Elementary Statistics   Chapter 1 Test – Form A

Name:_____ Course Number: _____ Section Number: _____

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Provide an appropriate response.

1) Define the terms population, sample, parameter and statistic. How does a census compare to a sample?

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Identify the number as either continuous or discrete.

2) The total number of phone calls a sales representative makes in a month is 425.

   A) Continuous   B) Discrete

3) The number of limbs on a 2–year–old oak tree is 21.

   A) Continuous   B) Discrete

Determine which of the four levels of measurement (nominal, ordinal, interval, ratio) is most appropriate.

4) The subjects in which college students major.

   A) Ratio   B) Ordinal   C) Nominal   D) Interval

5) Amount of fat (in grams) in cookies.

   A) Nominal   B) Interval   C) Ordinal   D) Ratio

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Identify the sample and population. Also, determine whether the sample is likely to be representative of the population.

6) In a poll of 50,000 randomly selected college students, 74% answered "yes" when asked "Do you have a television in your dorm room?".

Use critical thinking to develop an alternative conclusion.

7) A study shows that adults who work at their desk all day weigh more than those who do not. Conclusion: Desk jobs cause people to gain weight.

Use critical thinking to address the key issue.

8) A questionnaire is sent to 10,000 persons. 5,000 responded to the questionnaire. 3,000 of the respondents say that they "love chocolate ice cream". We conclude that 60% of people love chocolate ice cream. What is wrong with this survey?

9) A researcher wished to gauge public opinion on gun control. He randomly selected 1000 people from among registered voters and asked them the following question: "Do you believe that gun control laws which restrict the ability of Americans to protect their families should be eliminated?". Identify the abuse of statistics and suggest a way the researcher's methods could be improved.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Perform the requested conversions. Round decimals to the nearest thousandth and percents to the nearest tenth of a percent, if necessary.

10) Convert 0.34 to an equivalent fraction and percent.

   A) $\dfrac{8}{25}$, 34%   B) $\dfrac{8}{25}$, 3.4%   C) $\dfrac{17}{50}$, 3.4%   D) $\dfrac{17}{50}$, 34%

Solve the problem.

11) A gardener has 28 clients, 25% of whom are businesses. Find the number of business clients.

   A) 7000 clients   B) 700 clients   C) 7 clients   D) 70 clients

Is the study experimental or observational?

12) A marketing firm does a survey to find out how many people use a product. Of the one hundred people contacted, fifteen said they use the product.

   A) Experimental   B) Observational

13) A clinic gives a drug to a group of ten patients and a placebo to another group of ten patients to find out if the drug has an effect on the patients' illness.

   A) Observational   B) Experimental

Identify the type of observational study.

14) A statistical analyst obtains data about ankle injuries by examining a hospital's records from the past 3 years.

   A) Retrospective   B) Cross–sectional   C) Prospective   D) None of these

Identify which of these types of sampling is used: random, stratified, systematic, cluster, convenience.

15) A tax auditor selects every 1000th income tax return that is received.

   A) Random
   B) Systematic
   C) Convenience
   D) Cluster
   E) Stratified

16) A pollster uses a computer to generate 500 random numbers, then interviews the voters corresponding to those numbers.

   A) Stratified
   B) Cluster
   C) Convenience
   D) Systematic
   E) Random

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Provide an appropriate response.

17) Define random sample. Explain why this is important in design of experiments.

18) Define sampling error and nonsampling error. Give examples of nonsampling error.

19) A market researcher obtains a sample of 50 people by standing outside a store and asking every 20th person who enters the store to fill out a survey until she has 50 people. What sampling method is being used here? Will the resulting sample be a random sample? Will it be a simple random sample? Explain your thinking.

20) Explain the difference between stratified and cluster sampling.

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

1) A population is the complete collection of all elements. A sample is a subset of elements drawn from a population. A parameter is a numerical measurement describing some characteristic of a population. A statistic is a numerical measurement describing some characteristic of a sample. A census is the collection of data from every element in a population; a sample is a subset of a population.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

2) B
3) B
4) C
5) D

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

6) Sample: the 50,000 selected college students; population: all college students; representative
7) Desk job workers are confined to their chairs for most of their work day. Other jobs require standing or walking around which burns calories. It is probably the lack of exercise that causes higher weights, not the desk job itself. Avoid causality altogether by saying lack of walking and exercise is associated with higher weights.
8) This is not a random sample. The survey is based on voluntary, self–selected responses and therefore has serious potential for bias.
9) The question is loaded. A more neutral way to phrase the question would be, for example, "Do you believe that gun control laws should be strengthened, weakened, or left in their current form?".

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

10) D
11) C
12) B
13) B
14) A
15) B
16) E

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

17) In random sampling, each member of the population has an equal chance of being selected. Random sampling provides us with the best representative sample in which all groups of the population are approximately proportionately represented. Careless sampling can easily result in a biased sample which may be useless.
18) Sampling error is the difference between a sample result and the true population result. Such an error results from chance sample fluctuations. A nonsampling error occurs when the sample data are incorrectly collected, recorded, or analyzed. Examples include nonrandom samples, defective measuring instruments, biased survey questions, a large number of refusals, copying sample data incorrectly.
19) This is systematic sampling. The sample obtained will be a random sample because everyone has the same chance of being chosen but will not be a simple random sample as different samples of 50 people have different chances of being chosen. Specifically, the sample is random because each person has one chance in twenty of being selected. The sample is not simple random because different samples of size 50 by this design have different chances of being selected due to the numbers of people arriving at the store at different times.

20) In both cluster sampling and stratified sampling, sub-groups (clusters or strata) are formed. However, in stratified sampling, all strata are used and a sample is selected from each strata. In cluster sampling, a sample of the clusters is first selected, then all members of those clusters are selected.

Elementary Statistics   Chapter 1 Test – Form B

Name:_____ Course Number: _____ Section Number: _____

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Provide an appropriate response.
   1) Distinguish between qualitative and quantitative data. Give an example for each.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Determine whether the given value is a statistic or a parameter.
   2) After taking the first exam, 15 of the students dropped the class.
      A) Statistic   B) Parameter

   3) A sample of 120 employees of a company is selected, and the average age is found to be 37 years.
      A) Statistic   B) Parameter

Determine which of the four levels of measurement (nominal, ordinal, interval, ratio) is most appropriate.
   4) The sample of spheres categorized from softest to hardest.
      A) Ordinal   B) Nominal   C) Ratio   D) Interval

   5) Temperatures of the ocean at various depths.
      A) Interval   B) Ordinal   C) Nominal   D) Ratio

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Identify the sample and population. Also, determine whether the sample is likely to be representative of the population.
   6) 100,000 randomly selected adults were asked whether they drink at least 48 oz of water each day and only 45% said yes.

Use critical thinking to develop an alternative conclusion.
   7) In a study of headache patients, every one of the study subjects with a headache was found to be improved after taking a week off of work. Conclusion: Taking time off work cures headaches.

Use critical thinking to address the key issue.
   8) A researcher published this survey result: "74% of people would be willing to spend 10 percent more for energy from a non–polluting source". The survey question was announced on a national radio show and 1,200 listeners responded by calling in. What is wrong with this survey?

   9) "38% of adults in the United States regularly visit a doctor". This conclusion was reached by a college student after she had questioned 520 randomly selected members of her college. What is wrong with her survey?

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Perform the requested conversions. Round decimals to the nearest thousandth and percents to the nearest tenth of a percent, if necessary.

10) Convert 8.4% to an equivalent fraction and decimal.

A) $\frac{2}{25}$, 0.84   B) $\frac{21}{250}$, 0.84   C) $\frac{2}{25}$, 0.084   D) $\frac{21}{250}$, 0.084

Solve the problem.

11) Alex and Juana went on a 120–mile canoe trip with their class. On the first day they traveled 30 miles. What percent of the total distance did they canoe?

A) 4%   B) 0.25%   C) 25%   D) 400%

Is the study experimental or observational?

12) A political pollster reports that his candidate has a 10% lead in the polls with 10% undecided.

A) Experimental   B) Observational

13) A T.V. show's executives commissioned a study to gauge the impact of the show's ratings on the sales of its advertisers.

A) Observational   B) Experimental

Identify the type of observational study.

14) A researcher plans to obtain data by following those in cancer remission since January of 2002.

A) Cross–sectional   B) Retrospective   C) Prospective   D) None of these

Identify which of these types of sampling is used: random, stratified, systematic, cluster, convenience.

15) A sample consists of every 49th student from a group of 496 students.

A) Stratified

B) Random

C) Cluster

D) Systematic

E) Convenience

16) The name of each contestant is written on a separate card, the cards are placed in a bag, and three names are picked from the bag.

A) Cluster

B) Random

C) Stratified

D) Convenience

E) Systematic

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Use critical thinking to address the key issue.

17) "7 out of 10 dentists recommend Brand X toothpaste". This finding is based on the results of a survey of 10 randomly selected dentists. What is wrong with this survey?

Provide an appropriate response.

18) List five different abuses of statistics and give examples for each.

19) A teacher at a school obtains a sample of students by selecting a random sample of 20 students from each grade. What kind of sampling is being used here? Will the resulting sample be a simple random sample of the population of students at the school? Explain your thinking.

20) At a school there are two different math classes of the same age. The two classes have different teachers. The school principal is interested in gauging the effectiveness of two different teaching methods and asks each teacher to try one of the methods. At the end of the semester both classes are given the same test and the results are compared. In this experiment, what is the variable of interest? Give some examples of variables which could be confounding variables.

Answer Key
Testname: ELEMENTARY STATISTICS CHAPTER 1 TEST FORM B

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

1) Qualitative data can be separated into categories that are distinguished by nonnumeric characteristics. Quantitative data consist of numbers representing counts or measurements. Examples will vary.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

2) B
3) A
4) A
5) A

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

6) Sample: the 10,000 selected adults; population: all adults; representative
7) Headaches generally last for only a few hours, so anything would seem like a cure. There is no evidence to suggest that taking time off work will cure a headache.
8) This is not a random sample. The survey is based on voluntary, self–selected responses and therefore has serious potential for bias.
9) The sample is biased. College students are not representative of the U.S. population as a whole.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

10) D
11) C
12) B
13) B
14) C
15) D
16) B

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

17) The sample was too small.
18) Answers will vary but include small samples, precise numbers, guesstimates, distorted percentages, partial picture, deliberate distortions, loaded questions, misleading graphs, misleading pictographs, pollster pressure, or bad samples. Examples will vary.
19) This is stratified sampling. The sample obtained will not be a simple random sample because different samples of students have different chances of being selected. Specifically, it would not be possible to select samples of the same size with students in different grades.
20) The variable of interest is the teaching method. Possible confounding variables are "skill of teacher" (is one teacher better than the other?), "aptitude of students" (do the two classes have students of the same ability?), "amount of study time" (does one class have students who are more conscientious?).

Elementary Statistics   Chapter 1 Test – Form C

Name:_____ Course Number: _____ Section Number: _____

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Provide an appropriate response.

1) Define continuous and discrete data and give an example of each.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Determine whether the given value is a statistic or a parameter.

2) A health and fitness club surveys 40 randomly selected members and found that the average weight of those questioned is 157 lb.

   A) Statistic   B) Parameter

3) After inspecting all of 55,000 kg of meat stored at the Wurst Sausage Company, it was found that 45,000 kg of the meat was spoiled.

   A) Statistic   B) Parameter

Determine which of the four levels of measurement (nominal, ordinal, interval, ratio) is most appropriate.

4) Salaries of college professors.

   A) Ratio   B) Ordinal   C) Interval   D) Nominal

5) Survey responses of "good, better, best".

   A) Ordinal   B) Ratio   C) Interval   D) Nominal

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Identify the sample and population. Also, determine whether the sample is likely to be representative of the population.

6) An employee at the local ice cream parlor asks three customers if they like chocolate ice cream.

Use critical thinking to address the key issue.

7) You plan to make a survey of 200 people. The plan is to talk to every 10th person coming out of the school library. Is there a problem with your plan?

8) A national television channel posted the result of their web poll: "63 percent of Americans favor changing from gasoline to hydrogen fuel for cars." The survey question had been available for three days and 50,000 viewers responded. Should we conclude that hydrogen–powered cars are favored by a majority of Americans? Explain.

9) A company accused of downsizing workers defended itself with the following statement: "Yes, we were forced to lay off 20% of our workforce last year, but this year we increased our workforce by 20%, and we therefore now have the same number of employees as before the layoff." What is the flaw in this argument?

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Perform the requested conversions. Round decimals to the nearest thousandth and percents to the nearest tenth of a percent, if necessary.

10) Convert 1.2 to an equivalent fraction and percent.

   A) $1\frac{1}{10}$, 12%   B) $1\frac{1}{5}$, 120%   C) $1\frac{1}{5}$, 12%   D) $1\frac{1}{10}$, 120%

Solve the problem.

11) On a test of 80 items, Ariel got 68 correct. What percent were correct?

   A) 117.647059%   B) 1.17647059%   C) 0.85%   D) 85%

Is the study experimental or observational?

12) A quality control specialist compares the output from a machine with a new lubricant to the output of machines with the old lubricant.

   A) Experimental   B) Observational

13) A stock analyst selects a stock from a group of twenty for investment by choosing the stock with the greatest earnings per share reported for the last quarter.

   A) Experimental   B) Observational

Identify the type of observational study.

14) A town obtains current employment data by polling 10,000 of its citizens this month.

   A) Prospective   B) Retrospective   C) Cross–sectional   D) None of these

Identify which of these types of sampling is used: random, stratified, systematic, cluster, convenience.

15) A market researcher selects 500 drivers under 30 years of age and 500 drivers over 30 years of age.

   A) Cluster

   B) Systematic

   C) Stratified

   D) Random

   E) Convenience

16) A researcher interviews 19 work colleagues who work in his building.

   A) Stratified

   B) Random

   C) Cluster

   D) Systematic

   E) Convenience

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Provide an appropriate response.

17) Describe a double blind experiment and explain why blinding is used. Define the term "placebo effect" as part of the answer.

18) Define observational study and experiment. Define the terms "treatment group" and "control group" as part of your answer.

19) A researcher obtains a sample of high school teachers in his school district by randomly selecting 10 high schools and interviewing all the teachers at each of these 10 schools. What kind of sampling is being used here? Will the resulting sample be a simple random sample of the population of teachers in the school district? Explain your thinking.

20) Explain what is meant by the term "confounding" and give an example of an experiment in which confounding is likely to be a problem.

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

1) Continuous numerical data result from infinitely many possible values that can be associated with points on a continuous scale so that there are no gaps or interruptions. Discrete data result from either a finite number of possible values or a countable number of possible values. Examples will vary.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

2) A
3) B
4) A
5) A

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

6) Sample: the 3 selected customers; population: all customers; not representative
7) People who don't go to the library are excluded.
8) This is not a random sample. The survey is based on voluntary, self–selected responses and therefore has serious potential for bias, because the result should not be generalized to all Americans.
9) Answers will vary. Possible answer: This is a misleading use of percentages, as 20% of the reduced workforce is smaller than 20% of the original workforce. The company therefore did not hire as many new workers as it originally laid off. The size of the current workforce is therefore smaller than the size of the workforce before the layoffs.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

10) B
11) D
12) A
13) B
14) C
15) C
16) E

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

17) A double blind experiment is one in which neither the subjects nor the researchers know who is getting the treatment. Blinding is when the subject does not know whether he or she is receiving a treatment or a placebo. Blinding is used to counteract the placebo effect in which an untreated subject believes he or she is receiving a treatment and reports an improvement in symptoms due to this belief.
18) In an observational study, we observe and measure specific characteristics, but we don't attempt to manipulate or modify the subjects being studied. In an experiment we apply some treatment and then proceed to observe its effects on the subjects. In the experiment, the group receiving the treatment is called the treatment group. The control group is the group that is not given the treatment.
19) This is cluster sampling. The sample obtained will not be a simple random sample of all high school teachers in the district because different samples have different chances of being selected due to varying numbers of teachers in different schools.
20) Confounding occurs in an experiment when the effects of two or more variables cannot be distinguished from each other. Examples will vary.

Elementary Statistics   Chapter 2 Test – Form A

Name:_____   Course Number: _____   Section Number: _____

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Identify as many similarities and differences that you can find.

1) Suppose that a data set has a minimum value of 28 and a maximum value of 73 and that you want 5 classes. Explain how to find the class width for this frequency distribution. What happens if you mistakenly use a class width of 9 instead of 10?

2) A company advertises an average of 42,000 miles for one of its new tires. In the manufacturing process there is some variation around that average. Would the company want a process that provides a large or a small variance? Justify your answer.

Use the range rule of thumb to solve the problem.

3) The data shows the roundtrip mileage that 43 randomly selected professors and students drive to school each day. Graph the frequency polygons and determine whether there appears to be any significant difference between the two groups.

Score	Frequency		Score	Frequency
10–14	2		10–14	0
15–19	5		15–19	6
20–24	13		20–24	9
25–29	17		25–29	21
30–34	6		30–34	7
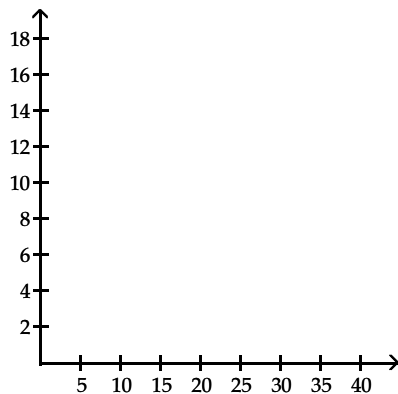
MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Use the pie chart to solve the problem.

4) The pie chart shows the percent of the total population of 12,200 of Springfield living in the given types of housing. Round your result to the nearest whole number.
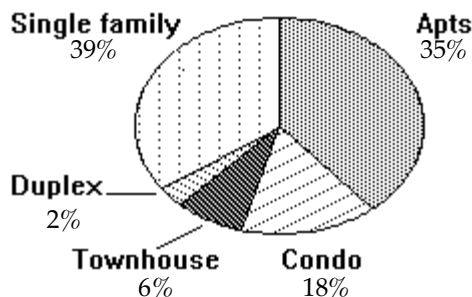
Find the number of people who live in single family houses.

    A) 4758 people   B) 39 people   C) 5368 people   D) 7442 people

Use the range rule of thumb to solve the problem.

5) Six college buddies bought each other Christmas gifts. They spent:

    $236.88 $150.51 $154.55

    $299.92 $290.97 $251.46

What was the mean amount spent? Round your answer to the nearest cent.

    A) $264.86   B) $230.72   C) $346.07   D) $276.86

Find the median for the given sample data.

6) The number of vehicles passing through a bank drive–up line during each 15–minute period was recorded. The results are shown below. Find the median number of vehicles going through the line in a fifteen–minute period.

    23 25 23 26

    26 23 28 25

    33 29 29 27

    22 29 23 18

    13 25 25 25

    A) 26   B) 29   C) 25   D) 24.85

Find the mode(s) for the given sample data.

7) 79, 25, 79, 13, 25, 29, 56, 79

    A) 79   B) 48.1   C) 42.5   D) 25

Find the midrange for the given sample data.

8) The weights (in ounces) of 18 cookies are shown. Find the midrange.

   0.68 1.29 0.93 1.02 0.74 1.43

    1.29 1.20 0.68 1.46 1.33 1.14

    1.33 1.46 0.74 1.33 1.02 0.93

   A) 1.070   B) 1.14   C) 1.100   D) 1.055

Use the range rule of thumb to solve the problem.

