1. Height, in meters, is measured for every person in a sample. Then the data are converted to the height measurements are converted from meters to centimeters by multiplying each by 100. Which of the following statistics will be the same for both sets of measurements?

(A) The mean of the height measurements

(B) The median of the height measurements

(C) The standard deviation of the height measurements

(D) The maximum of the height measurements

(E) The z-scores of the height measurements

2. A school principal wanted to investigate student opinion about the food served in the school cafeteria. The principal selected at random samples of 50 first-year students, 50 second-year students, 50 third year students, and 50 fourth-year students to complete a questionnaire. Which of the following best describes the principal's sampling plan?

(A) A stratified random sample
(B) A simple random sample
(C) A cluster sample
(D) A convenience sample
(E) A systematic sample

3. A candy company produces individually wrapped candies. The quality control manager for the company believes that the weight of the candies is approximately normally distributed with mean 720 milligrams (mg). If the manager's belief is correct, which of the following intervals of weights will contain the largest proportion of the candies in the distribution of weights?

(A) 740 mg to 780 mg

(B) 700 mg to 740 mg

(C) 680 mg to 720 mg

(D) 660 mg to 700 mg

(E) 620 mg to 660 mg

4. A company currently uses Brand A lightbulbs, which have a mean life of 1,000 hours. A salesperson marketing Brand B claims Brand B bulbs have a longer mean life. The company will switch to Brand B only if there is convincing evidence that the mean life of Brand B is greater than 1,000 hours. Which of the following hypotheses should the company test?

(A) H_0 : The mean life of Brand B bulbs is 1,000 hours.
H_a : The mean life of Brand B bulbs is more than 1,000 hours.

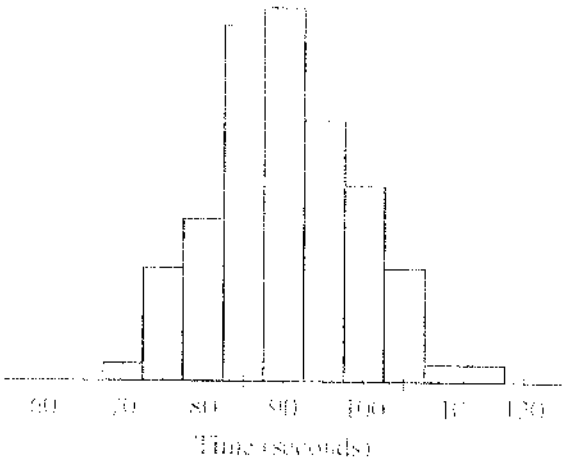
(B) H_0 : The mean life of Brand B bulbs is 1,000 hours.
H_a : The mean life of Brand B bulbs is less than 1,000 hours.

(C) H_0 : The mean life of Brand A bulbs is 1,000 hours.
H_a : The mean life of Brand A bulbs is more than 1,000 hours.

(D) H_0 : The mean life of Brand A bulbs is 1,000 hours.
H_a : The mean life of Brand A bulbs is less than 1,000 hours.

(E) H_0 : The mean life of Brand A bulbs is equal to the mean life of Brand B bulbs.
H_a : The mean life of Brand A bulbs is not equal to the mean life of Brand B bulbs.

5. The amount of time required for a group of 100 cars to pass through a toll booth was recorded. The histogram below shows the distribution of these times, in seconds, for the 100 cars.



Which of the following values is closest to the standard deviation of the 100 times?

(A) 2.5 seconds

(B) 10 seconds

(C) 20 seconds

(D) 50 seconds

(E) 90 seconds

6. A graph (not shown) of the selling prices of homes in a certain city for the month of April reveals that the distribution is skewed to the left. Which of the following statements is the most reasonable conclusion about the selling prices based on the graph?

(A) The mean is greater than the median.

(B) The median is the average of the first quartile and the third quartile.

(C) There are fewer selling prices between the first quartile and the median than there are between the median and the third quartile.

(D) There are more selling prices that are less than the mean than selling prices that are greater than the mean.

(E) The value of maximum minus third quartile is less than the value of first quartile minus minimum.

7. A survey was conducted in which both men and women were asked their opinion about capital punishment. Each response to this question were "in favor of," "not in favor of," or "no opinion." A chi-square test is to be used to determine whether the response to this question is independent of gender. The number of degrees of freedom for the chi-square test in this situation is

(A) 0

(B) 2

(C) 3

(D) 5

(E) 6

8. If a probability distribution is symmetric, which of the following statements must be true?

(A) The distribution is normal.

(B) The distribution is uniform.

(C) The distribution is binomial.

(D) The mean of the distribution is equal to the median of the distribution.

