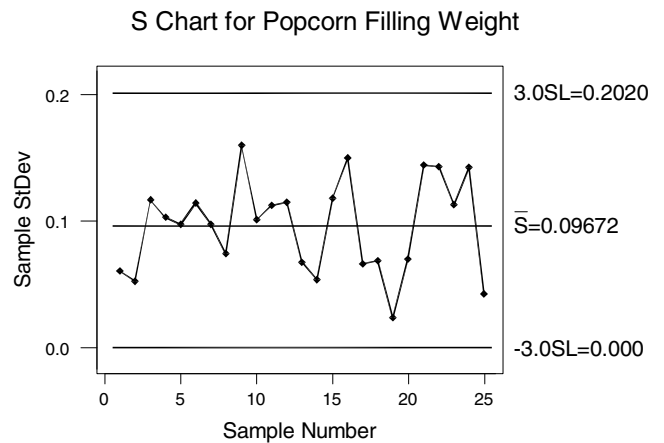
- A) True
- B) False

38. Halon 1301 is an extinguishing agent for fires resulting from flammable vapors and liquids. A chemical company producing fire-extinguishing mixtures involving Halon 1301 is interested in the mean concentration by volume of Halon 1301. Specifically, they are interested in testing the hypotheses:  $H_0: \mu = 5.7$  versus  $H_1: \mu \neq 5.7$ . They sampled 20 batches and found the sample mean concentration to be 5.68 and the sample standard deviation to be 0.30. The test is conducted at the 5% significance level. Which of the following statements is correct?

- A) We would not reject  $H_0$ , as the test statistic,  $t = -0.30$ , is between  $-2.093$  and  $2.093$ .
- B) We would not reject  $H_0$ , as the test statistic,  $t = -0.07$ , is between  $-2.093$  and  $2.093$ .
- C) We would not reject  $H_0$ , as the test statistic,  $t = -0.30$ , is between  $-1.729$  and  $1.729$ .
- D) We would reject  $H_0$ , as the test statistic,  $t = -0.30$ , is between  $-2.093$  and  $2.093$ .
- E) We would reject  $H_0$ , as the test statistic,  $t = -0.30$ , is between  $-1.729$  and  $1.729$ .

39. A city bus has a capacity of 36 people. The weights of the passengers have a distribution with a mean of 163 pounds and a standard deviation of 24 pounds. If the bus is full, what is the chance that the total weight in the bus is less than 5,500 pounds?
- A) 0.0000  
 B) 0.0052  
 C) 0.3336  
 D) 0.6664  
 E) 0.9948

40. A food processing process produces premium popcorn. The weight on the box is listed as 6 ounces. The graph at the right shows a control chart on the standard deviation of fill weight based on 25 subgroups of size 5. Which of the following statements gives a correct interpretation of the chart?



- A) The chart indicates that the filling process is in control both in mean level and variability.  
 B) The chart indicates that the filling process is in control with respect to variability and is thus filling at the correct mean level.  
 C) The chart indicates that the filling process is in control with respect to variability but the mean level is too high.  
 D) The chart indicates that the filling process is in control with respect to variability but the mean level is too low.  
 E) The chart indicates that the filling process is in control with respect to variability but says nothing about the mean level of the process.

41. *The Wall Street Journal* (March 28, 1994) reported the results of a survey based on a random sample of 617 U.S. companies. In the sample they found that 56 companies require their employees to surrender business-related airline frequent-flyer mile awards to the company. Let  $\pi$  be the proportion of *all* U.S. companies that had such a requirement at that time. Which of the following gives a 95% confidence interval for  $\pi$ ?

- A)  $0.09 \pm 3 \sqrt{\frac{0.09(0.91)}{617}}$   
 B)  $0.09 \pm 3 \sqrt{\frac{0.5(0.5)}{617}}$   
 C)  $0.09 \pm 2 \sqrt{\frac{0.09(0.91)}{617}}$   
 D)  $0.09 \pm 2 \sqrt{\frac{0.5(0.5)}{56}}$   
 E)  $0.09 \pm 2 \sqrt{\frac{0.09(0.91)}{56}}$

42. The table below displays a small universe and categorical variable. Use the following portion of a random number table to select a random sample of size 3. **86041 02791 11524 50108 12799**  
 Use the assigned IDs and start at the beginning (left) of the row and read across. Which subjects are selected for the sample?