9) 100 casino patrons, were interviewed as they left the casino. 30 of them said they spent most of the time playing the slots. 30 of them said they played blackjack. 15 said they played craps. 5 said roulette. 5 said poker. The rest were not sure what they played the most. Select the Pareto chart that displays these findings.

A)

B)

C)

D)
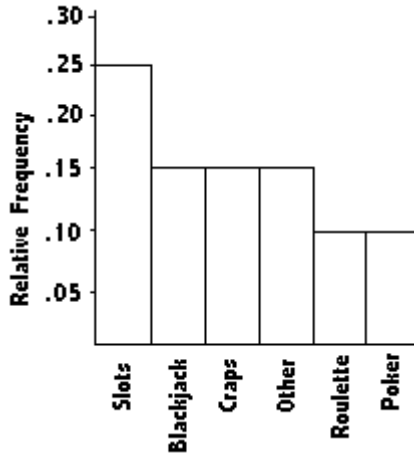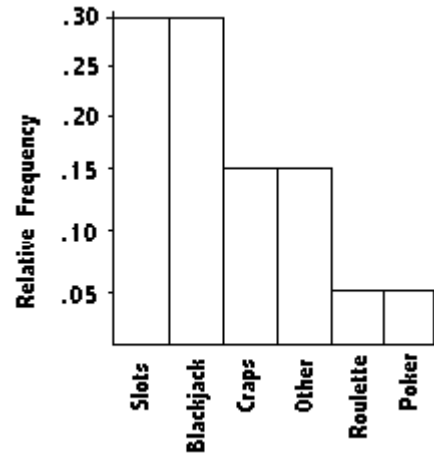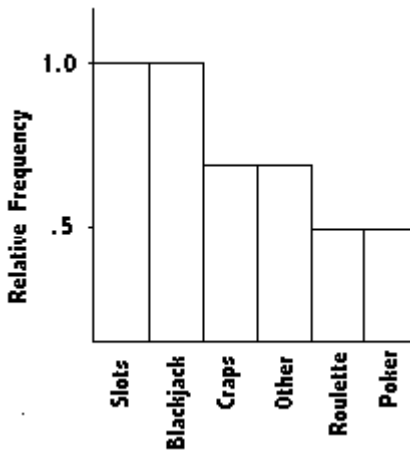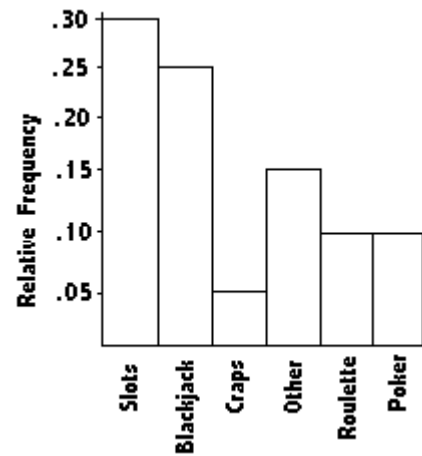
Find the mean of the data summarized in the given frequency distribution.

10) A company had 80 employees whose salaries are summarized in the frequency distribution below. Find the mean salary.

Salary ($)	Employees
5,001–10,000	18
10,001–15,000	20
15,001–20,000	20
20,001–25,000	14
25,001–30,000	8

A) $14,287.95   B) $17,500   C) $15,875.50   D) $17,463.05

Find the range for the given data.

11) Fred, a local mechanic, gathered the following data regarding the price, in dollars, of an oil and filter change at twelve competing service stations:

32.95 24.95 26.95 28.95
18.95 28.95 30.95 22.95
24.95 26.95 29.95 28.95

Compute the range.

   A) $12   B) $10   C) $8   D) $14

Find the variance for the given data. Round your answer to one more decimal place than the original data.

12) Compute the variance. The owner of a small manufacturing plant employs six people. As part of their personnel file, she asked each one to record to the nearest one–tenth of a mile the distance they travel one way from home to work. The six distances are listed below:

   52 38 15 24 15 39

   A) 222.7   B) 38.9   C) 32.5   D) 167.4

Find the standard deviation for the given data. Round your answer to one more decimal place than the original data.

13) To get the best deal on a CD player, Tom called eight appliance stores and asked the cost of a specific model. The prices he was quoted are listed below:

   $249 $195 $162 $446 $279 $214 $307 $187

Compute the standard deviation s.

   A) $578,041.0   B) $91.3   C) $233.0   D) $519,690.1

Use the range rule of thumb to solve the problem.

14) The heights in feet of people who work in an office are as follows. Use the range rule of thumb to estimate the standard deviation. Round results to the nearest tenth.

5.7 6.0 5.8 5.4 5.6 6.0 5.5 6.2 6.0 6.0 5.5 5.8 5.6 5.7 5.9 6.0 6.1 5.5 5.7 6.1

   A) 1.2   B) 0.1   C) 0.2   D) 0.5

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Use the range rule of thumb to solve the problem.

15) Weekly sales for the Dade Company average $10,000 with a standard deviation of $450. During a recent week sales were $9050. Is that amount unusually low? Why or why not?

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Solve the problem. Round results to the nearest hundredth.

16) A department store, on average, has daily sales of $28,176.44. The standard deviation of sales is $ 1500. On Tuesday, the store sold $34,083.30 worth of goods. Find Tuesday's z score. Was Tuesday an unusually good day?

   A) 4.25, yes   B) 3.94, yes   C) 4.13, no   D) 3.15, no

Determine which score corresponds to the higher relative position.

17) Which score has a better relative position, a score of 35.1 on a test for which $\bar{x} = 30$ and $s = 3$, or a score of 299.7 on a test for which $\bar{x} = 270$ and $s = 27$?

   A) A score of 299.7

   B) Both scores have the same relative position.

   C) A score of 35.1

Find the percentile for the data point.

18) Data set: 108 120 112 106 114 116 106 104 111 108 112 122 104 108 110 105;
data point 114

   A) 62   B) 75   C) 85   D) 70

Find the indicated measure.

19) The weights (in pounds) of 30 newborn babies are listed below. Find Q_1.

5.5 5.7 5.8 6.0 6.1 6.1 6.3 6.4 6.5 6.6
6.7 6.7 6.7 6.9 7.0 7.0 7.0 7.1 7.2 7.2
7.4 7.5 7.7 7.7 7.8 8.0 8.1 8.1 8.3 8.7

   A) 6.4   B) 5.8   C) 7.5   D) 6.3

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Identify as many similarities and differences that you can find.

20) Describe any similarities or differences in the two distributions represented by the following boxplots. Assume the two boxplots have the same scale.
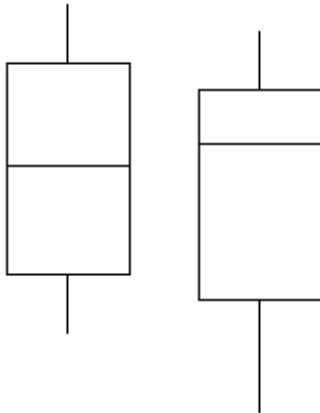
SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

1) For the given data, the class width is 9, since that value is the range, 73 – 28, divided by the number of classes. However, the quotient should always be rounded up, even when a whole number results. If 9 were mistakenly used as the class width, the last datum, which is 73, would be cut off the distribution because the upper limit of the fifth class is 72. More data would be cut off, if the class start was below 28.

2) Answers will vary.

3) There does not appear to be a significant difference.
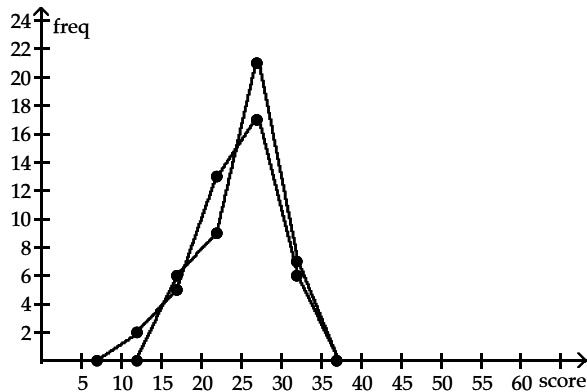
MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

4) A
5) B
6) C
7) A
8) A
9) B
10) C
11) D
12) A
13) B
14) C

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

15) Yes, $9050 is unusually low because it is less than $9100, which is two standard deviations below the mean.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

16) B
17) C
18) B
19) A

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

20) Let the boxplot on the left represent distribution A; boxplot on the right, distribution B. Distribution A is uniform; distribution B is skewed to the left. Distribution A has a higher maximum value. Distribution B has a lower minimum value. The median of distribution B exceeds that of A. Both interquartile ranges are the same, implying the variation among the middle 50% of values of each distribution is the same. There are no outliers for either distribution, but distribution B shows more variation.

Elementary Statistics   Chapter 2 Test – Form B

Name:_____ Course Number: _____ Section Number: _____

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Identify as many similarities and differences that you can find.

1) Suppose you are comparing frequency data for two different groups, 25 managers and 150 blue collar workers. Why would a relative frequency distribution be better than a frequency distribution?

2) Without calculating the standard deviation, compare the standard deviation for the following three data sets. (Note: All data sets have a mean of 30.) Which do you expect to have the largest standard deviation and which do you expect to have the smallest standard deviation? Explain your answers in terms of the formula

$$s = \sqrt{\frac{\sum(x - \bar{x})^2}{n - 1}}.$$ (This is formula 2–4.)

30, 30, 30, 30, 30, 30, 30, 30, 30, 30
20, 25, 25, 30, 30, 30, 30, 35, 35, 40
20, 20, 20, 25, 25, 35, 35, 40, 40, 40

Solve the problem.

3) The frequency distribution below shows the amount of weight loss during the first month of a diet program for both males and females. Compare the results and determine whether there appears to be a significant difference between the two genders.

Weight (lb)	Frequency (males)	Weight (lb)	Frequency (females)
5–7	2	5–7	4
8–10	9	8–10	3
11–13	18	11–13	19
14–16	13	14–16	5
17–19	4	17–19	15
20–22	1	20–22	1
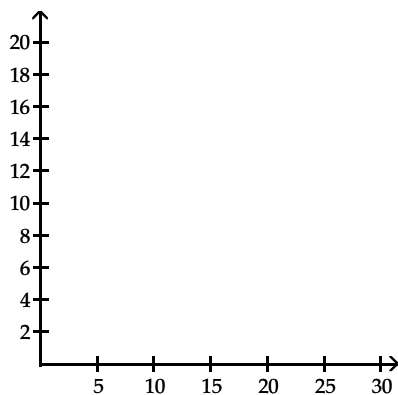
MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Use the pie chart to solve the problem.

4) The pie chart below gives the inventory of the men's department of a store.

Suits $48,564
Trousers $40,044
Shirts $7668
Underwear $5112
Sweaters $16,188
Ties $6816
Socks $2556
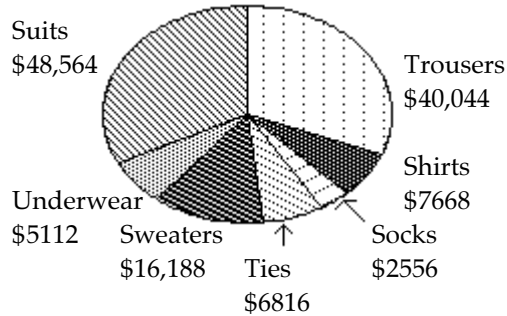
What is the total inventory?

A) $129,504   B) $124,392   C) $86,904   D) $126,948

Find the mean for the given sample data.

5) Frank's Furniture employees earned the following amounts last week:

$310.03 $154.07 $259.17 $196.57 $372.14

$318.15 $369.45 $381.28 $261.00

What was the mean amount earned by an employee last week? Round your answer to the nearest cent.

A) $327.73   B) $291.32   C) $284.65   D) $374.55

Find the median for the given sample data.

6) The weights (in ounces) of 21 cookies are shown. Find the median weight.

0.77 1.43 0.82 1.62 0.70 0.79 1.10
1.43 1.53 0.91 0.77 1.48 1.16 0.66
0.47 1.48 0.79 1.16 1.72 0.70 0.56

A) 0.91 ounces   B) 0.79 ounces   C) 0.66 ounces   D) 1.43 ounces

Find the mode(s) for the given sample data.

7) 20, 21, 46, 21, 49, 21, 49

A) 49   B) 46   C) 21   D) 32.4

Find the midrange for the given sample data.

8) The speeds (in mph) of the cars passing a certain checkpoint are measured by radar. The results are shown below. Find the midrange.

44.4 41.8 42.9 40.7 43.5
40.1 44.6 41.9 44.4 42.0
43.5 41.9 40.7 43.5 41.8

A) 42.25   B) 42.35   C) 42.0   D) 4.50

Solve the problem.

9) At the National Criminologists Association's annual convention, participants filled out a questionnaire asking what they thought was the most important cause for criminal behavior. The tally was as follows.

Cause	Frequency
education	49
drugs	147
family	98
poverty	171.5
other	24.5

Select the Pareto chart that displays these findings.

A)

B)

C)

D)
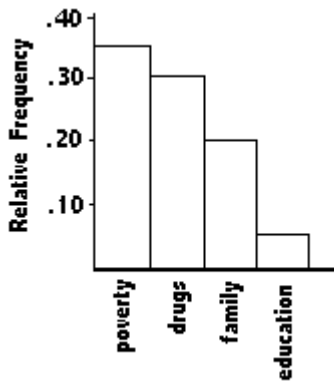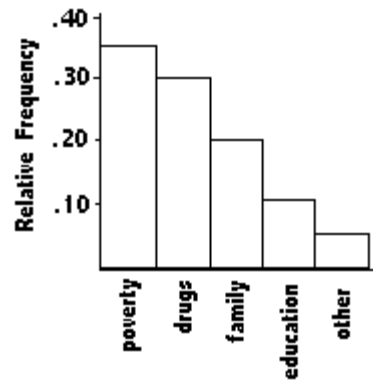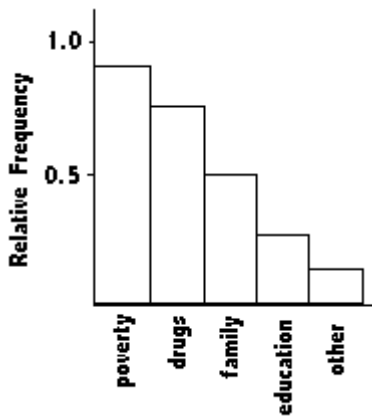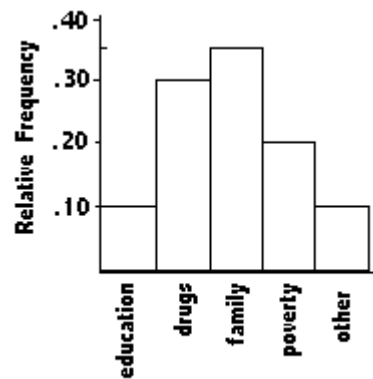
Find the mean of the data summarized in the given frequency distribution.

10) The manager of a bank recorded the amount of time each customer spent waiting in line during peak business hours one Monday. The frequency distribution below summarizes the results. Find the mean waiting time. Round your answer to one decimal place.

Waiting time (minutes)	Number of customers
0 – 3	13
4 – 7	9
8 – 11	9
12 – 15	8
16 – 19	4
20 – 23	3
24 – 27	1

  A) 13.5 min   B) 6.7 min   C) 9.2 min   D) 9.0 min

Find the range for the given data.

11) The owner of a small manufacturing plant employs six people. As part of their personnel file, she asked each one to record to the nearest one–tenth of a mile the distance they travel one way from home to work. The six distances are listed below:

   2.6 5.5 1.6 4.1 6.8 3.6

   Compute the range.

  A) 5.5   B) 1.6   C) 5.2   D) 1

Find the variance for the given data. Round your answer to one more decimal place than the original data.

12) Compute the variance. Jeanne is currently taking college zoology. The instructor often gives quizzes. On the past five quizzes, Jeanne got the following scores:

   17 10 7 14 3

  A) 52.4   B) 24.6   C) 30.6   D) 30.7

Find the standard deviation for the given data. Round your answer to one more decimal place than the original data.

13) The normal monthly precipitation (in inches) for August is listed for 12 different U.S. cities.

   3.5 1.6 2.4 3.7 4.1 3.9
   1.0 3.6 4.2 3.4 3.7 2.2

   Compute the standard deviation.

  A) 1.00   B) 1.09   C) 1.05   D) 12.03

Solve the problem.

14) The race speeds for twenty cars in a 200–mile race are listed below. Use the range rule of thumb to estimate the standard deviation. Round results to the nearest tenth.

   185.6 187.1 189.2 186.3 175.6 189.1 186.7 177.1 178.2 180.9 188.6 183.4 175.8
   178.2 179.2 181.4 184.5 180.7 183.3 179.9

  A) 7.5   B) 6.8   C) 1.1   D) 3.4

Elementary Statistics   Chapter 2 Test – Form B

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Use the range rule of thumb to solve the problem.

15) A test of manual dexterity yields values having a mean of 50 and a standard deviation of 10. Is a score of 80 unusually high?

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Solve the problem. Round results to the nearest hundredth.

16) The mean height of a basketball team is 6.1 feet with a standard deviation of 0.2 feet. The team's center is 6.7 feet tall. Find the center's z score. Is his score unusual?

    A) 2.5, no   B) 2.55, no   C) 3.3, yes   D) 3, yes

Determine which score corresponds to the higher relative position.

17) Which score has a better relative position, a score of 42.6 on a test for which $\bar{x} = 29$ and $s = 8$, or a score of 292.4 on a test for which $\bar{x} = 238$ and $s = 32$?

    A) A score of 292.4

    B) Both scores have the same relative position.

    C) A score of 42.6

Find the percentile for the data point.

18) In a data set with a range of 55.1 to 102.8 and 300 observations, there are 207 data points with values less than 88.6. Find the percentile for 88.6.

    A) 32   B) 116.03   C) 69   D) 670

Find the indicated measure.

19) The test scores of 40 students are listed below. Find P_{85}.

30 35 43 44 47 48 54 55 56 57
59 62 63 65 66 68 69 69 71 72
72 73 74 76 77 77 78 79 80 81
81 82 83 85 89 92 93 94 97 98

    A) 34   B) 85   C) 87   D) 89

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Identify as many similarities and differences that you can find.

20) Describe any similarities or differences in the two distributions represented by the following boxplots. Assume the two boxplots have the same scale.
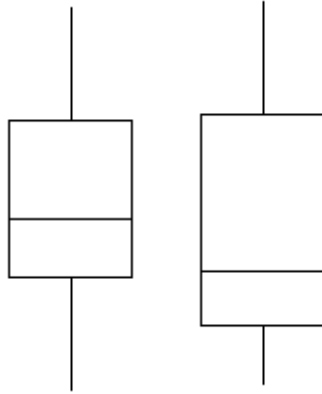
SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

1) Answers will vary depending on examples given. However, since 150 is six times 25, relative frequencies adjust for the extreme difference in sample sizes.

2) Since the standard deviation measures average spread from the mean, the first data set, which shows no variation, has the smallest standard deviation, zero. The last data set would have the most variation because the mean is not in the set, and the values are more spread out from 30 in comparison to the middle data set where four values equal 30.