(E) The standard deviation of the distribution is equal to the variance of the distribution.

9. Let X represent the number of fish caught per hour by a randomly selected fisherman at Lake Lure. The mean of X is 2.5, and the standard deviation of X is approximately 1.408. Two fishermen are selected at random from Lake Lure and the number appearing on the box plot for the sum of their catches is recorded. Which of the following is closest to the standard deviation of the resulting sums?

(A) 1.768

(B) 1.846

(C) 2.415

(D) 3.416

(E) 5.835

10. Based on previous research, the standard deviation of the distribution of the age at which children begin to walk is estimated to be 1.5 months. A random sample of children will be selected, and the age at which each child begins to walk will be recorded. A 99 percent confidence interval for the average age at which children begin to walk will be constructed using the data obtained from the sample of children. Of the following, which is the smallest sample size that will result in a margin of error of 0.1 month or less for the confidence interval?

(A) 400

(B) 900

(C) 1,300

(D) 1,600

(E) 2,100

11. Let X be a random variable that has a skewed distribution with mean $\mu = 10$ and standard deviation $\sigma = 10$. Based on random samples of size 400, the sampling distribution of $\bar{x}$ is

(A) highly skewed with mean 10 and standard deviation 10

(B) highly skewed with mean 10 and standard deviation 5

(C) highly skewed with mean 10 and standard deviation 0.5

(D) approximately normal with mean 10 and standard deviation 10

(E) approximately normal with mean 10 and standard deviation 0.5

12. The number of hurricanes reaching the East Coast of the United States was recorded for the last fifty years by the National Hurricane Center. Summary statistics are shown below.

Min = 12	Max = 34
Lower quartile = 15	Upper quartile = 22
Median = 16	$\bar{x}$ = 20

Which of the following statements is true?

(A) The smallest observation is 12 and it is an outlier. No other observations in the data set could be outliers.

(B) The largest observation is 24 and it is an outlier. No other observations in the data set could be outliers.

(C) Both 12 and 24 are outliers. It is possible that there are other outliers.

(D) 12 is an outlier and it is possible that there are other outliers at the low end of the data set. There are no outliers at the high end of the data set.

(E) 24 is an outlier and it is possible that there are other outliers at the high end of the data set. There are no outliers at the low end of the data set.

A medical researcher is studying the effectiveness of a new medication for migraine headaches. The researcher is specifically interested in how quickly pain relief occurs after the medication is taken. A double-blind experiment was conducted in which 10 people who experience chronic pain were randomly selected to take either the new or the current medication. Each of the 10 people recorded the time, in minutes, from taking the medication until pain relief. After an appropriate time period, each of the 10 people took the other medication and recorded the time from taking the medication until pain relief. The medication each person took first was randomly determined, and because both medications look the same, the people in the study did not know which medication was taken first. The table below shows summary statistics for the results.

	Minutes until Pain Relief		Difference (new minus current)
	New Medication	Current Medication	
Mean	15.600	16.025	−0.425
Standard deviation	1.811	2.833	1.395

Which of the following values is closest to the p-value of the appropriate t-test?