ID	Name	Favor Company Benefit plan?	ID	Name	Favor Company Benefit plan?
1	Alan	Yes	7	Gus	Yes
2	Bert	Yes	8	Helen	No
3	Carrie	No	9	Irene	Yes
4	Dora	Yes	10	Jack	No
5	Edith	Yes	11	Kathy	No
6	Frank	Yes	12	Leo	Yes

- A) Helen, Frank, Dora  
 B) Dora, Jack, Kathy  
 C) Alan, Bert Carrie  
 D) Dora, Bert, Kathy  
 E) Kathy, Dora, Alan
43. Refer to question 42. If  $\pi$  is the population proportion who favor the company benefit plan, what is the value of  $\pi$ ? (to the nearest hundredth)
- A) 0.33  
 B) 0.50  
 C) 0.67  
 D) 0.95  
 E) Cannot be determined from the information given.
44. A state tax department routinely audits major companies. A large manufacturer has reported that the average amount of taxable purchases per invoice is \$288. The tax department selects a random sample of 200 such invoices and finds a mean taxable amount of \$297. The standard deviation in the sample is \$60. If the tax department uses the companies reported mean as a null hypothesis value and suspects that the company is reporting values that are too low, what is the  $p$ -value of the hypothesis test?
- A) 0.0100  
 B) 0.0170  
 C) 0.0500  
 D) 0.1500  
 E) 0.4404

45. Two discussion sections of *Statistics for Business* carried out the Random Rectangles exercise in their discussion classes. One class was of size 8 and the other of size 16. Minitab results of comparing the means of the samples of areas are summarized below. (You may assume that all of these numbers have been calculated correctly!)

### Two-Sample T-Test and CI: Random Areas by Section

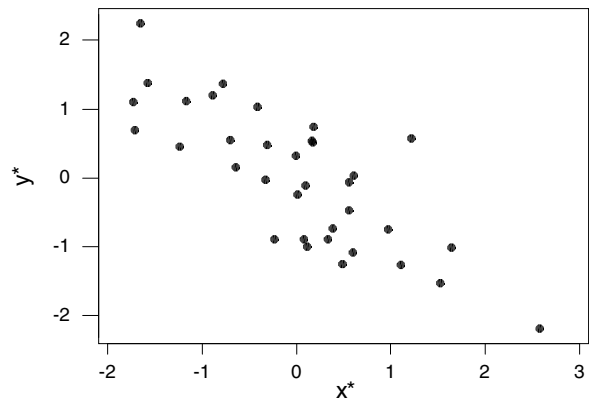
Two-sample T

Section	N	Mean	StDev	SE Mean
1	8	475	136	48
2	16	495	188	47

Difference =  $\mu$  (1) -  $\mu$  (2)  
 Estimate for difference: -20.0  
 95% CI for difference: (-161.1, 121.1)  
 T-Test of difference = 0 (vs not =): T-Value = -0.30 P-Value = 0.769 DF = 18

Do these results give evidence of statistically significant differences between the means of the two sections?

- A) The results are statistically significantly different at the 1% significance level.  
 B) The results are statistically significantly different at the 5% significance level.  
 C) The results are statistically significantly different at the 10% significance level.  
 D) The results are **not** statistically significantly different at the any significance level.  
 E) The results are **not** statistically significantly different at the 5% significance level.
46. One of the following equations is the least squares regression line for the data in the scatterplot at the right. Both variables were first standardized. Which one is it? (Hint: The correlation here is about  $-0.8$ .)
- A)  $y^* = 1 - 0.8 x^*$   
 B)  $y^* = -1 - 0.8 x^*$   
 C)  $y^* = [1/(-0.8)] x^*$   
 D)  $y^* = -1 - x^*$   
 E)  $y^* = -0.8 x^*$



47. In class we tossed a blow-up globe to estimate the proportion,  $\pi$ , of the Earth's surface that was covered with water. With our small sample of 15 tosses, we obtained a 95% confidence interval for  $\pi$  of from 0.51 to 0.95. Which one of the following statements gives a correct interpretation of this interval?
- A) The probability is 95% that  $\pi$  is somewhere between 0.51 and 0.95.  
 B) The probability is 95%, or even greater, that  $\pi$  is somewhere between 0.51 and 0.95.  
 C) The probability is between 51% and 95% that our confidence interval contains the value of  $\pi$ .  
 D) If we were to repeat the sampling, each time recalculating the 95% confidence interval for  $\pi$ , in the long run 95% of these intervals would contain the value of  $\pi$ .  
 E) None of the above gives a correct interpretation of our confidence interval.

48. The percentage of data points falling at or below the third quartile of a distribution is

- A) 25%
- B) 33%
- C) 50%
- D) 75%
- E) 100%

49. Consider flipping a coin 10 times and using the resulting data to test the null hypothesis that the coin is fair or balanced. An investigator decides to reject the null hypothesis only if she gets 1 or fewer successes or 9 or more successes. With this decision rule, what is the probability of a Type I error? (The table at the right gives the Binomial probabilities for various numbers of successes when  $n = 10$  and  $\pi = 0.5$ .)

- A) 0.000977
- B) 0.009766
- C) 0.010743
- D) 0.021486
- E) 0.050000

Successes	Probability
0	0.000977
1	0.009766
2	0.043945
3	0.117188
4	0.205078
5	0.246094
6	0.205078
7	0.117188
8	0.043945
9	0.009766
10	0.000977

50. A treatment that has no active ingredient is a

- A) confounding treatment
- B) experimental treatment
- C) placebo treatment
- D) observational treatment
- E) biased treatment