3) There does not appear to be a significant difference.
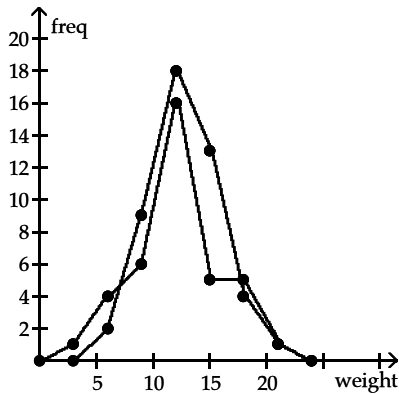
MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

4) D
5) B
6) A
7) C
8) B
9) B
10) D
11) C
12) D
13) C
14) D

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

15) Yes, because 80 is greater than 70, which is two standard deviations above the mean.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

16) D
17) B
18) C
19) C

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

20) Let the boxplot on the left represent distribution A; boxplot on the right, distribution B. Both
distributions are skewed to the right, and their ranges are the same. The interquartile range of
distribution B shows more variability, implying its middle 50% of values are more spread than the
middle 50% of values in distribution A. Therefore, there is more variation among the values in
distribution B than in distribution A. The median of distribution A exceeds that of distribution B.
Neither distribution has outliers.

Elementary Statistics   Chapter 2 Test – Form C

Name:_____ Course Number: _____ Section Number: _____

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Provide an appropriate response.

1) One purpose of displaying data graphically is to provide clues about trends. The given values are weights (ounces) of steaks listed on a restaurant menu as "20 ounce porterhouse" steaks. The weights are supposed to be 21 ounces because they supposedly lose an ounce when cooked. Create a frequency distribution with 5 classes. Based on your distribution, comment on the advertised "20 ounce" steaks.

   17 20 21 18 20 20 20 18 19 19 20 19 21 20 18 20 20 19 18 19

2) We want to compare two different groups of students, students taking Composition 1 in a traditional lecture format and students taking Composition 1 in a distance learning format. We know that the mean score on the research paper is 85 for both groups. What additional information would be provided by knowing the standard deviation?

Solve the problem.

3) In a survey, 20 people were asked how many magazines they had purchased during the previous year. The results are shown below. Construct a histogram to represent the data. Use 4 classes with a class width of 10, and begin with a lower class limit of –0.5. What is the approximate amount at the center?

    6 15 3 36 25 18 12 18 5 30
   24 7 0 22 33 24 19 4 12 9
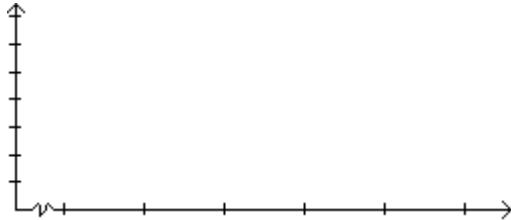
Elementary Statistics   Chapter 2 Test – Form C

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Use the pie chart to solve the problem.

4) A survey of the 4429 vehicles on the campus of State University yielded the following pie chart.
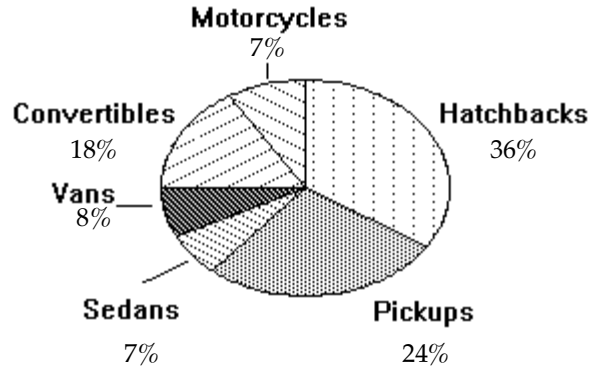
Find the number of sedans. Round your result to the nearest whole number.

A) 310   B) 4119   C) 7   D) 531

Find the mean for the given sample data.

5) The local Tupperware dealers earned these commissions last month:

$4377.47 $3183.76 $1970.16 $2270.88

$3860.06 $2508.55 $1569.64

$4205.30 $1663.68 $3960.71

What was the mean commission earned? Round your answer to the nearest cent.

A) $3285.58   B) $3696.28   C) $2951.02   D) $2957.02

Find the median for the given sample data.

6) The normal monthly precipitation (in inches) for August is listed for 20 different U.S. cities. Find the median of the data.

3.5 1.6 2.4 3.7 4.1

3.9 1.0 3.6 4.2 3.4

3.7 2.2 1.5 4.2 3.4

2.7 0.4 3.7 2.0 3.6

A) 3.45 in.   B) 3.50 in.   C) 3.40 in.   D) 2.94 in.

Find the mode(s) for the given sample data.

7) 98, 53, 32, 53, 29, 98

A) 60.5   B) 53   C) 98, 53   D) 98

Find the midrange for the given sample data.

8) A meteorologist records the number of clear days in a given year in each of 21 different U.S. cities. The results are shown below. Find the midrange.

72 143 52 84 100 98 101
120 99 121 86 60 59 71
125 130 104 74 83 55 169

  A) 110.5   B) 112   C) 98   D) 117

Solve the problem.

9) A car dealer is deciding what kinds of vehicles he should order from the factory. He looks at his sales report for the preceding period. Choose the vertical scale so that the relative frequencies are represented.

Vehicle	Sales
Economy	10
Sports	2.5
Family	17.5
Luxury	5
Truck	15

Select the appropriate Pareto chart to help him decide.

A)

B)

C)

D)
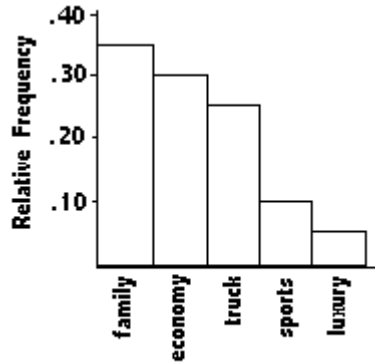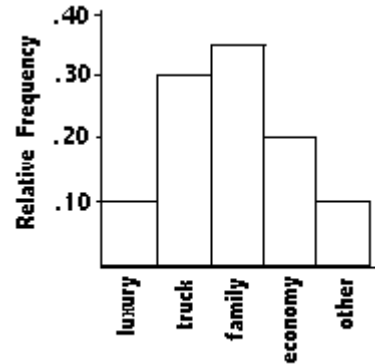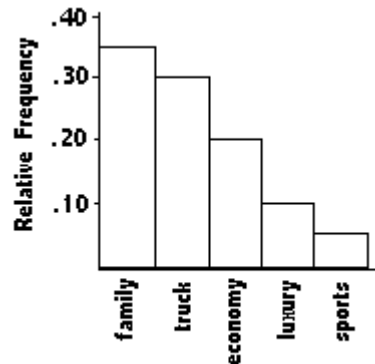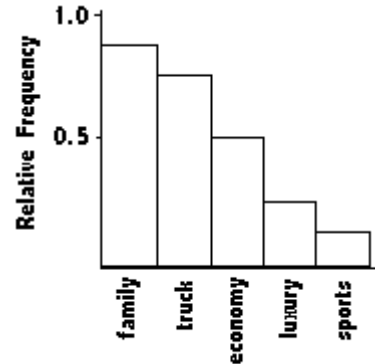
Find the mean of the data summarized in the given frequency distribution.

10) The heights of a group of professional basketball players are summarized in the frequency distribution below. Find the mean height. Round your answer to one decimal place.

Height (in.)	Frequency
70 – 71	2
72 – 73	7
74 – 75	8
76 – 77	10
78 – 79	10
80 – 81	4
82 – 83	1

A) 13.5 in.   B) 78.0 in.   C) 76.2 in.   D) 74.4 in.

Find the range for the given data.

11) To get the best deal on a microwave oven, Jeremy called six appliance stores and asked the cost of a specific model. The prices he was quoted are listed below:

$110 $541 $139 $650 $413 $265

Compute the range.

A) $110   B) $541   C) $126   D) $540

Find the variance for the given data. Round your answer to one more decimal place than the original data.

12) 4, 13, 6, 4, and 20

A) 48.7   B) 39.0   C) 48.8   D) 67.2

Find the standard deviation for the given data. Round your answer to one more decimal place than the original data.

13) The manager of a small dry cleaner employs six people. As part of their personnel file, she asked each one to record to the nearest one–tenth of a mile the distance they travel one way from home to work. The six distances are listed below:

17.6 22.9 29.8 29.7 12.2 15.8

Compute the standard deviation s.

A) 2730.7   B) 7.38   C) 3002.8   D) 29.8

Solve the problem.

14) The following is a set of data showing the water temperature in a heated tub at different time intervals. Use the range rule of thumb to estimate the standard deviation. Round results to the nearest tenth.

114.4 114.6 116.4 113.3 114.8 114.3 113.1 115.0 114.5 113.5 114.1 114.7 116.2
115.5 115.9 114.9 113.8 114.1 115.8 116.0

A) 0.8   B) 1.1   C) –56.1   D) 0.6

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Use the range rule of thumb to solve the problem.

15) Adolf's Restaurant's advertisement boasts that the average price of a full–course dinner is $25. It is known that the standard deviation of dinner prices is $10.15. Is a full–course dinner priced at $44.30 an unusual value? Why or why not?

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Find the z–score corresponding to the given value and use the z–score to determine whether the value is unusual. Consider a score to be unusual if its z–score is less than –2.00 or greater than 2.00. Round the z–score to the nearest tenth if necessary.

16) A time for the 100 meter sprint of 21.2 seconds at a school where the mean time for the 100 meter sprint is 17.6 seconds and the standard deviation is 2.1 seconds.

    A) 1.7; unusual   B) 1.7; not unusual

    C) 3.6; unusual   D) –1.7; not unusual

Determine which score corresponds to the higher relative position.

17) Which score has the better relative position: a score of 34.8 on a test for which $\bar{x} = 30$ and $s = 6$, a score of 5.5 on a test for which $\bar{x} = 4.5$ and $s = 1.3$ or a score of 366.4 on a test for which $\bar{x} = 332$ and $s = 43$?

    A) A score of 366.4   B) A score of 34.8   C) A score of 5.5

Find the percentile for the data point.

18) Data set: 16 8 56 40 16 40 64 72 88 24 8 64 48 8 64;
data point 56

    A) 70   B) 52   C) 60   D) 35

Find the indicated measure.

19) The test scores of 40 students are listed below. Find P_{56}.

30 35 43 44 47 48 54 55 56 57
59 62 63 65 66 68 69 69 71 72
72 73 74 76 77 77 78 79 80 81
81 82 83 85 89 92 93 94 97 98

    A) 74   B) 73.5   C) 73   D) 22.4

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Provide an appropriate response.

20) Boxplots are graphs that are useful for revealing central tendency, the spread of the data, the distribution of the data and the presence of outliers. Draw an example of a boxplot and comment on each of these characteristics as shown by your boxplot.

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

1) Answers will vary. Yet, the focus is as follows. The class width is 1 based on a range of 4 to accommodate 5 classes. The accompanying frequency distribution shows only two steaks satisfying the description. The other 18 steaks weigh under 21 ounces. Therefore, the ad is incorrect most of the time.
2) Answers will vary. However, the main concept is that the standard deviation tells us whether the scores are clustered about the mean or spread farther apart.
3) The approximate amount at the center is 16 magazines.
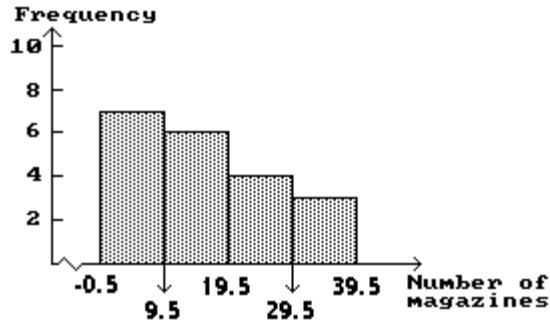
MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

4) A
5) D
6) A
7) C
8) A
9) C
10) C
11) D
12) C
13) B
14) A

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

15) This value is not unusual, since it is within the usual range of $4.70 to $45.30.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

16) B
17) C
18) C
19) A

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

20) Answers will vary.

Elementary Statistics   Chapter 3 Test – Form A

Name:_____ Course Number: _____ Section Number: _____

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Provide an appropriate response.

1) On an exam on probability concepts, Sue had an answer of $\frac{13}{8}$ for one problem. Explain how she knew that this result was incorrect.

2)   Cause of Death

	Cancer	Heart Disease	Other	Total
Smoker	135	310	205	650
Nonsmoker	55	155	140	350
Total	190	465	345	1,000

Discuss the methods for finding the following two probabilities and explain the important differences in the computations.
1) If one person is randomly selected, find the probability that he or she died of heart disease.
2) If one person is randomly selected, find the probability that he or she died of heart disease given that he or she was a nonsmoker.

3) Suppose that a class of 30 students is assigned to write an essay.
1) Suppose 4 essays are randomly chosen to appear on the class bulletin board. How many different groups of 4 are possible?
2) Suppose 4 essays are randomly chosen for awards of $10, $7, $5, and $3. How many different groups of 4 are possible?
Explain the significant differences between problems 1 and 2.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Express the indicated degree of likelihood as a probability value.

4) "There is a 40% chance of rain tomorrow."

   A) 40   B) 0.60   C) 0.40   D) 4

Find the indicated probability.

5) A bag contains 6 red marbles, 3 blue marbles, and 7 green marbles. If a marble is randomly selected from the bag, what is the probability that it is blue?

   A) $\frac{1}{3}$ B) $\frac{1}{7}$ C) $\frac{3}{16}$ D) $\frac{1}{13}$

Answer the question, considering an event to be "unusual" if its probability is less than or equal to 0.05.

6) Assume that one student in your class of 27 students is randomly selected to win a prize. Would it be "unusual" for you to win?

   A) Yes   B) No

From the information provided, create the sample space of possible outcomes.

    7) Flip a coin twice.

        A) HH HT TH TT   B) HH TT HT HT   C) HT TH   D) HH HT TT

Answer the question.

    8) Find the odds against correctly guessing the answer to a multiple choice question with 4 possible answers.

        A) 3 : 1   B) 3 : 4   C) 4 : 1   D) 4 : 3

Find the indicated probability.

    9) The manager of a bank recorded the amount of time each customer spent waiting in line during peak business hours one Monday. The frequency table below summarizes the results.

Waiting Time (minutes)	Number of Customers
0–3	14
4–7	9
8–11	11
12–15	6
16–19	7
20–23	3
24–27	2

    If we randomly select one of the customers represented in the table, what is the probability that the waiting time is at least 12 minutes or between 8 and 15 minutes?

        A) 0.519   B) 0.63   C) 0.558   D) 0.2

    10) 100 employees of a company are asked how they get to work and whether they work full time or part time. The figure below shows the results. If one of the 100 employees is randomly selected, find the probability that the person drives alone or cycles to work.
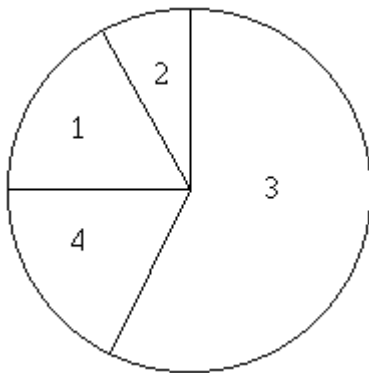
1. Public transportation: 10 full time, 7 part time
2. Bicycle: 5 full time, 4 part time
3. Drive alone: 29 full time, 27 part time
4. Carpool: 9 full time, 9 part time

        A) 0.37   B) 0.56   C) 0.34   D) 0.65

11) In one town, 70% of adults have health insurance. What is the probability that 6 adults selected at random from the town all have health insurance?

    A) 0.086   B) 4.2   C) 0.118   D) 0.7

12) A IRS auditor randomly selects 3 tax returns from 49 returns of which 9 contain errors. What is the probability that she selects none of those containing errors?

    A) 0.0046   B) 0.5363   C) 0.0062   D) 0.544

Provide a written description of the complement of the given event.

13) When several textbooks are returned from editing, none of the books are found to be errorless.

    A) At least one of the textbooks is errorless.

    B) None of the textbooks are errorless.

    C) All of the textbooks are errorless.

Find the indicated probability.

14) A study conducted at a certain college shows that 64% of the school's graduates find a job in their chosen field within a year after graduation. Find the probability that among 6 randomly selected graduates, at least one finds a job in his or her chosen field within a year of graduating.

    A) 0.167   B) 0.931   C) 0.640   D) 0.998

15) The table below shows the soft drinks preferences of people in three age groups.

	cola	root beer	lemon–lime
under 21 years of age	40	25	20
between 21 and 40	35	20	30
over 40 years of age	20	30	35

If one of the 255 subjects is randomly selected, find the probability that the person is over 40 years of age.

    A) $\dfrac{1}{2}$ B) $\dfrac{1}{3}$ C) $\dfrac{2}{5}$ D) $\dfrac{3}{5}$

16) The following table contains data from a study of two airlines which fly to Small Town, USA.

	Number of flights which were on time	Number of flights which were late
Podunk Airlines	33	6
Upstate Airlines	43	5

If one of the 87 flights is randomly selected, find the probability that the flight selected is an Upstate Airlines flight given that it was late.

    A) $\dfrac{5}{48}$ B) $\dfrac{5}{11}$

    C) $\dfrac{5}{87}$ D) None of the above is correct.

Solve the problem.

17) A firm uses trend projection and seasonal factors to simulate sales for a given time period. It assigns "0" if sales fall, "1" if sales are steady, "2" if sales rise moderately, and "3" if sales rise a lot. The simulator generates the following output.

0 1 0 2 2 0 0 1 2 3 2 0 2 0 2 2 1 2 3 1 2 2 2 0 3 0 0 2 1 2 1

Estimate the probability that sales will rise at least moderately.

A) 0.512   B) 0.452   C) 0.516   D) 0.613

Evaluate the expression.

18) $10C_2$

A) 80,640   B) 40,320   C) 45   D) 5

Solve the problem.

19) A state lottery involves the random selection of six different numbers between 1 and 22. If you select one six number combination, what is the probability that it will be the winning combination?

A) $\dfrac{1}{74,613}$ B) $\dfrac{1}{113,379,904}$ C) $\dfrac{1}{53,721,360}$ D) $\dfrac{1}{720}$

20) How many 5–digit numbers can be formed using the digits 1, 2, 3, 4, 5, 6, 7 if repetition of digits is not allowed?

A) 120   B) 16,807   C) 2520   D) 119

Answer Key
Testname: ELEMENTARY STATISTICS CHAPTER 3 TEST FORM A

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

1) Probabilities cannot exceed 1.

2) Probability 1 is $\frac{465}{1,000}$, using the total of 1,000 deaths, whereas probability 2 is $\frac{155}{350}$, using only 350 nonsmokers in the survey. The second probability is a conditional probability, referring only to the nonsmokers in the survey.

3) Problem 1 is a combination, not dependent on order, while problem 2 is a permutation and is dependent on order.   27,405 different groups of 4 are possible for problem 1; 657,720 different groups of 4 are possible for problem 2.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

4) C
5) C
6) A
7) A
8) A
9) C
10) D
11) C
12) B
13) A
14) D
15) B
16) B
17) C
18) C
19) A
20) C

Elementary Statistics   Chapter 3 Test – Form B

Name:_____ Course Number: _____ Section Number: _____

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Provide an appropriate response.

1) Sometimes probabilities derived by the relative frequency method differ from the probabilities expected from classical probability methods. How does the law of large numbers apply in this situation?

2) Interpret the symbol $P(B \mid A)$ and explain what is meant by the expression. What do we know if $P(B \mid A)$ is not the same as $P(B)$?