(A) 0.1802

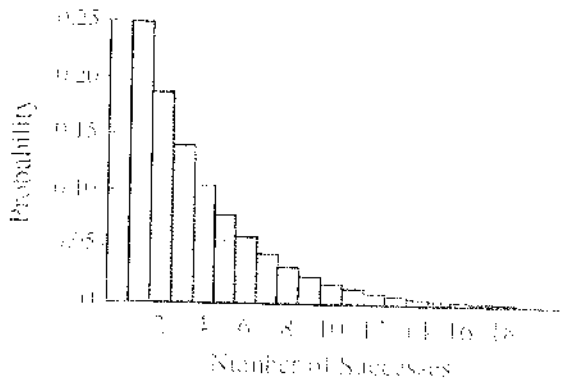
(B) 0.3604

(C) 0.4750

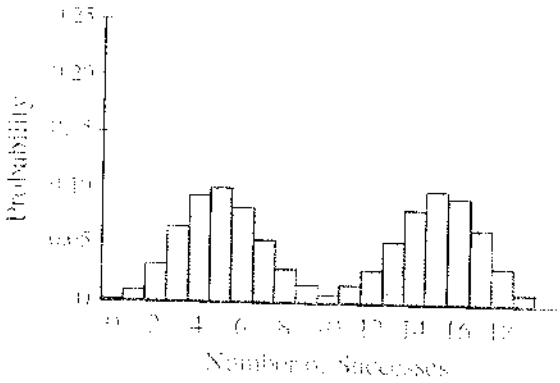
(D) 0.5770

11. Which of the following graphs represents a binomial distribution with $n = 20$ and $p = 0.25$?

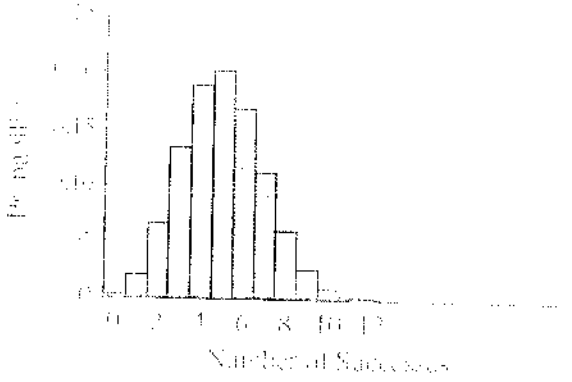
(A)



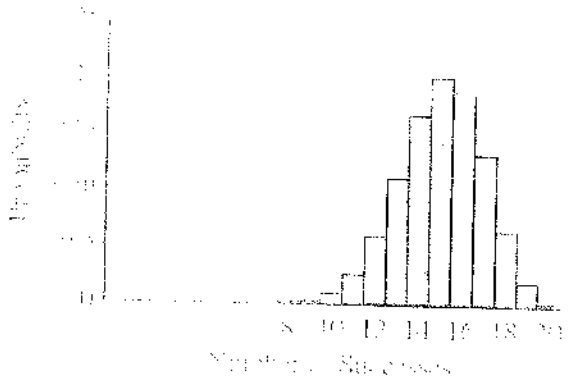
(B)



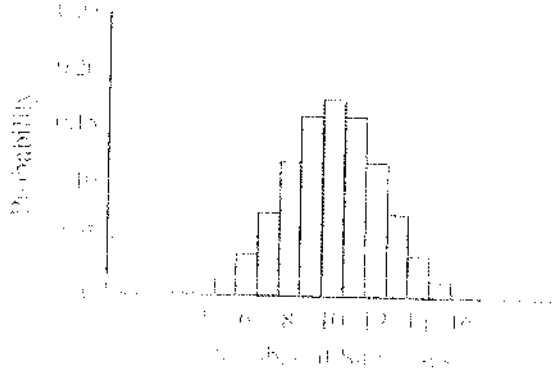
(C)



(D)



(E)



[illegible] to determine whether children learn their math facts faster by practicing with flash cards or by practicing on a computer. Children who volunteer for the study will be randomly assigned to one of the two treatments. Because the child's gender may affect the outcome, they will be blocking by gender. After practice, the children will be given a test on their multiplication facts. Why will it be impossible to conduct a double-blind study?

(A) The experimenter will know whether the child is a boy or a girl and whether he or she used flash cards or the computer.

(B) The child will know whether he or she is a boy or a girl.

(C) The child will know whether he or she used flash cards or the computer.

(D) The person who grades the tests will know whether the child was a boy or a girl.

(E) The person who grades the tests will know whether the child used flash cards or the computer.

16. A police officer is using a radar device to check motorists' speeds. Prior to beginning the speed check, the officer estimates that 40 percent of motorists will be driving more than 5 miles per hour over the speed limit. Assuming that the police officer's estimate is correct, what is the probability that among 4 randomly selected motorists, the officer will find at least 1 motorist driving more than 5 miles per hour over the speed limit?

(A) 0.0256

(B) 0.1296

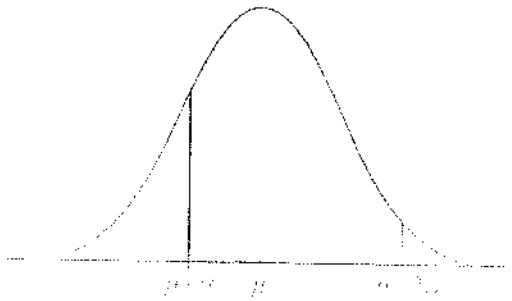
(C) 0.3456

(D) 0.8704

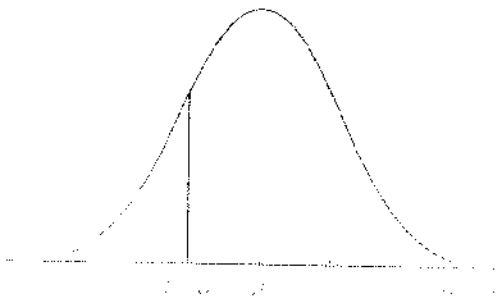
(E) 0.9744

17. Zucchini weights are approximately normally distributed with mean 0.8 pound and standard deviation 0.25 pound. Which of the following shaded regions best represents the probability that a randomly selected zucchini will weigh between 0.55 pound and 1.3 pounds?