3) Consider the following formulas: $_nP_r = \dfrac{n!}{(n-r)!}$ and $_nC_r = \dfrac{n!}{(n-r)!r!}$.

   Given the same values for n and r in each formula, which is the smaller value, P or C? How does this relate to the concept of counting the number of outcomes based on whether or not order is a criterion?

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Express the indicated degree of likelihood as a probability value.

4) "You have a 50–50 chance of choosing the correct answer."

   A) 0.25   B) 0.50   C) 0.9   D) 50

Find the indicated probability.

5) A class consists of 46 women and 87 men. If a student is randomly selected, what is the probability that the student is a woman?

   A) $\dfrac{1}{133}$ B) $\dfrac{46}{133}$ C) $\dfrac{87}{133}$ D) $\dfrac{46}{87}$

Answer the question, considering an event to be "unusual" if its probability is less than or equal to 0.05.

6) Assume that a study of 300 randomly selected school bus routes showed that 279 arrived on time. Is it "unusual" for a school bus to arrive late?

   A) Yes   B) No

From the information provided, create the sample space of possible outcomes.

7) Flip a coin three times.

   A) HHH HHT HTH HTT THH THT TTH TTT
   B) HHH HTT HTH TTT HTT THH HHT THT
   C) HTT THT HTH HHH TTH TTT
   D) HHH TTT THT HTH HHT TTH HTH

Answer the question.

8) In a certain town, 2% of people commute to work by bicycle. If a person is selected randomly from the town, what are the odds against selecting someone who commutes by bicycle?

   A) 1 : 49   B) 49 : 50   C) 49 : 1   D) 1 : 50

Find the indicated probability.

9) The table below describes the smoking habits of a group of asthma sufferers.

	Nonsmoker	Occasional smoker	Regular smoker	Heavy smoker	Total
Men	335	30	82	48	495
Women	420	33	71	33	557
Total	755	63	153	81	1052

If one of the 1052 people is randomly selected, find the probability that the person is a man or a heavy smoker.

   A) 0.502   B) 0.548   C) 0.593   D) 0.456

10) A bag contains 8 red marbles, 4 blue marbles, and 1 green marble. Find P(not blue).

   A) $\dfrac{9}{13}$ B) 9   C) $\dfrac{13}{9}$ D) $\dfrac{4}{13}$

11) A bin contains 78 light bulbs of which 4 are defective. If 5 light bulbs are randomly selected from the bin with replacement, find the probability that all the bulbs selected are good ones.

   A) 0.769   B) 0.779   C) 0   D) 0.949

12) The table below describes the smoking habits of a group of asthma sufferers.

	Nonsmoker	Light smoker	Heavy smoker	Total
Men	432	35	31	498
Women	438	39	43	520
Total	870	74	74	1018

If two different people are randomly selected from the 1018 subjects, find the probability that they are both heavy smokers.

   A) 0.005218   B) 0.0009273   C) 0.0001826   D) 0.005284

Provide a written description of the complement of the given event.

13) When 100 engines are shipped, all of them are free of defects.

   A) All of the engines are defective.

   B) At least one of the engines is defective.

   C) None of the engines are defective.

Find the indicated probability.

14) A sample of 4 different calculators is randomly selected from a group containing 12 that are defective and 40 that have no defects. What is the probability that at least one of the calculators is defective?

    A) 0.338   B) 0.120   C) 0.662   D) 0.650

Solve the problem.

15) In a certain lottery, five different numbers between 1 and 34 inclusive are drawn. These are the winning numbers. To win the lottery, a person must select the correct 5 numbers in the same order in which they were drawn. What is the probability of winning?

    A) $\dfrac{1}{33,390,720}$ B) $\dfrac{1}{120}$ C) $\dfrac{120}{33,390,720}$ D) $\dfrac{1}{34!}$

Find the indicated probability.

16) The table below shows the soft drinks preferences of people in three age groups.

	cola	root beer	lemon–lime
under 21 years of age	40	25	20
between 21 and 40	35	20	30
over 40 years of age	20	30	35

If one of the 255 subjects is randomly selected, find the probability that the person drinks root beer given that they are over 40.

    A) $\dfrac{2}{5}$ B) $\dfrac{2}{17}$

    C) $\dfrac{6}{17}$ D) None of the above is correct.

17) The table below describes the smoking habits of a group of asthma sufferers.

	Nonsmoker	Light smoker	Heavy smoker	Total
Men	340	68	72	480
Women	305	90	80	475
Total	645	158	152	955

If one of the 955 subjects is randomly selected, find the probability that the person chosen is a woman given that the person is a light smoker.

    A) 0.570   B) 0.265   C) 0.189   D) 0.094

Solve the problem.

18) A firm uses trend projection and seasonal factors to simulate sales for a given time period. It assigns "0" if sales fall, "1" if sales are steady, "2" if sales rise moderately, and "3" if sales rise a lot. The simulator generates the following output.

0 1 0 2 2 0 0 1 2 0 2 0 2 0 2 2 1 2 0 1 2 2 2 0 3 0 0 2 1 2 1

Estimate the probability that sales will remain steady.

    A) 0.125   B) 0.412   C) 0.194   D) 0.258

Evaluate the expression.

19) 10^P5

    A) 252   B) 2   C) 30,240   D) 5

Solve the problem.

20) The organizer of a television show must select 5 people to participate in the show. The participants will be selected from a list of 25 people who have written in to the show. If the participants are selected randomly, what is the probability that the 5 youngest people will be selected?

    A) $\dfrac{1}{120}$ B) $\dfrac{1}{53,130}$ C) $\dfrac{8}{25}$ D) $\dfrac{1}{6,375,600}$

Answer Key
Testname: ELEMENTARY STATISTICS CHAPTER 3 TEST FORM B

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

1) The law of large numbers states that as an experiment is repeated again and again, the relative frequency probabilities tend to approach the actual probabilities expected from the classical approach.
2) This is the symbol for conditional probability and means the probability of event B occurring given that A has occurred. A and B are not independent.
3) The combination value will be smaller, since order is not important. For example, ABC is equivalent to ACB and would not be counted twice. If, however, r is 0 or 1 then nPr = nCr.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

4) B
5) B
6) B
7) A
8) C
9) A
10) A
11) A
12) A
13) B
14) C
15) A
16) C
17) A
18) C
19) C
20) B

Elementary Statistics   Chapter 3 Test – Form C

Name:_____ Course Number: _____ Section Number: _____

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Provide an appropriate response.

1) Compare probabilities and odds. How can you convert odds to probabilities?

2) List two reasons it is better to sample without replacement when testing batches of products. When sampling without replacement, should you use the multiplication rule for independent or dependent events? Explain your answer.

3) Suppose a student is taking a 5–response multiple choice exam; that is, the choices are A, B, C, D, and E, with only one of the responses correct. Describe the **complement** method for determining the probability of getting at least one of the questions correct on the 15–question exam. Why would the complement method be the method of choice for this problem?

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Express the indicated degree of likelihood as a probability value.

4) "You have one chance in ten of winning the race."
   A) 0.5   B) 0.10   C) 0.90   D) 1

Find the indicated probability.

5) If a person is randomly selected, find the probability that his or her birthday is in May. Ignore leap years.

   A) $\dfrac{1}{365}$ B) $\dfrac{1}{12}$ C) $\dfrac{31}{365}$ D) $\dfrac{1}{31}$

Answer the question, considering an event to be "unusual" if its probability is less than or equal to 0.05.

6) Assume that a study of 500 randomly selected school bus routes showed that 479 arrived on time. Is it "unusual" for a school bus to arrive late?
   A) Yes   B) No

From the information provided, create the sample space of possible outcomes.

7) A coin and an octagonal die are tossed.
   A) H1 H2 H3 H4 H5 H6 T1 T2 T3 T4 T5 T6
   B) H1 H2 H3 H4 H5 H6 H7 H8 H9 H10 T1 T2 T3 T4 T5 T6 T7 T8 T9 T10
   C) H1 H2 H3 H4 H5 H6 H7 H8 T1 T2 T3 T4 T5 T6 T7 T8
   D) H1 H2 H3 H4 H5 T1 T2 T3 T4 T5

Answer the question.

8) Suppose you are playing a game of chance. If you bet $10 on a certain event, you will collect $500 (including your $10 bet) if you win. Find the odds used for determining the payoff.
   A) 1 : 49   B) 50 : 1   C) 49 : 1   D) 500 : 510

Find the indicated probability.

9) 100 employees of a company are asked how they get to work and whether they work full time or part time. The figure below shows the results. If one of the 100 employees is randomly selected, find the probability of getting someone who carpools or someone who works full time.
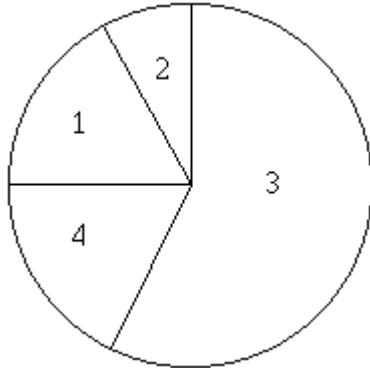
1. Public transportation: 9 full time, 6 part time
2. Bicycle: 3 full time, 5 part time
3. Drive alone: 30 full time, 30 part time
4. Carpool: 9 full time, 8 part time

  A) 0.13   B) 0.53   C) 0.59   D) 0.27

10) The table below describes the smoking habits of a group of asthma sufferers.

	Nonsmoker	Occasional smoker	Regular smoker	Heavy smoker	Total
Men	348	40	66	36	490
Women	431	46	90	30	597
Total	779	86	156	66	1087

If one of the 1087 people is randomly selected, find the probability of getting a regular or heavy smoker.

  A) 0.144   B) 0.459   C) 0.094   D) 0.204

11) In one town, 37% of all voters are Democrats. If two voters are randomly selected for a survey, find the probability that they are both Democrats.

  A) 0.133   B) 0.137   C) 0.740   D) 0.370

12) A sample of 4 different calculators is randomly selected from a group containing 36 that are defective and 29 that have no defects. What is the probability that all four of the calculators selected are defective?

  A) 0.0941   B) 0.4211   C) 0.0870   D) 2.4801

Provide a written description of the complement of the given event.

13) When 10 adults are tested for high blood pressure, at least one of the results are positive.

  A) None of the adults have high blood pressure.

  B) Nine of the adults have high blood pressure.

  C) All of the adults have high blood pressure.

Find the indicated probability.

14) In a batch of 8,000 clock radios 2% are defective. A sample of 12 clock radios is randomly selected without replacement from the 8,000 and tested. The entire batch will be rejected if at least one of those tested is defective. What is the probability that the entire batch will be rejected?

　　A) 0.785　　　　　　　B) 0.0833　　　　　　　C) 0.0200　　　　　　　D) 0.215

15) The table below shows the soft drinks preferences of people in three age groups.

	cola	root beer	lemon–lime
under 21 years of age	40	25	20
between 21 and 40	35	20	30
over 40 years of age	20	30	35

If one of the 255 subjects is randomly selected, find the probability that the person is over 40 years of age given that they drink root beer.

　　A) $\dfrac{5}{17}$　　　　　　　　　　　　　　　　B) $\dfrac{6}{17}$

　　C) $\dfrac{2}{5}$　　　　　　　　　　　　　　　　D) None of the above is correct.

16) The following table contains data from a study of two airlines which fly to Small Town, USA.

	Number of flights which were on time	Number of flights which were late
Podunk Airlines	33	6
Upstate Airlines	43	5

If one of the 87 flights is randomly selected, find the probability that the flight selected arrived on time given that it was an Upstate Airlines flight.

　　A) $\dfrac{43}{87}$　　　　　　　　　　　　　　　　B) $\dfrac{11}{76}$

　　C) $\dfrac{43}{48}$　　　　　　　　　　　　　　　　D) None of the above is correct.

Solve the problem.

17) A firm uses trend projection and seasonal factors to simulate sales for a given time period. It assigns "0" if sales fall, "1" if sales are steady, "2" if sales rise moderately, and "3" if sales rise a lot. The simulator generates the following output.

0 1 1 2 0 0 1 1 0 3 2 1 0 1 0 2 1 2 3 1 2 0 2 0 3 1 0 2 1 0 1

Estimate the probability that sales will rise moderately.

　　A) 0.312　　　　　　　B) 0.233　　　　　　　C) 0.226　　　　　　　D) 0.258

Evaluate the expression.

18) 10^P3

　　A) 120　　　　　　　B) 7　　　　　　　C) 27　　　　　　　D) 720

Solve the problem.

19) 8 basketball players are to be selected to play in a special game. The players will be selected from a list of 27 players. If the players are selected randomly, what is the probability that the 8 tallest players will be selected?

A) $\dfrac{1}{213,127,200}$ 　　　 B) $\dfrac{1}{40,320}$ 　　　 C) $\dfrac{1}{2,220,075}$ 　　　 D) $\dfrac{8}{27}$

20) A pollster wants to minimize the effect the order of the questions has on a person's response to a survey. How many different surveys are required to cover all possible arrangements if there are 6 questions on the survey?

A) 120 　　　 B) 720 　　　 C) 6 　　　 D) 36

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

1) Probabilities compare the number of occurrences of an event A to the total number of outcomes. Odds compare the number of occurrences of event A to the number of occurrences of the complement of event A. If the odds for A are 13:6, then $P(A) = \dfrac{13}{19}$ since there would be a total of 19 outcomes (13 + 6).

2) The two reasons include the lower chance of getting only good items when some defects are present, and sampling with replacement might allow you to test the same item more than once which would be inefficient. You should use the multiplication rule for dependent events, since the sample space has diminished and the probability of choosing a second good item has gotten smaller.

3) P(at least one correct) = 1 – P(none are correct). The alternative to the complement method is to find P(1), P(2),...P(15) and take this sum. This method is too time consuming and too difficult.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

4) B
5) C
6) A
7) C
8) C
9) C
10) D
11) B
12) C
13) A
14) D
15) C
16) C
17) C
18) D
19) C
20) B

Elementary Statistics   Chapter 4 Test – Form A

Name:_____ Course Number: _____ Section Number: _____

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Is the study experimental or observational?

1) A stock analyst observes the relationship between stock prices and earnings per share to help him select a stock for investment.

    A) Observational   B) Experimental

Identify the given random variable as being discrete or continuous.

2) The number of oil spills occurring off the Alaskan coast

    A) Continuous   B) Discrete

3) The height of a randomly selected student

    A) Discrete   B) Continuous

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Determine whether the following is a probability distribution. If not, identify the requirement that is not satisfied.

4)

x	P(x)
0	0.243
1	0.167
2	0.213
3	0.149
4	0.232
5	0.164

5) In a certain town, 20% of adults have a college degree. The accompanying table describes the probability distribution for the number of adults (among 4 randomly selected adults) who have a college degree.

x	P(x)
0	0.4096
1	0.4096
2	0.1536
3	0.0256
4	0.0016

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Find the mean of the given probability distribution.

6) The random variable x is the number of houses sold by a realtor in a single month at the Sendsom's Real Estate office. Its probability distribution is as follows.

Houses Sold (x)	Probability P(x)
0	0.24
1	0.01
2	0.12
3	0.16
4	0.01
5	0.14
6	0.11
7	0.21

    A) 3.60   B) 3.40   C) 3.50   D) 3.35

Solve the problem.

7) The random variable x is the number of houses sold by a realtor in a single month at the Sendsom's Real Estate Office. Its probability distribution is as follows. Find the standard deviation for the probability distribution.

Houses Sold (x)	Probability P(x)
0	0.24
1	0.01
2	0.12
3	0.16
4	0.01
5	0.14
6	0.11
7	0.21

    A) 2.62   B) 4.45   C) 6.86   D) 2.25

8) Find the variance for the given probability distribution.

x	P(x)
0	0.05
2	0.17
4	0.43
6	0.35

    A) 2.44   B) 2.85   C) 1.69   D) 1.56

9) A contractor is considering a sale that promises a profit of $38,000 with a probability of 0.7 or a loss (due to bad weather, strikes, and such) of $16,000 with a probability of 0.3. What is the expected profit?

    A) $26,600   B) $22,000   C) $37,800   D) $21,800

Determine whether the given procedure results in a binomial distribution. If not, state the reason why.

    10) Spinning a roulette wheel 6 times, keeping track of the occurrences of a winning number of "16".

        A) Not binomial: there are more than two outcomes for each trial.

        B) Procedure results in a binomial distribution..

        C) Not binomial: the trials are not independent.

        D) Not binomial: there are too many trials.

Assume that a researcher randomly selects 14 newborn babies and counts the number of girls selected, x. The probabilities corresponding to the 14 possible values of x are summarized in the given table. Answer the question using the table.

Probabilities of Girls

x(girls)	P(x)	x(girls)	P(x)	x(girls)	P(x)
0	0.000	5	0.122	10	0.061
1	0.001	6	0.183	11	0.022
2	0.006	7	0.209	12	0.006
3	0.022	8	0.183	13	0.001
4	0.061	9	0.122	14	0.000

    11) Find the probability of selecting 2 or more girls.

        A) 0.999   B) 0.994   C) 0.001   D) 0.006

Answer the question.

    12) Suppose that computer literacy among people ages 40 and older is being studied and that the accompanying tables describes the probability distribution for four randomly selected people, where x is the number that are computer literate. Is it unusual to find four computer literates among four randomly selected people?

x	P(x)
0	0.16
1	0.25
2	0.36
3	0.15
4	0.08

        A) No   B) Yes

Assume that a procedure yields a binomial distribution with a trial repeated n times. Use the binomial probability formula to find the probability of x successes given the probability p of success on a single trial.

    13) $n = 12$, $x = 5$, $p = 0.25$

        A) 0.103   B) 0.082   C) 0.091   D) 0.027

Find the indicated probability.

    14) The participants in a television quiz show are picked from a large pool of applicants with approximately equal numbers of men and women. Among the last 12 participants there have been only 2 women. If participants are picked randomly, what is the probability of getting 2 or fewer women when 12 people are picked?

        A) 0.0161   B) 0.0032   C) 0.0193   D) 0.0190

Find the standard deviation, σ, for the binomial distribution which has the stated values of n and p. Round your answer to the nearest hundredth.

15) n = 38; p = .4

A) σ = 6.29   B) σ = 3.02   C) σ = 0.61   D) σ = 7.14

Use the given values of n and p to find the minimum usual value μ – 2σ and the maximum usual value μ + 2σ.

16) n = 186, p = 0.13

A) Minimum: 19.59; maximum: 28.77   B) Minimum: 33.35; maximum: 15.01

C) Minimum: 15.01; maximum: 33.35   D) Minimum: –17.89; maximum: 66.25

Solve the problem.

17) The probability is 0.7 that a person shopping at a certain store will spend less than $20. For groups of size 22, find the mean number who spend less than $20.

A) 14.0   B) 6.6   C) 15.4   D) 6.0

18) A company manufactures batteries in batches of 18 and there is a 3% rate of defects. Find the standard deviation for the number of defects per batch.

A) 0.721   B) 0.735   C) 0.703   D) 0.724

Determine if the outcome is unusual. Consider as unusual any result that differs from the mean by more than 2 standard deviations. That is, unusual values are either less than μ – 2σ or greater than μ + 2σ.

19) A survey for brand recognition is done and it is determined that 68% of consumers have heard of Dull Computer Company. A survey of 800 randomly selected consumers is to be conducted. For such groups of 800, would it be unusual to get 451 consumers who recognize the Dull Computer Company name?

A) No   B) Yes

Use the Poisson Distribution to find the indicated probability.