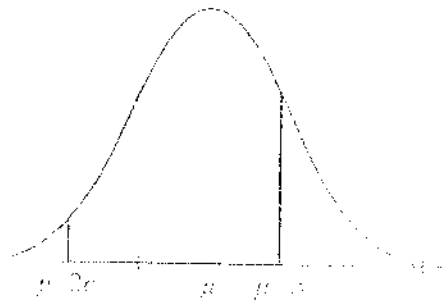
(A)



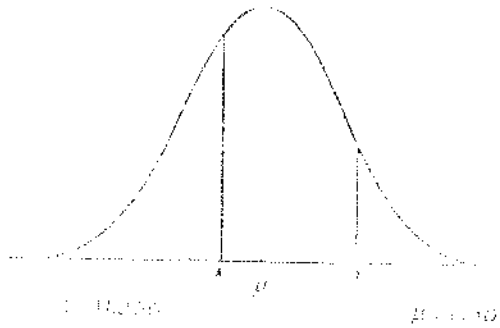
(B)



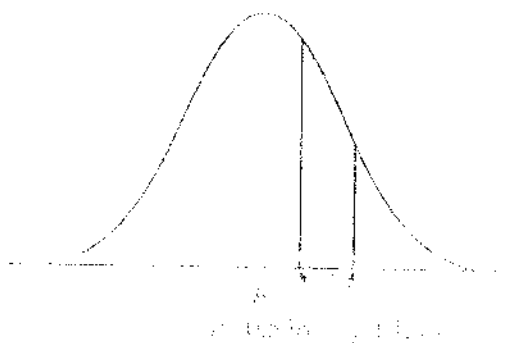
(C)



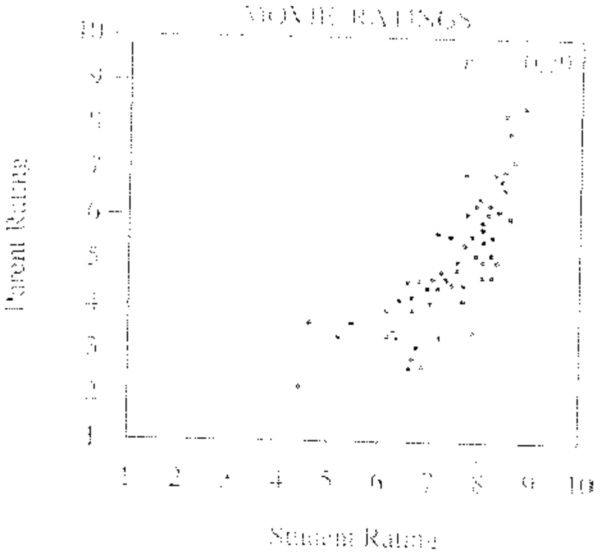
(D)



(E)



16. In a recent study, a group of students in a particular school were asked to rate 60 recently released movies. The rating system was on a scale from 1 to 10, where 1 was "terrible" and 10 was "excellent". For each movie, the average rating by the students and the average rating by their parents was calculated and the scatterplot below was constructed. The horizontal axis represents the student rating and the vertical axis represents the parent rating. Thus, each individual data point would represent the rating of a single movie.



Which of the following statements is justified by the scatterplot?

(A) The movies that the students liked the best also tended to be the movies that the parents liked the best, but the students tended to give lower scores.

(B) The movies that the students liked the best also tended to be the movies that the parents liked the best, but the students tended to give higher scores.

(C) The movies that the students liked the best also tended to be the movies that the parents liked the best, but each group tended to give the same scores.

(D) The movies that the students liked the best tended to be the movies that the parents liked the least, but the students tended to give lower scores.

(E) The movies that the students liked the best tended to be the movies that the parents liked the least, but the students tended to give higher scores.

17. Jessica wanted to determine if the proportion of males for a certain species of laboratory animal is less than 0.5. She was given access to appropriate records that contained information on 12,000 live births for the species. To construct a 95 percent confidence interval, she selected a simple random sample of 100 of the births from the records, and found that 31 births were male.

Based on the study, which of the following expressions is an appropriate 95 percent confidence interval estimate for p, the proportion of males in the 12,000 live births?

(A) $0.31 \pm 1.96\sqrt{\frac{(0.31)(0.69)}{12{,}000}}$

(B) $0.31 \pm 1.645\sqrt{\frac{(0.31)(0.69)}{12{,}000}}$

(C) $0.31 \pm 1.96\sqrt{\frac{(0.5)(0.5)}{12{,}000}}$

(D) $0.31 \pm 1.645\sqrt{\frac{(0.5)(0.5)}{100}}$

(E) $0.31 \pm 1.96\sqrt{\frac{(0.31)(0.69)}{100}}$

22. [illegible] for comparing weights between [illegible] provided scores for [illegible] streets dance and gymnastics packages with [illegible] proportions of [illegible] for the [illegible] Each [illegible] random sample of 500 service [illegible] from the town's records, sorted into one of 10 [illegible] categories. Which of the following tests could be used to determine whether the proportions of services [illegible] classified into the 10 service categories for the two different communities [illegible]?

(A) A two-sample z test for a difference of means

(B) A matched-pairs t test for means

(C) A chi-square test of association

(D) A chi-square goodness-of-fit test

(E) A z test for a correlation of proportions

21. Dan selected a random sample of 100 students from the 1,200 at his school to investigate preferences for making up school days lost due to emergency closings. The results are shown in the table below.

Preference	Number of Students
Extend the school year into the summer	58
Go to school on Saturdays in the spring	42

Dan incorrectly performed a large sample test of the difference in two proportions using $\frac{58}{100}$ and $\frac{42}{100}$ and calculated a p-value of 0.02. Consequently, he concluded that there was a significant difference in preference for the two options. Which of the following best describes his error in the analysis of these data?

(A) No statistical test was necessary because 0.58 is clearly larger than 0.42.

(B) The results of the test were invalid because less than 10% of the population was sampled.

(C) Dan performed a two-tailed test and should have performed a one-tailed test.

(D) A one-sample test for a proportion should have been performed because only one sample was used.

(E) More options should have been included, and a chi-square test should have been performed.

23. In a certain school, 17 percent of the students are enrolled in a psychology course, 28 percent are enrolled in a foreign language course, and 32 percent are enrolled in either a psychology course or a foreign language course or both. What is the probability that a student chosen at random from this school will be enrolled in both a foreign language course and a psychology course?

(A) 0.25

(B) 0.17

(C) 0.13

(D) 0.13

(E) 0.08

24. Monthly rent was determined for each apartment in a random sample of 100 apartments. The sample mean was $820 and the sample standard deviation was $25. A 95 percent, 95 percent confidence interval for the true mean monthly rent for the population of apartments from which this sample was selected is (S815, S825). Which of the following statements is a correct interpretation of the 95 percent confidence level?

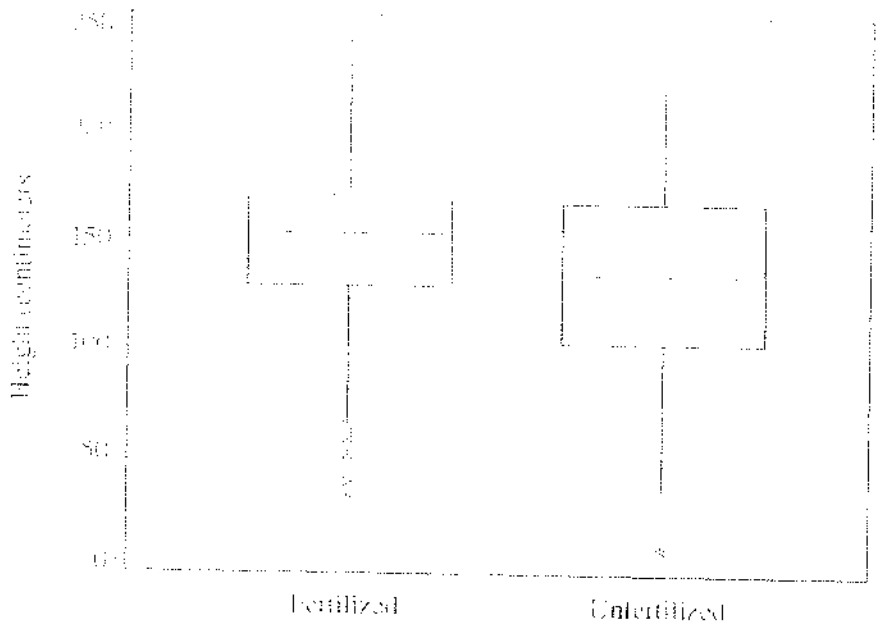
(A) In this population, about 95 percent of all rental prices are between $815 and $825.

(B) In this sample, about 95 percent of the 100 rental prices are between $815 and $825.

(C) In repeated sampling, the method produces intervals that include the population mean approximately 95 percent of the time.

(D) In repeated sampling, the method produces intervals that include the sample mean approximately 95 percent of the time.