20) The number of calls received by a car towing service averages 16.8 per day (per 24–hour period). After finding the mean number of calls per hour, find the probability that in a randomly selected hour the number of calls is 2.

A) 0.08516   B) 0.13383   C) 0.12166   D) 0.15208

Answer Key
Testname: ELEMENTARY STATISTICS CHAPTER 4 TEST FORM A

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

1) B
2) B
3) B

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

4) Not a probability distribution. The sum of the P(x)'s is not 1.
5) Probability distribution

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

6) A
7) A
8) B
9) D
10) B
11) A
12) A
13) A
14) C
15) B
16) C
17) C
18) D
19) B
20) C

Elementary Statistics   Chapter 4 Test – Form B

Name:_____ Course Number: _____ Section Number: _____

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Provide an appropriate response.

1) List the four requirements for a binomial distribution. Describe an experiment which is binomial and discuss how the experiment fits each of the four requirements.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Identify the given random variable as being discrete or continuous.

2) The braking time of a car

   A) Discrete   B) Continuous

3) The number of phone calls between New York and California on Thanksgiving day

   A) Discrete   B) Continuous

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Determine whether the following is a probability distribution. If not, identify the requirement that is not satisfied.

4) If a person is randomly selected from a certain town, the probability distribution for the number, x, of siblings is as described in the accompanying table.

x	P(x)
0	0.24
1	0.29
2	0.24
3	0.12
4	0.06
5	0.03

5)

x	P(x)
0	0.20
1	0.10
2	0.13
3	0.45
4	0.12

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Determine whether the given procedure results in a binomial distribution. If not, state the reason why.

6) Choosing 5 people (without replacement) from a group of 37 people, of which 15 are women, keeping track of the number of men chosen.

   A) Procedure results in a binomial distribution.

   B) Not binomial: there are too many trials.

   C) Not binomial: there are more than two outcomes for each trial.

   D) Not binomial: the trials are not independent.

Find the mean of the given probability distribution.

7) In a certain town, 40% of adults have a college degree. The accompanying table describes the probability distribution for the number of adults (among 4 randomly selected adults) who have a college degree.

x	P(x)
0	0.1296
1	0.3456
2	0.3456
3	0.1536
4	0.0256

   A) 1.50   B) 1.73   C) 1.60   D) 2.00

Solve the problem.

8) Find the variance for the given probability distribution.

x	P(x)
0	0.16
1	0.29
2	0.22
3	0.09
4	0.24

   A) 5.82   B) 2.21   C) 1.98   D) 2.14

9) A police department reports that the probabilities that 0, 1, 2, and 3 burglaries will be reported in a given day are 0.50, 0.41, 0.05, and 0.04, respectively. Find the standard deviation for the probability distribution. Round answer to the nearest hundredth.

   A) 0.76   B) 0.98   C) 1.04   D) 0.57

10) Suppose you buy 1 ticket for $1 out of a lottery of 1,000 tickets where the prize for the one winning ticket is to be $500. What is your expected value?

   A) –$0.50   B) $0.00   C) –$0.40   D) –$1.00

Assume that a researcher randomly selects 14 newborn babies and counts the number of girls selected, x. The probabilities corresponding to the 14 possible values of x are summarized in the given table. Answer the question using the table.

Probabilities of Girls

x(girls)	P(x)	x(girls)	P(x)	x(girls)	P(x)
0	0.000	5	0.122	10	0.061
1	0.001	6	0.183	11	0.022
2	0.006	7	0.209	12	0.006
3	0.022	8	0.183	13	0.001
4	0.061	9	0.122	14	0.000

11) Find the probability of selecting 9 or more girls.

    A) 0.212   B) 0.061   C) 0.001   D) 0.122

Answer the question.

12) Suppose that voting in municipal elections is being studied and that the accompanying tables describes the probability distribution for four randomly selected people, where x is the number that voted in the last election. Is it unusual to find four voters among four randomly selected people?

x	P(x)
0	0.23
1	0.32
2	0.26
3	0.15
4	0.04

    A) Yes   B) No

Assume that a procedure yields a binomial distribution with a trial repeated n times. Use the binomial probability formula to find the probability of x successes given the probability p of success on a single trial.

13) $n = 10$, $x = 2$, $p = \dfrac{1}{3}$

    A) 0.2156   B) 0.1951   C) 0.1929   D) 0.0028

Find the indicated probability.

14) An airline estimates that 91% of people booked on their flights actually show up. If the airline books 80 people on a flight for which the maximum number is 78, what is the probability that the number of people who show up will exceed the capacity of the plane?

    A) 0.0047   B) 0.0042   C) 0.0005   D) 0.0211

Find the standard deviation, σ, for the binomial distribution which has the stated values of n and p. Round your answer to the nearest hundredth.

15) $n = 1546$; $p = .57$

    A) $\sigma = 23.59$ B) $\sigma = 19.47$ C) $\sigma = 22.74$ D) $\sigma = 17.06$

Use the given values of n and p to find the minimum usual value μ – 2σ and the maximum usual value μ + 2σ.

16) $n = 290,\ p = \dfrac{1}{4}$

   A) Minimum: 87.25; maximum: 57.75   B) Minimum: 65.13; maximum: 79.87

   C) Minimum: 62.07; maximum: 82.93   D) Minimum: 57.75; maximum: 87.25

Solve the problem.

17) The probability of winning a certain lottery is 1/52,027. For people who play 724 times, find the mean number of wins.

   A) 0.0719   B) 0.000019   C) 0.0014   D) 0.0139

18) A company manufactures batteries in batches of 20 and there is a 3% rate of defects. Find the variance for the number of defects per batch.

   A) 0.582   B) 0.6   C) 0.553   D) 0.578

Determine if the outcome is unusual. Consider as unusual any result that differs from the mean by more than 2 standard deviations. That is, unusual values are either less than μ – 2σ or greater than μ + 2σ.

19) The Acme Candy Company claims that 60% of the jawbreakers it produces weigh more than .4 ounces. Suppose that 800 jawbreakers are selected at random from the production lines. Would it be unusual for this sample of 800 to contain 476 jawbreakers that weigh more than .4 ounces?

   A) No   B) Yes

Use the Poisson Distribution to find the indicated probability.

20) A computer salesman averages 1.5 sales per week. Use the Poisson distribution to find the probability that in a randomly selected week the number of computers sold is 0.

   A) 0.2789   B) 0.2454   C) 0.2231   D) 0.3347

Answer Key
Testname: ELEMENTARY STATISTICS CHAPTER 4 TEST FORM B

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

1) The four requirements are:
   1) The experiment must have a fixed number of trials.
   2) The trials must be independent.
   3) Each trial must have all outcomes classified into two categories.
   4) The probabilities must remain constant for each trial.
   Answers will vary for the experiment.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

2) B
3) A

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

4) Not a probability distribution. The sum of the P(x)'s is not 1.
5) Probability distribution.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

6) D
7) C
8) C
9) A
10) A
11) A
12) A
13) B
14) A
15) B
16) D
17) D
18) A
19) A
20) C

Elementary Statistics   Chapter 4 Test – Form C

Name:_____ Course Number: _____ Section Number: _____

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Provide an appropriate response.

1) Identify each of the variables in the Binomial Probability Formula.

$$P(x) = \frac{n!}{(n-x)!x!} \cdot p^x \cdot q^{n-x}$$

Also, explain what the fraction $\frac{n!}{(n-x)!x!}$ computes.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Identify the given random variable as being discrete or continuous.

2) The number of freshmen in the required course, English 101

   A) Discrete   B) Continuous

3) The pH level in a shampoo

   A) Discrete   B) Continuous

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Determine whether the following is a probability distribution. If not, identify the requirement that is not satisfied.

4)

x	P(x)
0	0.309
1	0.232
2	–0.092
3	0.245
4	0.153
5	0.153

5) A police department reports that the probabilities that 0, 1, 2, 3, and 4 car thefts will be reported in a given day are 0.091, 0.218, 0.261, 0.209, and 0.125, respectively.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Find the mean of the given probability distribution.

6) The probabilities that a batch of 4 computers will contain 0, 1, 2, 3, and 4 defective computers are 0.6274, 0.3102, 0.0575, 0.0047, and 0.0001, respectively. Round answer to the nearest hundredth.

   A) 0.34   B) 2.00   C) 1.07   D) 0.44

Solve the problem.

7) In a certain town, 70% of adults have a college degree. The accompanying table describes the probability distribution for the number of adults (among 4 randomly selected adults) who have a college degree. Find the standard deviation for the probability distribution.

x	P(x)
0	0.0081
1	0.0756
2	0.2646
3	0.4116
4	0.2401

A) 1.06   B) 2.95   C) 0.92   D) 0.84

8) The accompanying table shows the probability distribution for x, the number that shows up when a loaded die is rolled. Find the variance for the probability distribution.

x	P(x)
1	0.23
2	0.10
3	0.10
4	0.24
5	0.11
6	0.22

A) 12.48   B) 3.37   C) 16.04   D) 3.15

9) A 28–year–old man pays $158 for a one–year life insurance policy with coverage of $110,000. If the probability that he will live through the year is 0.9994, what is the expected value for the insurance policy?

A) $66.00   B) –$92.00   C) $109,934.00   D) –$157.91

Assume that a researcher randomly selects 14 newborn babies and counts the number of girls selected, x. The probabilities corresponding to the 14 possible values of x are summarized in the given table. Answer the question using the table.

Probabilities of Girls

x(girls)	P(x)	x(girls)	P(x)	x(girls)	P(x)
0	0.000	5	0.122	10	0.061
1	0.001	6	0.183	11	0.022
2	0.006	7	0.209	12	0.006
3	0.022	8	0.183	13	0.001
4	0.061	9	0.122	14	0.000

10) Find the probability of selecting 12 or more girls.

A) 0.007   B) 0.001   C) 0.006   D) 0.022

Determine whether the given procedure results in a binomial distribution. If not, state the reason why.

11) Choosing 4 marbles from a box of 40 marbles (20 purple, 12 red, and 8 green) one at a time without replacement, keeping track of the number of red marbles chosen.

   A) Not binomial: there are too many trials.

   B) Not binomial: there are more than two outcomes for each trial.

   C) Not binomial: the trials are not independent.

   D) Procedure results in a binomial distribution.

Answer the question.

12) Suppose that a law enforcement group studying traffic violations determines that the accompanying table describes the probability distribution for five randomly selected people, where x is the number that have received a speeding ticket in the last 2 years. Is it unusual to find no speeders among five randomly selected people?

x	P(x)
0	0.08
1	0.18
2	0.25
3	0.22
4	0.19
5	0.08

   A) No   B) Yes

Assume that a procedure yields a binomial distribution with a trial repeated n times. Use the binomial probability formula to find the probability of x successes given the probability p of success on a single trial.

13) n = 64, x = 3, p = 0.04

   A) 0.375   B) 0.139   C) 0.091   D) 0.221

Find the indicated probability.

14) A car insurance company has determined that 9% of all drivers were involved in a car accident last year. Among the 12 drivers living on one particular street, 3 were involved in a car accident last year. If 12 drivers are randomly selected, what is the probability of getting 3 or more who were involved in a car accident last year?

   A) 0.0866   B) 0.9314   C) 0.4091   D) 0.0686

Find the standard deviation, σ, for the binomial distribution which has the stated values of n and p. Round your answer to the nearest hundredth.

15) n = 40; p = 3/5

   A) $\sigma = 3.10$ B) $\sigma = 0.69$ C) $\sigma = 6.37$ D) $\sigma = 7.22$

Use the given values of n and p to find the minimum usual value $\mu - 2\sigma$ and the maximum usual value $\mu + 2\sigma$.

16) n = 107, p = 0.23

   A) Minimum: 15.9; maximum: 33.32   B) Minimum: 33.32; maximum: 15.9

   C) Minimum: –13.29; maximum: 62.51   D) Minimum: 20.26; maximum: 28.96

Solve the problem.

17) A company manufactures batteries in batches of 8 and there is a 3% rate of defects. Find the mean number of defects per batch.

   A) 0.232   B) 0.248   C) 0.24   D) 7.76

18) In a certain town, 50% of voters favor a given ballot measure. For groups of 22 voters, find the variance for the number who favor the measure.

   A) 2.35   B) 5.50   C) 11.00   D) 30.25

Determine if the outcome is unusual. Consider as unusual any result that differs from the mean by more than 2 standard deviations. That is, unusual values are either less than $\mu - 2\sigma$ or greater than $\mu + 2\sigma$.

19) According to AccuData Media Research, 36% of televisions within the Chicago city limits are tuned to "Eyewitness News" at 5:00 pm on Sunday nights. At 5:00 pm on a given Sunday, 2500 such televisions are randomly selected and checked to determine what is being watched. Would it be unusual to find that 990 of the 2500 televisions are tuned to "Eyewitness News"?

   A) No   B) Yes

Use the Poisson Distribution to find the indicated probability.

20) A mountain search and rescue team receives an average of $\mu = 0.71$ calls per day. Find the probability that on a randomly selected day, they will receive fewer than two calls.

   A) 0.8407   B) 0.3491   C) 0.1593   D) 0.1239

Answer Key
Testname: ELEMENTARY STATISTICS CHAPTER 4 TEST FORM C

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

1) n is the fixed number of trials, x is the number of successes, p is the probability of success in one of the n trials, and q is the probability of failure in one of the n trials. The fraction determines the number of different arrangements of x successes out of n trials.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

2) A
3) B

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

4) Not a probability distribution. One of the P(x)'s is negative.
5) Not a probability distribution. The sum of the P(x)'s is not 1.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

6) D
7) C
8) B
9) B
10) A
11) C
12) A
13) D
14) A
15) A
16) A
17) C
18) B
19) B
20) A

Elementary Statistics   Chapter 5 Test – Form A

Name:_____   Course Number: _____   Section Number: _____

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Provide an appropriate response.

1) Replacement times for T.V. sets are normally distributed with a mean of 8.2 years and a standard deviation of 1.1 years (based on data from "Getting Things Fixed," <u>Consumers Reports</u>). (a) Find the probability that a randomly selected T.V. will have a replacement time between 6.5 and 9.5 years. (b) Find the probability that a randomly selected T.V. will have a replacement time between 9.5 and 10.5 years. These two problems can be solved by the same procedure. Draw the diagram for each and discuss the difference. Then, explain why the same procedure can be used.

2) The typical computer random–number generator yields numbers in a uniform distribution between 0 and 1 with a mean of 0.500 and a standard deviation of 0.289. Consider the following problems. (a) Suppose a sample of size 50 is randomly generated. Find the probability that the mean is below 0.300. (b) Suppose a sample size of 15 is randomly generated. Find the probability that the mean is below 0.300. These two problems appear to be very similar. Only one can be solved by the Central Limit theorem. Which one and why? Use the Central Limit theorem to find that probability.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Using the following uniform density curve, answer the question.
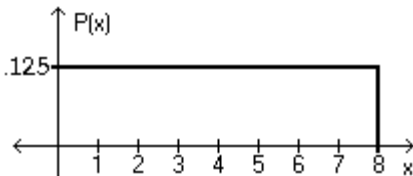
3) What is the probability that the random variable has a value between 0.6 and 1.4?
   A) 0.1000   B) 0.3500   C) 0.2250   D) 0.0250

Assume that the weight loss for the first month of a diet program varies between 6 pounds and 12 pounds, and is spread evenly over the range of possibilities, so that there is a uniform distribution. Find the probability of the given range of pounds lost.

4) Less than 10 pounds
   A) $\frac{5}{7}$ B) $\frac{2}{3}$ C) $\frac{1}{3}$ D) $\frac{1}{6}$

If Z is a standard normal variable, find the probability.

5) The probability that Z lies between –1.10 and –0.36
   A) –0.2237   B) 0.4951   C) 0.2237   D) 0.2239

Solve the problem.

6) A bank's loan officer rates applicants for credit. The ratings are normally distributed with a mean of 200 and a standard deviation of 50. Find P_{60}, the score which separates the lower 60% from the top 40%.

    A) 211.3   B) 207.8   C) 212.5   D) 187.5

Find the indicated probability.

7) The weekly salaries of teachers in one state are normally distributed with a mean of $490 and a standard deviation of $45. What is the probability that a randomly selected teacher earns more than $525 a week?

    A) 0.2823   B) 0.1003   C) 0.7823   D) 0.2177

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Provide an appropriate response.

8) A recent survey based on a random sample of n = 420 voters, predicted that the Independent candidate for the mayoral election will get 24% of the vote, but he actually gets 27%. Can it be concluded that the survey was done incorrectly?

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Identify the probability of each sample, and describe the sampling distribution of the sample means.

9) Personal phone calls received in the last three days by a new employee were 5, 4, and 2. Assume that samples of size 2 are randomly selected with replacement from this population of three values.

    A) 1/3; 1/3; 1/18; 1/6; 1/18; 1/9; 1/6; 1/18; 1/9

    B) 1/9; 2/9; 1/9; 0/9; 1/9; 0/9; 1/9; 2/9; 1/9

    C) 1/8; 1/9; 1/8; 1/9; 1/8; 1/9; 1/8; 1/9; 1/8

    D) 1/9; 1/9; 1/9; 1/9; 1/9; 1/9; 1/9; 1/9; 1/9

Solve the problem.

10) In one region, the September energy consumption levels for single–family homes are found to be normally distributed with a mean of 1050 kWh and a standard deviation of 218 kWh. If 50 different homes are randomly selected, find the probability that their mean energy consumption level for September is greater than 1075 kWh.

    A) 0.0438   B) 0.2090   C) 0.4562   D) 0.2910

The Precision Scientific Instrument Company manufactures thermometers that are supposed to give readings of 0°C at the freezing point of water. Tests on a large sample of these thermometers reveal that at the freezing point of water, some give readings below 0°C (denoted by negative numbers) and some give readings above 0°C (denoted by positive numbers). Assume that the mean reading is 0°C and the standard deviation of the readings is 1.00°C. Also assume that the frequency distribution of errors closely resembles the normal distribution. A thermometer is randomly selected and tested. Find the temperature reading corresponding to the given information.

11) If 9% of the thermometers are rejected because they have readings that are too high, but all other thermometers are acceptable, find the temperature that separates the rejected thermometers from the others.

   A) 1.34°   B) 1.26°   C) 1.39°   D) 1.45°

Assume that X has a normal distribution, and find the indicated probability.

12) The mean is $\mu = 22.0$ and the standard deviation is $\sigma = 2.4$.
   Find the probability that X is between 19.7 and 25.3.

   A) 1.0847   B) 0.4107   C) 0.7477   D) 0.3370

Solve the problem.

13) A final exam in Math 160 has a mean of 73 with standard deviation 7.8. If 24 students are randomly selected, find the probability that the mean of their test scores is less than 70.

   A) 0.1.006   B) 0.0301   C) 0.9699   D) 0.0278

14) A study of the amount of time it takes a mechanic to rebuild the transmission for a 1992 Chevrolet Cavalier shows that the mean is 8.4 hours and the standard deviation is 1.8 hours. If 40 mechanics are randomly selected, find the probability that their mean rebuild time exceeds 8.1 hours.

   A) 0.8531   B) 0.7285   C) 0.8457   D) 0.9146

Use the continuity correction and describe the region of the normal curve that corresponds to the indicated binomial probability.

15) The probability of exactly 56 green marbles

   A) The area between 56 and 56.5   B) The area between 55.5 and 57.5

   C) The area between 55.5 and 56   D) The area between 55.5 and 56.5

For the binomial distribution with the given values for n and p, state whether or not it is suitable to use the normal distribution as an approximation.