(E) There is a 95 percent probability that the interval [illegible]



22. The figure above summarizes the heights, in centimeters, of approximately 4000 pine seedlings six years after they were planted at a center for environmental study. Approximately half of the trees were fertilized yearly, and the remaining trees were never fertilized. Which of the following statements about the medians and interquartile ranges (IQRs) of the heights of the two groups of trees 6 years after being planted is true?

(A) The medians and IQRs are the same for the unfertilized trees and the fertilized trees.

(B) The median for the unfertilized trees is greater than the median for the fertilized trees, and the IQR is also greater for the unfertilized trees.

(C) The median for the unfertilized trees is the same as the median for the fertilized trees, and the IQR is greater for the unfertilized trees.

(D) The median for the unfertilized trees is less than the median for the fertilized trees, and the IQR is greater for the unfertilized trees.

(E) The median for the unfertilized trees is less than the median for the fertilized trees, and the IQR is less for the unfertilized trees.

23. Two friends, Andy and Bob, participate in a series of bowling events every week. From past experience, it is known that both friends' scores are approximately normally distributed, where Andy has a mean score of 150 with a standard deviation of 10, and Bob has a mean score of 160 with a standard deviation of 12. Assuming games from each week are independent, which of the following is closest to the probability that Andy will have a higher score than Bob for a single game?

(A) 0.10

(B) 0.28

(C) 0.31

(D) 0.55

(E) 0.69

24. A certain motel is roughly 20 miles from the entrance to Yosemite National Park. The motel manager wants to get a better estimate of the distance and asks five people to each measure the distance, to the nearest tenth of a mile, using the odometer in his or her car. The manager will use the median of the five measurements as the estimate of the distance. Which of the following statements is NOT a statistical justification for the manager's plan?

(A) Odometer reading should be considered a variable when used to measure this distance.

(B) The median of the five measurements is more likely to be close to the actual distance than is a single measurement.

(C) The actual distance should be considered a variable, and taking five measurements allows the manager to investigate the variability in the actual distance.

(D) If one or two odometers is giving inaccurate readings, the estimate still should be fairly close to the actual distance.

(E) The manager can present publication bias to tell the story he wants to tell.

A researcher is investigating the relationship between body weight and brain weight for a species of mammal. The researcher randomly selects 22 mammals of this species from the body weight database for the study. Body weight, in kilograms, and brain weight, in grams, are recorded for each animal. A linear regression analysis is performed on the data, yielding the output shown below.

Regression Analysis: Brain Wt vs Body Wt $n = 22$

Predictor	Coef	SE Coef	T	P
Constant	68.688	3.1270	21.966	0.000
Body Wt	1.096	0.1308	8.379	0.000

S = 103.995 R-sq = 77.8% R-sq (adj) = 77.6%

Assuming that all conditions for inference are met, which of the following expressions represents a 95 percent confidence interval for the slope of the least squares regression line?

(A) $1.096 \pm 2.086(0.1308)$

(B) $1.096 \pm 2.086(103.995)$

(C) $1.096 \pm 2.086\left(\frac{0.1308}{\sqrt{22}}\right)$

(D) $1.096 \pm 2.086\left(\frac{103.995}{\sqrt{22}}\right)$

(E) $68.688 \pm 2.086(3.1270)$

28. A marketing research consultant for a hotel chain hypothesizes that men and women differ in their color preference for guest rooms. The consultant shows pictures of rooms decorated with three different color schemes to each person in a random sample of 110 men and to each person in a random sample of 90 women. The consultant asks each person to choose his or her favorite color scheme. A chi-square test for homogeneity of proportions will be used to test the consultant's hypothesis. Assuming that the conditions for inference are met, which of the following statements is true for the test?

(A) The null hypothesis for the test is that the proportion of each gender who prefer each color scheme is $\frac{1}{3}$.

(B) The sample size is too small to detect a significant difference in a chi-square test for homogeneity of proportions.

(C) The test is not valid because the sample sizes are not equal.

(D) The more that men and women differ in their color preferences, the larger the chi-square statistic will be.

(E) The test would also be appropriate if 100 men and 100 women had been used for the study.

29. The distribution of heights of 6-year-old girls is approximately normally distributed with a mean of 46.0 inches and a standard deviation of 2.7 inches. Aliyaah is 6 years old, and her height is 0.90 standard deviation above the mean. Her friend Jayne is also 6 years old and is at the 93rd percentile of the height distribution. At what percentile is Aliyaah's height, and how does her height compare to Jayne's height?

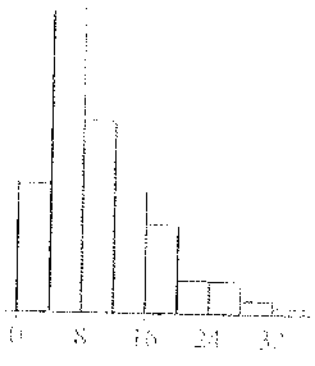
(A) Aliyaah's height is at the 17th percentile of the distribution, and she is shorter than Jayne.

(B) Aliyaah's height is at the 67th percentile of the distribution, and she is shorter than Jayne.

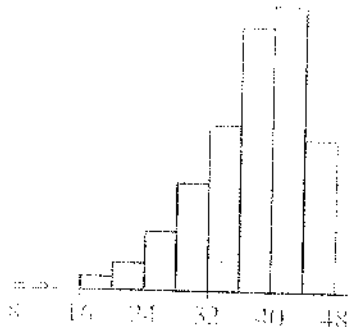
(C) Aliyaah's height is at the 67th percentile of the distribution, and she is taller than Jayne.

(D) Aliyaah's height is at the 83rd percentile of the distribution, and she is shorter than Jayne.

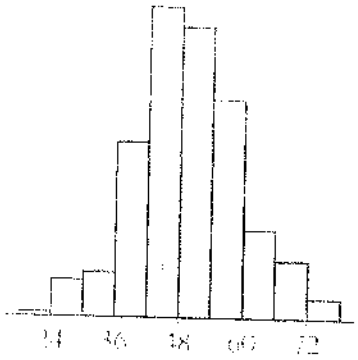
(E) Aliyaah's height is at the 83rd percentile of the distribution, and she is taller than Jayne.



Histogram J



Histogram K



Histogram L

30. For the three histograms above, which of the following correctly orders the histograms from the one with the smallest proportion of data above its mean to the one with the largest proportion of data above its mean?

(A) J, K, L

(B) J, L, K

(C) K, L, J

(D) L, K, J

(E) All three histograms have the same proportion of data above their respective means.

31. A recent study examined 699 car accidents in Toronto over a fourteen-month period. Records of phone-service providers were used to determine whether the driver was using a cell phone during or immediately before the accident. Overall, the researchers found that drivers using cell phones were 1.3 times as likely to have an accident as drivers who were not using cell phones. The result was statistically significant. Which of the following can be concluded from this study?

(A) Cell phone use increases the likelihood of a car accident.

(B) There is an association between cell phone use and accidents, but not necessarily a causal relationship.

(C) There is a correlation between cell phone use and accidents, but not necessarily an association.

(D) The association between cell phone use and accidents is negative.

(E) Cell phone use causes more accidents in Canada, but not necessarily in the United States.

32. A randomized block design will be used in an experiment to compare several diets that interest people from getting a sunburn. Which of the following should guide the construction of the blocks?

(A) Each participant in the same block should receive the same diet.

(B) Participants should be randomly assigned to the blocks.

(C) Participants should be kept blind as to which block they are in.

(D) Participants within each block should be as similar as possible with respect to how easily they get sunburned.

(E) Participants within each block should be as different as possible with respect to how easily they get sunburned.

33. A regional transportation authority is interested in estimating the mean number of minutes working adults in the region spend commuting to work on a typical day. A random sample of working adults will be selected from each of three strata: urban, suburban, and rural. Selected individuals will be asked the number of minutes they spend commuting to work on a typical day. Why is stratification used in this situation?

(A) To remove bias when estimating the proportion of working adults living in urban, suburban, and rural areas.

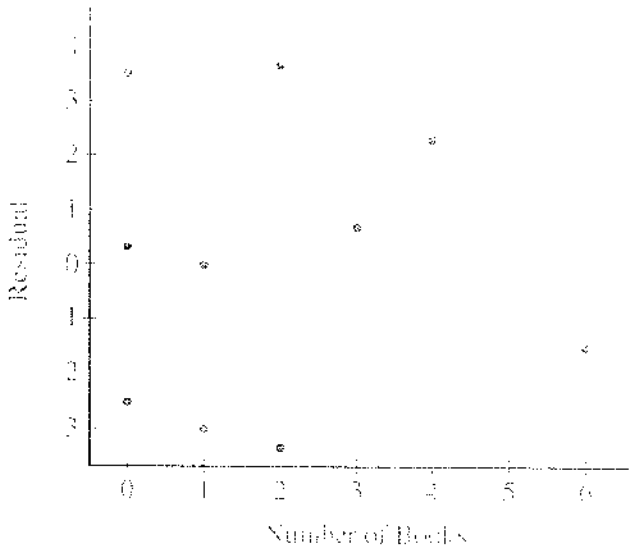
(B) To remove bias when estimating the mean commuting time.