16) $n = 53$ and $p = .7$

   A) Normal approximation is not suitable.   B) Normal approximation is suitable.

Estimate the indicated probability by using the normal distribution as an approximation to the binomial distribution.

17) A product is manufactured in batches of 120 and the overall rate of defects is 5%. Estimate the probability that a randomly selected batch contains more than 6 defects.

   A) 0.4641   B) 0.5871   C) 0.0832   D) 0.4168

Use the normal distribution to approximate the desired probability.

18) A coin is tossed 20 times. A person, who claims to have extrasensory perception, is asked to predict the outcome of each flip in advance. She predicts correctly on 16 tosses. What is the probability of being correct 16 or more times by guessing? Does this probability seem to verify her claim?

   A) .4931 , no   B) .0069 , no   C) .4931 , yes   D) .0069 , yes

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Solve the problem.

19) A normal probability plot is given below for the weekly incomes (in dollars) of a sample of engineers in one town. Use the plot to assess the normality of the incomes of engineers in this town. Explain your reasoning.
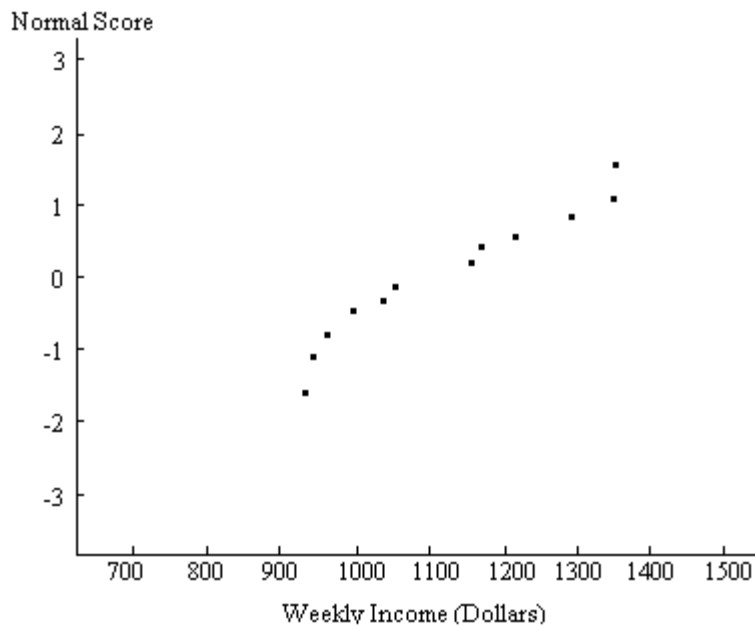
Examine the given data set and determine whether the requirement of a normal distribution is satisfied. Assume that the requirement for a normal distribution is loose in the sense that the population distribution need not be exactly normal, but it must have a distribution which is basically symmetric with only one mode. Explain why you do or do not think that the requirement is satisfied.

20) The heart rates (in beats per minute) of 30 randomly selected students are given below.

   78 64 69 75 80
   63 70 72 72 68
   77 71 74 84 70
   62 67 71 69 58
   74 70 80 63 88
   60 68 69 70 71

Answer Key
Testname: ELEMENTARY STATISTICS CHAPTER 5 TEST FORM A

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

1) For problem (a), the probability is 0.8204. For problem (b), the probability is 0.1007. The diagram for (a) shows the union of areas on both sides of the mean; the diagram for (b) shows an area to the right of the mean. Both problems can be solved by the same procedure: find the equivalent z score and associated area, i.e., probability, for each x value; subtract the smaller area from the larger area. Table A–2 facilitates this common procedure because it provides cumulative areas from the left for both negative and positive z scores.

2) Problem (a) can be solved by the Central Limit theorem. Even though the parent population is not normal, samples of size 50 are large. Their distribution will be normal. The probability is 0.0001. Problem (b) cannot be solved by the Central Limit theorem, because the sample size is smaller than 30 and the parent population is not normal. Their distribution will not be normal.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

3) A
4) B
5) C
6) C
7) D

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

8) No, because of sampling variability, sample proportions will naturally vary from the true population proportion, even if sampling is done with a perfectly valid procedure.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

9) D
10) B
11) A
12) C
13) B
14) A
15) D
16) B
17) D
18) D

**SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.**

19) Since the normal probability plot displays curvature, it appears that incomes of engineers in this town are probably not normally distributed.

20) The requirement for normality is satisfied since a histogram of the data is roughly bell shaped; it is roughly symmetric with a single mode.

Elementary Statistics   Chapter 5 Test – Form B

Name:_____   Course Number: _____   Section Number: _____

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Provide an appropriate response.

1) Consider the uniform distribution shown below. Find the probability that x is greater than 6. Discuss the relationship between area under a density curve and probability.
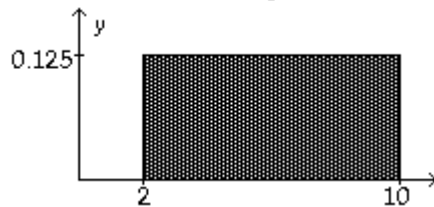
2) SAT verbal scores are normally distributed with a mean of 430 and a standard deviation of 120 (based on data from the College Board ATP). (a) If a single student is randomly selected, find the probability that the sample mean is above 500. (b) If a sample of 35 students are selected randomly, find the probability that the sample mean is above 500. These two problems appear to be very similar. Which problem requires the application of the Central Limit theorem, and in what way does the solution process differ between the two problems?

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Using the following uniform density curve, answer the question.
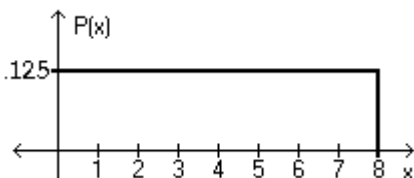
3) What is the probability that the random variable has a value between 0.4 and 0.7?
   A) 0.088   B) 0.163   C) 0.288   D) 0.038

Assume that the weight loss for the first month of a diet program varies between 6 pounds and 12 pounds, and is spread evenly over the range of possibilities, so that there is a uniform distribution. Find the probability of the given range of pounds lost.

4) More than 9 pounds
   A) $\frac{1}{2}$ B) $\frac{5}{6}$ C) $\frac{2}{3}$ D) $\frac{1}{7}$

If Z is a standard normal variable, find the probability.

5) The probability that Z lies between 0.7 and 1.98
   A) 0.2175   B) –0.2181   C) 1.7341   D) 0.2181

Elementary Statistics   Chapter 5 Test – Form B

The Precision Scientific Instrument Company manufactures thermometers that are supposed to give readings of 0°C at the freezing point of water. Tests on a large sample of these thermometers reveal that at the freezing point of water, some give readings below 0°C (denoted by negative numbers) and some give readings above 0°C (denoted by positive numbers). Assume that the mean reading is 0°C and the standard deviation of the readings is 1.00°C. Also assume that the frequency distribution of errors closely resembles the normal distribution. A thermometer is randomly selected and tested. Find the temperature reading corresponding to the given information.

6) If 7% of the thermometers are rejected because they have readings that are too low, but all other thermometers are acceptable, find the temperature that separates the rejected thermometers from the others.

   A) –1.53°   B) –1.48°   C) –1.26°   D) –1.39°

Assume that X has a normal distribution, and find the indicated probability.

7) The mean is $\mu = 15.2$ and the standard deviation is $\sigma = 0.9$.
   Find the probability that X is between 14.3 and 16.1.

   A) 0.8413   B) 0.6826   C) 0.3413   D) 0.1587

Solve the problem.

8) In one region, the September energy consumption levels for single–family homes are found to be normally distributed with a mean of 1050 kWh and a standard deviation of 218 kWh. Find P_{45}, which is the consumption level separating the bottom 45% from the top 55%.

   A) 1087.8   B) 1148.1   C) 1021.7   D) 1078.3

Find the indicated probability.

9) Assume that the weights of quarters are normally distributed with a mean of 5.67 g and a standard deviation 0.070 g. A vending machine will only accept coins weighing between 5.48 g and 5.82 g. What percentage of legal quarters will be rejected?

   A) 1.96%   B) 1.62%   C) 2.48%   D) 0.0196%

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Provide an appropriate response.

10) A poll of 1400 randomly selected students in grades 6 through 8 was conducted and found that 30% enjoy playing sports. Would confidence in the results increase if the sample size were 3200 instead of 1400? Why or why not?

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Identify the probability of each sample, and describe the sampling distribution of the sample means.

11) The number of books sold over the course of the four–day book fair were 196, 195, 264, and 60. Assume that samples of size 2 are randomly selected with replacement from this population of four values.

   A) 0/16; 1/16; 1/8; 0/16; 1/16; 1/8; 1/16; 0/16; 1/8; 1/16; 1/16; 1/8; 1/16; 0/16; 1/8; 1/16

   B) 1/2; 1/16; 1/4; 1/16; 1/4; 1/16; 1/2; 1/16; 1/4; 1/16; 1/2; 1/16; 1/4; 1/16; 1/2; 1/16

   C) 1/16; 1/8; 0/16; 1/16; 1/8; 0/16; 1/16; 1/8; 0/16; 1/16; 1/8; 0/16; 1/16; 1/8; 0/16; 1/16

   D) 1/16; 1/16; 1/16; 1/16; 1/16; 1/16; 1/16; 1/16; 1/16; 1/16; 1/16; 1/16; 1/16; 1/16; 1/16; 1/16

Solve the problem.

12) Suppose that replacement times for washing machines are normally distributed with a mean of 9.3 years and a standard deviation of 1.1 years. Find the probability that 70 randomly selected washing machines will have a mean replacement time less than 9.1 years.

   A) 0.4357   B) 0.4286   C) 0.0643   D) 0.0714

13) A study of the amount of time it takes a mechanic to rebuild the transmission for a 1992 Chevrolet Cavalier shows that the mean is 8.4 hours and the standard deviation is 1.8 hours. If 40 mechanics are randomly selected, find the probability that their mean rebuild time exceeds 9.1 hours.

   A) 0.0046   B) 0.1285   C) 0.1046   D) 0.0069

14) A final exam in Math 160 has a mean of 73 with standard deviation 7.8. If 24 students are randomly selected, find the probability that the mean of their test scores is less than 76.

   A) 0.9203   B) 0.9699   C) 0.8962   D) 0.0301

Use the continuity correction and describe the region of the normal curve that corresponds to the indicated binomial probability.

15) The probability that the number of correct answers is between 23 and 60 inclusive

   A) The area between 22.5 and 60.5   B) The area between 22.5 and 59.5

   C) The area between 23.5 and 59.5   D) The area between 23 and 60

For the binomial distribution with the given values for n and p, state whether or not it is suitable to use the normal distribution as an approximation.

16) n = 19 and p = .8

   A) Normal approximation is suitable.   B) Normal approximation is not suitable.

Estimate the indicated probability by using the normal distribution as an approximation to the binomial distribution.

17) Two percent of hair dryers produced in a certain plant are defective. Estimate the probability that of 10,000 randomly selected hair dryers, exactly 225 are defective.

   A) 0.0057   B) 0.0051   C) 0.0065   D) 0.0034

Use the normal distribution to approximate the desired probability.

18) A coin is tossed 20 times. A person, who claims to have extrasensory perception, is asked to predict the outcome of each flip in advance. She predicts correctly on 14 tosses. What is the probability of being correct 14 or more times by guessing? Does this probability seem to verify her claim?

   A) .4418 , yes   B) .0582 , no   C) .0582 , yes   D) .4418 , no

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Solve the problem.

19) A normal probability plot is given below for a sample of scores on an aptitude test. Use the plot to assess the normality of scores on this test. Explain your reasoning.
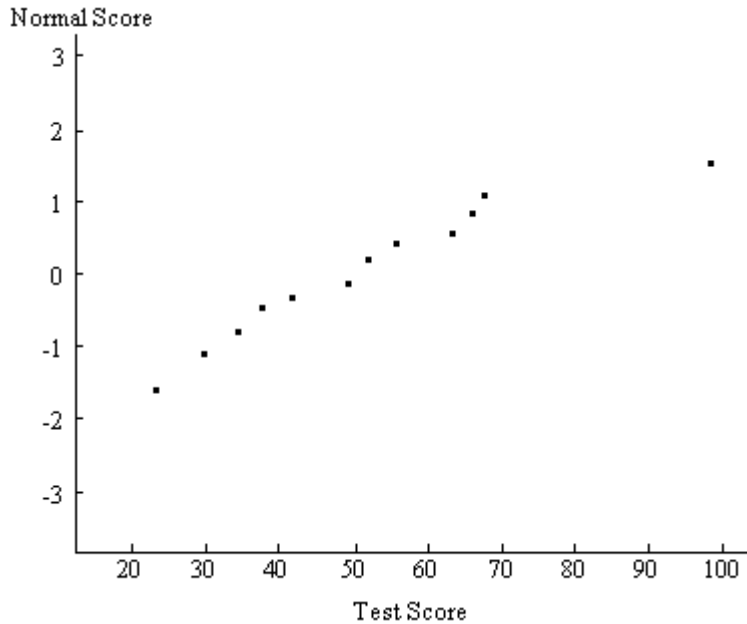
Examine the given data set and determine whether the requirement of a normal distribution is satisfied. Assume that the requirement for a normal distribution is loose in the sense that the population distribution need not be exactly normal, but it must have a distribution which is basically symmetric with only one mode. Explain why you do or do not think that the requirement is satisfied.

20) The ages of 35 students selected randomly from one college are as follows:

```
21  23  20  24  20
19  20  19  22  32
20  24  26  21  37
23  18  34  25  30
22  24  23  19  28
20  29  21  35  25
20  21  28  22  32
```

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

1) The area under the curve from 6 to 10 is 0.5, thus the probability that x is greater than 6 is 0.5.

2) In the first, the student must use the formula $z = \dfrac{x - \mu}{\sigma}$, whereas in the second problem, the student must

use the Central Limit theorem and the formula $z = \dfrac{\overline{x} - \mu}{\dfrac{\sigma}{\sqrt{n}}}$, since the problem involves a sample. The

probability for the first is 0.2810; for the second, 0.0003.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

3) D
4) A
5) D
6) B
7) B
8) C
9) A

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

10) Yes. As the sample size increases, the sample statistics tend to vary less and they tend to be closer to the population parameter.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

11) D
12) C
13) D
14) B
15) A
16) B
17) A
18) B

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

19) Since the normal probability plot is roughly linear, it appears that scores on this test are approximately normally distributed.

20) The requirement for normality is not satisfied, since a histogram of the data is not bell shaped. The data does have a single mode; however the histogram is not symmetric, but is skewed to the right.

Elementary Statistics   Chapter 5 Test – Form C

Name:_____ Course Number: _____ Section Number: _____

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Provide an appropriate response.

1) Lengths of pregnancies are normally distributed with a mean of 268 days and a standard deviation of 15 days. (a) Find the probability of a pregnancy lasting more than 250 days. (b) Find the probability of a pregnancy lasting more than 280 days. These two problems can be solved by the same procedure. Draw the diagram for each and discuss the difference. Then, explain why the same procedure can be used.

2) SAT verbal scores are normally distributed with a mean of 430 and a standard deviation of 120 (based on the data from the College Board ATP). If a sample of 15 students is selected randomly, find the probability that the sample mean is above 500. Does the Central Limit theorem apply for this problem?

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Using the following uniform density curve, answer the question.
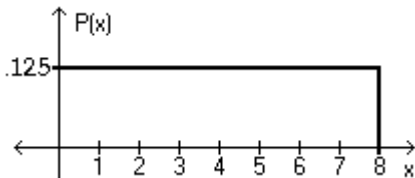
3) What is the probability that the random variable has a value greater than 3.5?

    A) 0.4375   B) 0.5125   C) 0.5625   D) 0.6875

Assume that the weight loss for the first month of a diet program varies between 6 pounds and 12 pounds, and is spread evenly over the range of possibilities, so that there is a uniform distribution. Find the probability of the given range of pounds lost.

4) Between 9 pounds and 12 pounds

    A) $\dfrac{1}{2}$ B) $\dfrac{1}{3}$ C) $\dfrac{1}{4}$ D) $\dfrac{2}{3}$

If Z is a standard normal variable, find the probability.

5) $P(-0.73 < Z < 2.27)$

    A) 0.7557   B) 0.2211   C) 1.54   D) 0.4884

The Precision Scientific Instrument Company manufactures thermometers that are supposed to give readings of 0°C at the freezing point of water. Tests on a large sample of these thermometers reveal that at the freezing point of water, some give readings below 0°C (denoted by negative numbers) and some give readings above 0°C (denoted by positive numbers). Assume that the mean reading is 0°C and the standard deviation of the readings is 1.00°C. Also assume that the frequency distribution of errors closely resembles the normal distribution. A thermometer is randomly selected and tested. Find the temperature reading corresponding to the given information.

6) A quality control analyst wants to examine thermometers that give readings in the bottom 4%. Find the reading that separates the bottom 4% from the others.

   A) –1.75°   B) –1.63°   C) –1.48°   D) –1.89°

Assume that X has a normal distribution, and find the indicated probability.

7) The mean is $\mu = 137.0$ and the standard deviation is $\sigma = 5.3$.
   Find the probability that X is between 134.4 and 140.1.

   A) 0.6242   B) 0.4069   C) 0.8138   D) 1.0311

Solve the problem.

8) The weights of certain machine components are normally distributed with a mean of 8.92 g and a standard deviation of 0.06 g. Find the two weights that separate the top 3% and the bottom 3%. Theses weights could serve as limits used to identify which components should be rejected.

   A) 8.89 g and 8.95 g   B) 8.81 g and 9.03 g
   C) 8.91 g and 8.93 g   D) 8.79 g and 9.08 g

Find the indicated probability.

9) A bank's loan officer rates applicants for credit. The ratings are normally distributed with a mean of 200 and a standard deviation of 50. If an applicant is randomly selected, find the probability of a rating that is between 170 and 220.

   A) 0.1554   B) 0.2257   C) 0.3811   D) 0.0703

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Provide an appropriate response.

10) A poll of 1400 randomly selected students in grades 6 through 8 was conducted and found that 57% enjoy playing sports. What is the sampling distribution suggested by the given data?

List the different possible samples, and find the mean of each of them.

11) Personal phone calls received in the last three days by a new employee were 4, 1, and 3. Assume that samples of size 2 are randomly selected with replacement from this population of three values.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Solve the problem.

12) A bank's loan officer rates applicants for credit. The ratings are normally distributed with a mean of 200 and a standard deviation of 50. If 40 different applicants are randomly selected, find the probability that their mean is above 215.

   A) 0.1179   B) 0.0287   C) 0.3821   D) 0.4713

13) A study of the amount of time it takes a mechanic to rebuild the transmission for a 1992 Chevrolet Cavalier shows that the mean is 8.4 hours and the standard deviation is 1.8 hours. If 40 mechanics are randomly selected, find the probability that their mean rebuild time is less than 7.6 hours.

    A) 0.0036   B) 0.0103   C) 0.0008   D) 0.0025

14) A final exam in Math 160 has a mean of 73 with standard deviation 7.8. If 24 students are randomly selected, find the probability that the mean of their test scores is greater than 71.

    A) 0.8962   B) 0.9012   C) 0.5036   D) 0.0008

15) The amount of snowfall falling in a certain mountain range is normally distributed with a mean of 109 inches, and a standard deviation of 10 inches. What is the probability that the mean annual snowfall during 25 randomly picked years will exceed 111.8 inches?