(C) To reduce bias when estimating the mean commuting time.

(D) To decrease the [illegible] of the proportion of the people from working adults living in urban, suburban, and rural areas.

(E) To decrease the variability in the mean, and the number of [illegible]

7. The weight, in pounds, of a full backpack and the corresponding number of books in the backpack were recorded for each of 8 middle school students. The scatterplot, data were used to create the residual plot and the regression output shown below.



Parameter	Estimate	Std. Err.	Alternative	DF	T-Stat	P-Value
Intercept	10.53	1.23	≠ 0	8	8.57	< 0.0001
Slope	0.53	0.46	≠ 0	8	1.15	0.2825

Which of the following values is closest to the actual weight, in pounds, of the backpack for the student who had 4 books in the backpack?

(A) 8

(B) 10

(C) 13

(D) 15

(E) 17

8. A group of students wanted to determine if the average number of text messages sent yesterday by students in their school was greater than 100. They selected a simple random sample of 25 students and recorded the number of text messages he or she sent yesterday. An appropriate t test was conducted and resulted in a p-value of 0.0585. Assuming the conditions for the test were met, which of the following is an appropriate conclusion?

(A) Because $p = 0.30$, at the 10% significance level, it can be concluded that the mean number of text messages sent yesterday by students in the school is less than 100.

(B) Because $p = 0.30$, at the 10% significance level, it cannot be concluded that the mean number of text messages sent yesterday by students in the school is greater than 100.

(C) Because $p > 0.05$, at the 5% significance level, it can be concluded that the mean number of text messages sent yesterday by students in the school is greater than 100.

(D) Because $p > 0.05$, at the 5% significance level, it can be concluded that the mean number of text messages sent yesterday by students in the school is less than 100.

(E) Because $p > 0.05$, at the 5% significance level, it cannot be concluded that the mean number of text messages sent yesterday by students in the school is greater than 100.

37. Two classes are competing to donate the greatest total amount of money to a charity each week for the next year. The first class collects weekly donations that are approximately normally distributed with mean $40 and standard deviation $10, and the second class collects weekly donations that are approximately normally distributed with mean $60 and standard deviation $20. Which of the following is closest to the expected number of weeks in a 52-week year that their combined donation will exceed $1200?

(A) 0, the combined donation will never exceed $1200 in a week

(B) 1 week

(C) 3 weeks

(D) 5 weeks

(E) 8 weeks

38. A university will add fruit juice vending machines to its classroom buildings if the student body president is convinced that more than 20 percent of the students will use them. A random sample of n students will be selected and asked whether or not they would use the vending machines. A large sample test for proportions at the significance level of $\alpha = 0.05$ will be performed. The null hypothesis that the proportion of all students who would use the vending machines is 20 percent will be tested against the alternative that more than 20 percent of all students would use them. For which of the following situations would the power of the test be highest?

(A) The sample size is $n = 750$ and 20 percent of all students use the vending machines.

(B) The sample size is $n = 750$, and 25 percent of all students use the vending machines.

(C) The sample size is $n = 1{,}000$, and 25 percent of all students use the vending machines.

(D) The sample size is $n = 500$, and 50 percent of all students use the vending machines.

(E) The sample size is $n = 1{,}000$, and 50 percent of all students use the vending machines.

39. Each of the faces of a fair six-sided number cube is numbered with one of the numbers 1 through 6, with a different number appearing on each face. Two such number cubes will be tossed, and the sum of the numbers appearing on the faces that land up will be recorded. What is the probability that the sum will be 4, given that the sum is less than or equal to 6?

(A) $\frac{2}{36}$

(B) $\frac{3}{36}$

(C) $\frac{3}{6}$

(D) $\frac{3}{4}$

(E) $\frac{2}{3}$

40. An experiment will be conducted to test the effectiveness of a weight-loss supplement. Volunteers will be randomly assigned to take either the supplement or a placebo for 90 days, with 12 volunteers in each group. The volunteers will not know which treatment they receive. At the end of the experiment, researchers plan to calculate the mean weight loss for each of the two groups and to construct a two-sample z confidence interval for the difference of the two treatment means. Which of the following assumptions is necessary for the confidence interval to be valid?

(A) The sample size is greater than or equal to 10 percent of the population size.

(B) Each of the two groups has at least 5 successes and at least 5 failures.

(C) The distributions of weight loss of the two treatments are approximately normally distributed.

(D) The standard deviations of the 90-day weights of the volunteers in the two groups are equal.

(E) The sample means of the weights of the volunteers in the two groups are equal.