    A) 0.5808   B) 0.0808   C) 0.0026   D) 0.4192

For the binomial distribution with the given values for n and p, state whether or not it is suitable to use the normal distribution as an approximation.

16) n = 33 and p = .9

    A) Normal approximation is not suitable.   B) Normal approximation is suitable.

Estimate the indicated probability by using the normal distribution as an approximation to the binomial distribution.

17) In one county, the conviction rate for speeding is 85%. Estimate the probability that of the next 100 speeding summonses issued, there will be at least 90 convictions.

    A) 0.0420   B) 0.8962   C) 0.1038   D) 0.3962

Use the normal distribution to approximate the desired probability.

18) Merta reports that 74% of its trains are on time. A check of 60 randomly selected trains shows that 38 of them arrived on time. Find the probability that among the 60 trains, 38 or fewer arrive on time. Based on the result, does it seem plausible that the "on–time" rate of 74% could be correct?

    A) .0316 , yes   B) .0409 , no   C) .0409 , yes   D) .0316 , no

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Examine the given data set and determine whether the requirement of a normal distribution is satisfied. Assume that the requirement for a normal distribution is loose in the sense that the population distribution need not be exactly normal, but it must have a distribution which is basically symmetric with only one mode. Explain why you do or do not think that the requirement is satisfied.

19) The amount of rainfall (in inches) in 25 consecutive years in a certain city.

20.4	25.1	22.8	27.0	23.5
24.2	26.0	25.6	23.3	24.1
21.9	27.6	24.7	25.3	21.6
31.0	23.6	26.1	25.5	24.8
18.1	22.4	24.9	30.0	29.3

Solve the problem.

20) A normal probability plot is given below for the lifetimes (in hours) of a sample of batteries of a particular brand. Use the plot to assess the normality of the lifetimes of these batteries. Explain your reasoning.
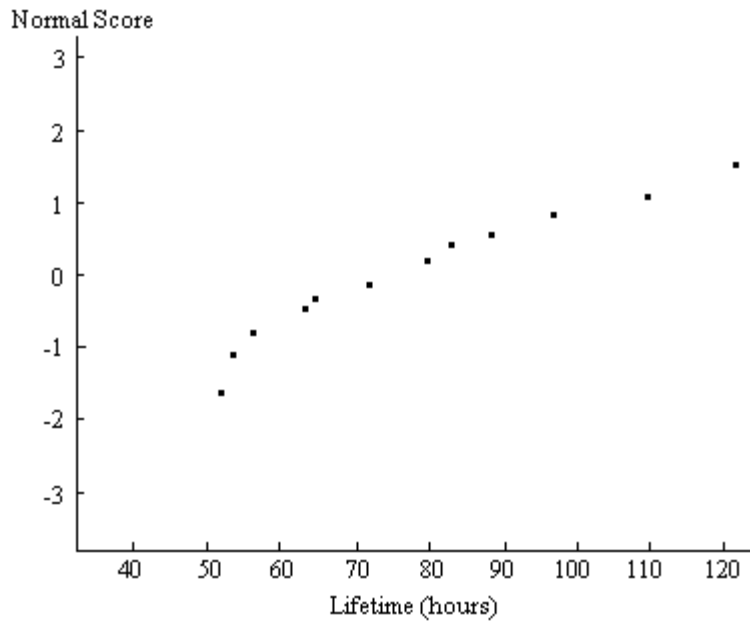
Answer Key
Testname: ELEMENTARY STATISTICS CHAPTER 5 TEST FORM C

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

1) For problem (a), the probability is 0.8849. For problem (b), the probability is 0.2119. The drawings
   show that the area, i.e., probability, for (a) begins to the left of the mean and extends to positive infinity;
   for (b) the area begins to the right of the mean and extends to positive infinity. The procedure is the
   same, which is: find the equivalent z score for the given x value, then find the area associated with that z
   score, and subtract that area from 1.0000. Table A–2 facilitates this common procedure because it
   provides cumulative areas from the left for both negative and positive z scores.
2) Yes; even though the sample size is small, the original population is normal and the population SD is
   known. The probability is 0.0119.

**MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the
question.**

3) C
4) A
5) A
6) A
7) B
8) B
9) C

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

10) It is the probability distribution of all sample proportions found for all possible samples of size 1400. It
    consists of all sample proportions along with their corresponding probabilities.
11) Possible samples: 4–4; 4–1; 4–3; 1–4; 1–1; 1–3; 3–4; 3–1; 3–3
    Means: 4, 2.5, 3.5, 2.5, 1, 2, 3.5, 2, 3

**MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the
question.**

12) B
13) D
14) A
15) B
16) A
17) C
18) B

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

19) The requirement for normality is satisfied since a histogram of the data is roughly bell shaped; it is
    roughly symmetric with a single mode.
20) Since the normal probability plot displays curvature, it appears that lifetimes of these batteries are
    probably not normally distributed.

Elementary Statistics   Chapter 6 Test – Form A

Name:_____ Course Number: _____ Section Number: _____

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Provide an appropriate response.

1) Define margin of error. Explain the relation between the confidence interval and the error estimate. Suppose a confidence interval is $9.65 < \mu < 11.35$. Find the sample mean $\bar{x}$ and the error estimate E.

2) When determining the sample size for a desired margin of error, the formula is $n = \dfrac{\left[z_{\alpha/2}\right]^2 \cdot \hat{p}\hat{q}}{E^2}$. Based on this formula, discuss the fact that sample size is not dependent on the population size; that is, it is not necessary to sample a particular percent of the population.

3) When determining sample size we need to know $\hat{p}$. If we have no prior information, what are two methods that can be used?

4) Why would manufacturers and businesses be interested in constructing a confidence interval for the population variance? Would manufacturers and businesses want large or small variances?

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Solve the problem.

5) Find the critical value $z_{\alpha/2}$ that corresponds to a degree of confidence of 98%.

    A) 2.575   B) 2.33   C) 1.75   D) 2.05

Express the confidence interval in the form of $\hat{p} \pm E$.

6) $0.033 < p < 0.493$

    A) $\hat{p} = 0.23 \pm 0.5$ B) $\hat{p} = 0.263 \pm 0.23$ C) $\hat{p} = 0.263 \pm 0.5$ D) $\hat{p} = 0.23 \pm 0.6$

Find the margin of error for the 95% confidence interval used to estimate the population proportion.

7) $n = 163, x = 96$

    A) 0.0680   B) 0.0755   C) 0.132   D) 0.00291

Use the given degree of confidence and sample data to construct a confidence interval for the population proportion p.

8) $n = 165, x = 138$; 95 percent

    A) $0.779 < p < 0.892$ B) $0.791 < p < 0.881$

    C) $0.790 < p < 0.882$ D) $0.780 < p < 0.893$

Find the minimum sample size you should use to assure that your estimate of $\hat{p}$ will be within the required margin of error around the population p.

9) Margin of error: 0.04; confidence level: 99%; from a prior study, $\hat{p}$ is estimated by 0.13

    A) 563   B) 272   C) 469   D) 19

Solve the problem.

10) 459 randomly selected light bulbs were tested in a laboratory, 291 lasted more than 500 hours. Find a point estimate of the true proportion of all light bulbs that last more than 500 hours.

    A) 0.632   B) 0.366   C) 0.388   D) 0.634

Use the given degree of confidence and sample data to construct a confidence interval for the population proportion p.

11) Of 139 adults selected randomly from one town, 30 of them smoke. Construct a 99% confidence interval for the true percentage of all adults in the town that smoke.

    A) $15.8\% < p < 27.3\%$ B) $12.6\% < p < 30.6\%$

    C) $13.5\% < p < 29.7\%$ D) $14.7\% < p < 28.4\%$

Solve the problem.

12) A researcher is interested in estimating the proportion of voters who favor a tax on e–commerce. Based on a sample of 250 people, she obtains the following 99% confidence interval for the population proportion p:

    $0.113 < p < 0.171$

    Which of the statements below is a valid interpretation of this confidence interval?
    A: There is a 99% chance that the true value of p lies between 0.113 and 0.171.
    B: If many different samples of size 250 were selected and, based on each sample, a confidence interval were constructed, 99% of the time the true value of p would lie between 0.113 and 0.171.
    C: If many different samples of size 250 were selected and, based on each sample, a confidence interval were constructed, in the long run 99% of the confidence intervals would contain the true value of p.
    D: If 100 different samples of size 250 were selected and, based on each sample, a confidence interval were constructed, exactly 99 of these confidence intervals would contain the true value of p.

    A) D   B) A   C) B   D) C

Use the confidence level and sample data to find the margin of error E.

13) College students' annual earnings: 99% confidence; $n = 74, \bar{x} = \$3967, \sigma = \$874$

    A) $262   B) $9   C) $237   D) $1187

Use the confidence level and sample data to find a confidence interval for estimating the population μ.

14) A group of 56 randomly selected students have a mean score of 30.8 with a standard deviation of 4.5 on a placement test. What is the 90 percent confidence interval for the mean score, μ, of all students taking the test?

    A) $29.2 < \mu < 32.4$ B) $29.4 < \mu < 32.2$ C) $29.6 < \mu < 32.0$ D) $29.8 < \mu < 31.8$

Use the margin of error, confidence level, and standard deviation σ to find the minimum sample size required to estimate an unknown population mean μ.

15) Margin of error: $139, confidence level: 95%, σ = $513

    A) 5   B) 53   C) 46   D) 3

Do one of the following, as appropriate: (a) Find the critical value $z_{\alpha/2}$, (b) find the critical value $t_{\alpha/2}$, (c) state that neither the normal nor the t distribution applies.

16) 99%; n = 17; σ is unknown; population appears to be normally distributed.

    A) $z_{\alpha/2} = 2.575$ B) $t_{\alpha/2} = 2.921$ C) $t_{\alpha/2} = 2.898$ D) neither

Use the given degree of confidence and sample data to construct a confidence interval for the population mean μ. Assume that the population has a normal distribution.

17) A savings and loan association needs information concerning the checking account balances of its local customers. A random sample of 14 accounts was checked and yielded a mean balance of $664.14 and a standard deviation of $297.29. Find a 98% confidence interval for the true mean checking account balance for local customers.

    A) $492.52 < μ < $835.76   B) $493.71 < μ < $834.57

    C) $453.59 < μ < $874.69   D) $455.65 < μ < $872.63

Solve the problem.

18) A researcher wishes to construct a 95% confidence interval for a population mean. She selects a simple random sample of size n = 20 from the population. The population is normally distributed and σ is unknown. When constructing the confidence interval, the researcher should use the t distribution; however, she incorrectly uses the normal distribution. Will the true confidence level of the resulting confidence interval be greater than 95%, smaller than 95%, or exactly 95%?

    A) Smaller than 95%   B) Exactly 95%   C) Greater than 95%

Find the appropriate minimum sample size.

19) You want to be 95% confident that the sample variance is within 40% of the population variance.

    A) 224   B) 11   C) 14   D) 56

Use the given degree of confidence and sample data to find a confidence interval for the population standard deviation σ. Assume that the population has a normal distribution.

20) The amounts (in ounces) of juice in eight randomly selected juice bottles are:

15.4 15.7 15.2 15.8
15.8 15.4 15.0 15.6

Find a 98 percent confidence interval for the population standard deviation σ.

    A) (0.17, 0.60)   B) (0.18, 0.60)   C) (0.18, 0.69)   D) (0.20, 0.79)

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

1) The margin of error is the maximum likely difference between the observed sample mean $\overline{x}$ and the true value for the population mean μ. The confidence interval is found by taking the sample mean $\overline{x}$ and adding the margin of error E to find the high value and subtracting E to find the low value of the interval. In the interval $9.65 < \mu < 11.35$, the sample mean $\overline{x}$ is 10.5 and the error estimate E is 0.85.

2) As shown in the formula, the appropriate sample size is dependent on the appropriate z score, the sample proportion, and the margin of error, not on N, the population size.

3) Use a result from a prior study or use $\hat{p} = 0.5$.

4) Manufacturers and businesses would be interested in small variances -- a consistent product. They would be interested in confidence intervals for the population variance to control consistency of their product.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

5) B
6) B
7) B
8) D
9) C
10) D
11) B
12) D
13) A
14) D
15) B
16) B
17) C
18) A
19) D
20) C

Elementary Statistics   Chapter 6 Test – Form B

Name:_____ Course Number: _____ Section Number: _____

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Provide an appropriate response.

1) Give two reasons the sample mean is the best point estimate for μ.

2) Interpret the following 95% confidence interval for mean weekly salaries of shift managers at Guiseppe's Pizza and Pasta.
$325.80 < \mu < 472.30$

3) What is the best point estimate for the population proportion? Explain why that point estimate is best.

4) Draw a diagram of the chi–square distribution. Discuss its shape and values.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Solve the problem.

5) Find the critical value $z_{\alpha/2}$ that corresponds to a degree of confidence of 91%.

   A) 1.645   B) 1.75   C) 1.70   D) 1.34

Express the confidence interval in the form of $\hat{p} \pm E$.

6) $-0.056 < p < 0.964$

   A) $\hat{p} = 0.454 \pm 0.4$ B) $\hat{p} = 0.454 \pm 0.51$ C) $\hat{p} = 0.454 \pm 0.3$ D) $\hat{p} = 0.51 \pm 0.4$

Find the margin of error for the 95% confidence interval used to estimate the population proportion.

7) $n = 390, x = 50$

   A) 0.0299   B) 0.0332   C) 0.0398   D) 0.0349

Use the given degree of confidence and sample data to construct a confidence interval for the population proportion p.

8) $n = 60, x = 26$; 95 percent

   A) $0.327 < p < 0.539$ B) $0.308 < p < 0.558$
   C) $0.307 < p < 0.559$ D) $0.328 < p < 0.538$

Find the minimum sample size you should use to assure that your estimate of $\hat{p}$ will be within the required margin of error around the population p.

9) Margin of error: 0.07; confidence level: 95%; from a prior study, $\hat{p}$ is estimated by the decimal equivalent of 91%.

   A) 195   B) 57   C) 5   D) 65

Solve the problem.

10) Find the point estimate of the true proportion of people who wear hearing aids if, in a random sample of 599 people, 43 people had hearing aids.

A) 0.070   B) 0.067   C) 0.928   D) 0.072

Use the given degree of confidence and sample data to construct a confidence interval for the population proportion p.

11) Of 116 randomly selected adults, 34 were found to have high blood pressure. Construct a 95% confidence interval for the true <u>percentage</u> of all adults that have high blood pressure.

A) $22.3\% < p < 36.3\%$ B) $18.4\% < p < 40.2\%$

C) $21.0\% < p < 37.6\%$ D) $19.5\% < p < 39.2\%$

Use the confidence level and sample data to find the margin of error E.

12) Replacement times for washing machines: 90% confidence; $n = 44$, $\bar{x} = 11.8$ years, $\sigma = 2.4$ years

A) 6.6 years   B) 0.5 years   C) 0.6 years   D) 0.1 years

Use the confidence level and sample data to find a confidence interval for estimating the population μ.

13) 39 packages are randomly selected from packages received by a parcel service. The sample has a mean weight of 15.3 pounds and a standard deviation of 1.9 pounds. What is the 95 percent confidence interval for the true mean weight, μ, of all packages received by the parcel service?

A) $14.7 < \mu < 15.9$ B) $14.5 < \mu < 16.1$ C) $14.6 < \mu < 16.0$ D) $14.8 < \mu < 15.8$

Use the margin of error, confidence level, and standard deviation σ to find the minimum sample size required to estimate an unknown population mean μ.

14) Margin of error: $136, confidence level: 99%, $\sigma = \$545$

A) 54   B) 62   C) 107   D) 11

Do one of the following, as appropriate: (a) Find the critical value $z_{\alpha/2}$, (b) find the critical value $t_{\alpha/2}$, (c) state that neither the normal nor the t distribution applies.

15) 91%; $n = 45$; σ is known; population appears to be very skewed.

A) $z_{\alpha/2} = 1.75$ B) $z_{\alpha/2} = 1.70$ C) $t_{\alpha/2} = 1.645$ D) $t_{\alpha/2} = 1.34$

Use the given degree of confidence and sample data to construct a confidence interval for the population mean μ. Assume that the population has a normal distribution.

16) A sociologist develops a test to measure attitudes about public transportation, and 27 randomly selected subjects are given the test. Their mean score is 76.2 and their standard deviation is 21.4. Construct the 95% confidence interval for the mean score of all such subjects.

A) $69.2 < \mu < 83.2$ B) $64.2 < \mu < 88.2$ C) $74.6 < \mu < 77.8$ D) $67.7 < \mu < 84.7$

Solve the problem.

17) A researcher wishes to construct a 95% confidence interval for a population mean. She selects a simple random sample of size n = 20 from the population. The population is normally distributed and σ is known. When constructing the confidence interval, the researcher should use the normal distribution; however, she incorrectly uses the t distribution. How does this incorrectly calculated confidence relate to the correct confidence interval?

    A) The calculated confidence interval is wider than the correct confidence interval.

    B) The calculated confidence interval is narrower than the correct confidence interval.

    C) The calculated confidence interval is shifted to the right of the correct confidence interval.

    D) The calculated confidence interval is shifted to the left of the correct confidence interval.

Use the given degree of confidence and sample data to find a confidence interval for the population standard deviation σ. Assume that the population has a normal distribution.

18) The mean replacement time for a random sample of 20 washing machines is 9.5 years and the standard deviation is 2.4 years. Construct a 99% confidence interval for the standard deviation, σ, of the replacement times of all washing machines of this type.

    A) 1.7 yr < σ < 3.8 yr   B) 1.6 yr < σ < 4.6 yr

    C) 1.7 yr < σ < 4.0 yr   D) 1.7 yr < σ < 5.0 yr

Find the appropriate minimum sample size.

19) You want to be 99% confident that the sample standard deviation s is within 5% of the population standard deviation.

    A) 1,335   B) 923   C) 2,638   D) 2,434

Use the given degree of confidence and sample data to find a confidence interval for the population standard deviation σ. Assume that the population has a normal distribution.

20) The football coach randomly selected ten players and timed how long each player took to perform a certain drill. The times (in minutes) were:
11 11 7 6 10
 6 10 15 12 13
Find a 95 percent confidence interval for the population standard deviation σ.

    A) (2.1, 5.5)   B) (0.7, 2.2)   C) (2.1, 5.0)   D) (2.0, 5.0)

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

1) 1)   For many populations, the distribution of sample means has less variation than other measures of central tendency.
2)   Sample means tend to center about the population mean, not to systematically overestimate or underestimate μ.

2) We are 95% sure that the interval contains the true population value for mean weekly salaries of shift managers at Guiseppe's Pizza and Pasta.

3) The sample proportion $\hat{p}$.
1) $\hat{p}$ is unbiased (does not consistently overestimate or underestimate p).
2) $\hat{p}$ is most consistent (has the least variation of all the measures of central tendency).

4) The chi–square distribution is non–symmetric and skewed to the right. The values are 0 and positive. The sketch should resemble one of the drawings in Figure 6–8 or Figure 6–9.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

5) C
6) B
7) B
8) B
9) D
10) D
11) C
12) C
13) A
14) C
15) B
16) D
17) A
18) C
19) A
20) A

Elementary Statistics   Chapter 6 Test – Form C

Name:_____ Course Number: _____ Section Number: _____

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Provide an appropriate response.

1) How do you determine whether to use the z or t distribution in computing the margin of error,

   $E = z_{\alpha/2} \cdot \dfrac{\sigma}{\sqrt{n}}$ or $E = t_{\alpha/2} \cdot \dfrac{s}{\sqrt{n}}$?

2) The Bide–a–While efficiency hotel, which caters to business workers who stay for extended periods of time (weeks or months), offers room service. In a small study of 35 randomly selected room service orders, the 95% confidence interval for mean delivery time for room service is $24.8 < \mu < 29.6$ minutes. The marketing director is trying to determine if she can advertise "room service in under 30 minutes, or the order is free." How would you advise her?

3) Explain how confidence intervals might be used to make decisions. Give an example to clarify your explanation.

4) Why is s^2 the best point estimate of σ^2?

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Solve the problem.

5) Find the value of $-z_{\alpha/2}$ that corresponds to a level of confidence of 96.68 percent.

   A) 2.13   B) –1.84   C) 0.0166   D) –2.13

6) The following confidence interval is obtained for a population proportion, p:
   (0.283, 0.323)
   Use these confidence interval limits to find the point estimate, $\hat{p}$.

   A) 0.323   B) 0.308   C) 0.283   D) 0.303

Find the margin of error for the 95% confidence interval used to estimate the population proportion.

7) In a survey of 5400 T.V. viewers, 30% said they watch network news programs.

   A) 0.00915   B) 0.0140   C) 0.0122   D) 0.0160

Use the given degree of confidence and sample data to construct a confidence interval for the population proportion p.

8) n = 89, x = 25; 98 percent

   A) $0.187 < p < 0.375$ B) $0.169 < p < 0.393$
   C) $0.170 < p < 0.392$ D) $0.188 < p < 0.374$

Find the minimum sample size you should use to assure that your estimate of $\hat{p}$ will be within the required margin of error around the population p.

9) Margin of error: 0.04; confidence level: 90%; from a prior study, $\hat{p}$ is estimated by 0.19.

   A) 261   B) 783   C) 231   D) 10

Solve the problem.

10) 19 randomly picked people were asked if they rented or owned their own home, 18 said they rented. Obtain a point estimate of the true proportion of home owners.

   A) 0.105   B) 0.053   C) 0.486   D) 0.947

Use the given degree of confidence and sample data to construct a confidence interval for the population proportion p.

11) Of 225 employees selected randomly from one company, 18.67% of them commute by carpooling. Construct a 90% confidence interval for the true percentage of all employees of the company who carpool.

   A) $13.6\% < p < 23.8\%$ B) $14.4\% < p < 22.9\%$

   C) $12.0\% < p < 25.4\%$ D) $12.6\% < p < 24.7\%$

Use the confidence level and sample data to find the margin of error E.

12) The duration of telephone calls directed by a local telephone company: s = 3.8 minutes, n = 401, 80 percent confidence.

   A) 0.011 minutes   B) 0.006 minutes   C) 0.244 minutes   D) 0.237 minutes

Use the confidence level and sample data to find a confidence interval for estimating the population μ.

13) A laboratory tested 81 chicken eggs and found that the mean amount of cholesterol was 204 milligrams with s = 10.2 milligrams. Construct a 95 percent confidence interval for the true mean cholesterol content, μ, of all such eggs.

   A) $202 < \mu < 206$ B) $203 < \mu < 205$ C) $201 < \mu < 207$ D) $200 < \mu < 208$

Solve the problem.

14) When obtaining a confidence interval for a population mean in the case of a finite population of size N and a sample size n which is greater than 0.05N, the margin of error is multiplied by the following finite population correction factor:

$$\sqrt{\frac{N-n}{N-1}}$$

Find the 95% confidence interval for the mean of 200 weights if a sample of 37 of those weights yields a mean of 150.2 lb and a standard deviation of 24.2 lb.

   A) $142.4 \text{ lb} < \mu < 158.0 \text{ lb}$ B) $144.1 \text{ lb} < \mu < 156.3 \text{ lb}$

   C) $143.1 \text{ lb} < \mu < 157.3 \text{ lb}$ D) $142.9 \text{ lb} < \mu < 157.5 \text{ lb}$

Do one of the following, as appropriate: (a) Find the critical value $z_{\alpha/2}$, (b) find the critical value $t_{\alpha/2}$, (c) state that neither the normal nor the t distribution applies.

15) 90%; n = 9; σ = 4.2; population appears to be very skewed.

    A) Neither the normal nor the t distribution applies.

    B) $z_{\alpha}/2 = 1.645$

    C) $z_{\alpha}/2 = 2.365$

    D) $t_{\alpha}/2 = 1.860$

Use the given degree of confidence and sample data to construct a confidence interval for the population mean μ. Assume that the population has a normal distribution.

16) Thirty–five randomly selected students took the calculus final. If the sample mean was 82 and the standard deviation was 5.3, construct a 99 percent confidence interval for the mean score of all students.

    A) $80 < \mu < 84$ B) $79 < \mu < 85$ C) $78 < \mu < 86$ D) $81 < \mu < 83$

Solve the problem.

17) A simple random sample of students is selected, and the students are asked how much time they spent preparing for a test. The times (in hours) are as follows:
    1.3   7.2   4.2 12.5 6.6 2.5 5.5
Based on these results, a confidence interval for the population mean is found to be $\mu = 5.7 \pm 4.4$. Find the degree of confidence.

    A) 95%   B) 98%   C) 99%   D) 90%

Use the given degree of confidence and sample data to find a confidence interval for the population standard deviation σ. Assume that the population has a normal distribution.

18) To find the standard deviation of the diameter of wooden dowels, the manufacturer measures 19 randomly selected dowels and finds the standard deviation of the sample to be s = 0.16. Find the 95% confidence interval for the population standard deviation σ.

    A) $0.13 < \sigma < 0.22$ B) $0.12 < \sigma < 0.24$ C) $0.11 < \sigma < 0.25$ D) $0.15 < \sigma < 0.21$

Find the appropriate minimum sample size.

19) To be able to say with 95% confidence level that the standard deviation of a data set is within 10% of the population's standard deviation, the number of observations within the data set must be greater than or equal to what quantity?

    A) 805   B) 335   C) 250   D) 191

Use the given degree of confidence and sample data to find a confidence interval for the population standard deviation σ. Assume that the population has a normal distribution.

20) The daily intakes of milk (in ounces) for ten randomly selected people were:
    27.4 14.9 11.1 22.8 14.2
    10.5 12.8 13.7 21.5 23.2
Find a 99 percent confidence interval for the population standard deviation σ.

    A) (3.67, 12.16)   B) (3.55, 12.16)   C) (3.67, 13.54)   D) (0.87, 3.36)

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

1) Use the normal (z) distribution if the population SD is known and the population is normally distributed or if the population SD is known and the sample size exceeds 30. Use the t distribution if the population SD is unknown and the population is normally distributed or if the population SD is unknown and the sample size exceeds 30.

2) We are 95% sure that the interval $24.8 < \mu < 29.6$ minutes contains the true mean. But it is incorrect to say μ has a 95% chance of falling within the specific limits of 24.8 and 29.6 minutes. Therefore, it would not be advisable to advertise room service in under 30 minutes.

3) Answers will vary, but for example: Suppose we have a confidence interval of $0.456 < \mu < 0.462$ for the mean diameter of washers being being machined by the night shift of a plant. If the mean diameter is supposed to be 0.470, we can conclude that the process needs to be adjusted.

4) s^2 is unbiased, neither overestimating nor underestimating σ^2, and s^2 values are more consistent, having less variation about σ^2.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

5) D
6) D
7) C
8) C
9) A
10) B
11) B
12) C
13) A
14) D
15) A
16) A
17) B
18) B
19) D
20) C

Elementary Statistics   Chapter 7 Test – Form A

Name:_____ Course Number: _____ Section Number: _____

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Provide an appropriate response.

    1) Under what conditions do you reject H_0? Discuss both the traditional and the P–value approach.

Solve the problem.

    2) What do you conclude about the claim below? Do not use formal procedures or exact calculations. Use only the rare event rule and make a subjective estimate to determine whether the event is likely.

        Claim: An employee of a company is equally likely to take a sick day on any day of the week. Last year, the total number of sick days taken by all the employees of the company was 143. Of these, 52 were Mondays, 14 were Tuesdays, 17 were Wednesdays, 17 were Thursdays, and 43 were Fridays.

    3) Write the claim that is suggested by the given statement, then write a conclusion about the claim. Do not use symbolic expressions or formal procedures; use common sense.

        Last year an appliance manufacturer received many complaints about the high rate of defects among its washing machines. Approximately 9% of the machines were defective in some way. This year the company tightened up its quality control procedures. The latest shipment of 250 washing machines contained 2 defectives.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Identify the null hypothesis H_0 and the alternative hypothesis H_1.

    4) A researcher claims that 62% of voters favor gun control.

        A) H_0: $p < 0.62$ B) H_0: $p = 0.62$ C) H_0: $p \neq 0.62$ D) H_0: $p \geq 0.62$

          H_1: $p \geq 0.62$ H_1: $p \neq 0.62$ H_1: $p = 0.62$ H_1: $p < 0.62$

Assume that the data has a normal distribution and the number of observations is greater than fifty. Find the critical z value used to test a null hypothesis.

    5) $\alpha = 0.05$ for a left–tailed test.

        A) –1.645   B) ±1.96   C) ±1.645   D) –1.96

Use the given information to find the P–value.

    6) The test statistic in a right–tailed test is $z = 1.43$.

        A) 0.5000   B) 0.0434   C) 0.4236   D) 0.0764

Formulate the indicated conclusion in nontechnical terms. Be sure to address the original claim.

7) A researcher claims that the amounts of acetaminophen in a certain brand of cold tablets have a standard deviation different from the $\sigma = 3.3$ mg claimed by the manufacturer. Assuming that a hypothesis test of the claim has been conducted and that the conclusion is failure to reject the null hypothesis, state the conclusion in nontechnical terms.

   A) There is not sufficient evidence to support the claim that the standard deviation is equal to 3.3 mg.

   B) There is not sufficient evidence to support the claim that the standard deviation is different from 3.3 mg.

   C) There is sufficient evidence to support the claim that the standard deviation is different from 3.3 mg.

   D) There is sufficient evidence to support the claim that the standard deviation is equal to 3.3 mg.

Assume that a hypothesis test of the given claim will be conducted. Identify the type I error for the test.

8) Carter Motor Company claims that its new sedan, the Libra, will average better than 30 miles per gallon in the city. Identify the type I error for the test.

   A) The error of failing to reject the hypothesis that the mean is 30 miles per gallon when it is actually greater than 30 miles per gallon.

   B) The error of rejecting the hypothesis that the mean is 30 miles per gallon when it really is 30 miles per gallon.

   C) The error of rejecting the hypothesis that the mean is more than 30 miles per gallon when it really is more than 30 miles per gallon.

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Solve the problem.

9) Suppose that you perform a hypothesis test regarding a population mean, and that the evidence does not warrant rejection of the null hypothesis. When formulating the conclusion to the test, why is the phrase "fail to reject the null hypothesis" more accurate than the phrase "accept the null hypothesis"?

Identify the null hypothesis, alternative hypothesis, test statistic, P–value, conclusion about the null hypothesis, and final conclusion that addresses the original claim.

10) A supplier of 3.5" disks claims that only 1% of the disks are defective. In a random sample of 600 disks, it is found that 3% are defective, but the supplier claims that this is simply a sample fluctuation. At the 0.01 level of significance, test the supplier's claim that 1% are defective.

11) A nationwide study of American homeowners revealed that 64% have one or more lawn mowers. A lawn equipment manufacturer, located in Omaha, claims the estimate is too low for households in Omaha. Can the value 0.64 be rejected if a survey of 496 homes in Omaha yields 335 with one or more lawn mowers? Use $\alpha = 0.05$.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Find the P–value for the indicated hypothesis test.

12) A medical school claims that more than 28% of its students plan to go into general practice. It is found that among a random sample of 130 of the school's students, 32% of them plan to go into general practice. Find the P–value for a test of the school's claim.

   A) 0.1539   B) 0.1635   C) 0.3078   D) 0.3461

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Identify the null hypothesis, alternative hypothesis, test statistic, P–value, conclusion about the null hypothesis, and final conclusion that addresses the original claim.

13) Various temperature measurements are recorded at different times for a particular city. The mean of 25°C is obtained for 60 temperatures on 60 different days. Assuming that $\sigma = 1.5$°C, test the claim that the population mean is 22°C. Use a 0.05 significance level.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Determine whether the hypothesis test involves a sampling distribution of means that is a normal distribution, Student t distribution, or neither.

14) Claim: $\mu = 977$. Sample data: $n = 25$, $\overline{x} = 984$, $s = 25$. The sample data appear to come from a normally distributed population with $\sigma = 28$.

   A) Student t   B) Neither   C) Normal

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Assume that a simple random sample has been selected from a normally distributed population. Find the test statistic, P–value, critical value(s), and state the final conclusion.

15) Test the claim that for the adult population of one town, the mean annual salary is given by $\mu = \$30,000$. Sample data are summarized as $n = 17$, $\overline{x} = \$22,298$, and $s = \$14,200$. Use a significance level of $\alpha = 0.05$.

Test the given claim using the traditional method of hypothesis testing. Assume that the sample has been randomly selected from a population with a normal distribution.

16) A researcher wants to check the claim that convicted burglars spend an average of 18.7 months in jail. She takes a random sample of 11 such cases from court files and finds that $\overline{x} = 20.5$ months and $s = 7.9$ months. Test the null hypothesis that $\mu = 18.7$ at the 0.05 significance level.

17) A light–bulb manufacturer advertises that the average life for its light bulbs 900 hours. A random sample of 15 of its light bulbs resulted in the following lives in hours.

| 995 | 590 | 510 | 539 | 739 | 917 | 571 | 555 |
| 916 | 728 | 664 | 693 | 708 | 887 | 849 | |

At the 10% significance level, do the data provide evidence that the mean life for the company's light bulbs differs from the advertised mean?

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Find the critical value or values of x^2 based on the given information.

18) $H_1: \sigma > 26.1$

n = 9

$\alpha = 0.01$

    A) 20.090   B) 21.666   C) 1.646   D) 2.088

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Use the traditional method to test the given hypothesis. Assume that the population is normally distributed and that the sample has been randomly selected.

19) In one town, monthly incomes for men with college degrees are found to have a standard deviation of $650. Use a 0.01 significance level to test the claim that for men without college degrees in that town, incomes have a higher standard deviation. A random sample of 22 men without college degrees resulted in incomes with a standard deviation of $939.

20) With individual lines at the checkouts, a store manager finds that the standard deviation for the waiting times on Monday mornings is 5.2 minutes. After switching to a single waiting line, he finds that for a random sample of 29 customers, the waiting times have a standard deviation of 5.6 minutes. Use a 0.025 significance level to test the claim that with a single line, waiting times vary less than with individual lines.

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

1) For the traditional method, the test–statistic is in the critical region. For the P–value method, the P–value is less than or equal to the significance level α and the test statistic is on the proper side in a one–tailed test.

2) If the employees were equally likely to take sick days on any day of the week, the probability of obtaining such a distribution of sick days would be extremely small. Therefore, by the rare event rule, we conclude that the claim that an employee of the company is equally likely to take a sick day on any day of the week is probably not correct.

3) The claim is that the defect rate has decreased and is now less than 9%. If the overall defect rate were still 9%, it would be extremely unlikely that a shipment of 250 washing machines would contain as few as 2 defectives. Therefore, the claim that the defect rate has decreased is probably correct.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

4) B
5) A
6) D
7) B
8) B

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

9) In a hypothesis test, we do not prove the null hypothesis; we just determine whether we have sufficient evidence to reject the null hypothesis. If there is not sufficient evidence, this does not necessarily imply that the null hypothesis is true but that we don't have enough evidence to reject it.

10) H_0: $p = 0.01$. H_1: $p \neq 0.01$. Test statistic: $z = 4.92$. P–value = 0.0002.

Critical values: $z = \pm 2.575$. Reject null hypothesis. There is sufficient evidence to warrant rejection of the claim that 1% are defective.

11) H_0: $p = 0.64$. H_1: $p > 0.64$. Test statistic: $z = 1.643$. P–value = 0.0505.

Critical value: $z = 1.645$. Fail to reject null hypothesis. There is not sufficient sample evidence to support the claim that the proportion with lawn mowers in Omaha is greater than 0.64.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

12) A

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

13) H_0: $\mu = 22$; H_1: $\mu \neq 22$. Test statistic: $z = 15.49$.

P–value: 0.0002. Because the P–value of 0.0002 is less than the significance level of $\alpha = 0.05$, we reject the null hypothesis. There is sufficient evidence to warrant rejection of the claim that the population mean is 22 degrees Celsius.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

14) C

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

15) $\alpha = 0.05$

Test statistic: $t = -2.236$. $0.02 < $ P–value $ < 0.05$.

Critical value: $t = \pm 2.120$.

Because the test statistic is in the critical region and the P–value is less than the alpha level, we reject the null hypothesis. There is sufficient evidence to warrant rejection of the claim that $\mu = \$30,000$.

16) Test statistic: $t = 0.756$. Critical values: $t = \pm 2.228$. Fail to reject H_0. There is not sufficient evidence to warrant rejection of the claim that the mean is 18.7 months.

17) Test statistic: $t = -4.342$. Critical values: $t = \pm 1.761$. Reject H_0: $\mu = 900$ hours. The sample data support the claim that the true mean life differs from the advertised mean.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

18) A

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

19) Test statistic: $X^2 = 43.825$. Critical value: $X^2 = 38.932$. Reject H_0. The sample data support the claim that incomes of men without college degrees have a standard deviation greater than $650.

20) Test statistic: $X^2 = 32.473$. Critical value: $X^2 = 15.308$. Fail to reject H_0. There is not sufficient sample evidence to support the claim that with a single line, waiting times have a smaller standard deviation than with individual lines.

Elementary Statistics   Chapter 7 Test – Form B

Name:_____ Course Number: _____ Section Number: _____

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Provide an appropriate response.

1) Suppose the claim is in the alternate hypothesis. What form does your conclusion take? Suppose the claim is in the null hypothesis. What form does your conclusion take?

Solve the problem.

2) What do you conclude about the claim below? Do not use formal procedures or exact calculations. Use only the rare event rule and make a subjective estimate to determine whether the event is likely.

Claim: A roulette wheel is fair and in 40 consecutive spins of the wheel, black shows up 23 times. (A roulette wheel has 38 equally likely slots of which half are black).

3) Write the claim that is suggested by the given statement, then write a conclusion about the claim. Do not use symbolic expressions or formal procedures; use common sense.

A math teacher tries a new method for teaching her introductory statistics class. Last year the mean score on the final test was 73. This year the mean on the same final was 76.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Identify the null hypothesis H_0 and the alternative hypothesis H_1.

4) A cereal company claims that the mean weight of the cereal in its packets is at least 14 oz.

A) H_0: $\mu < 14$ B) H_0: $\mu = 14$ C) H_0: $\mu > 14$ D) H_0: $\mu = 14$

    H_1: $\mu \geq 14$ H_1: $\mu < 14$ H_1: $\mu \leq 14$ H_1: $\mu > 14$

Assume that the data has a normal distribution and the number of observations is greater than fifty. Find the critical z value used to test a null hypothesis.

5) $\alpha = 0.1$ for a two–tailed test.

A) ±1.4805   B) ±2.33   C) ±1.645   D) ±2.052

Use the given information to find the P–value.

6) The test statistic in a left–tailed test is $z = -2.05$.

A) 0.0453   B) 0.4798   C) 0.5000   D) 0.0202

Formulate the indicated conclusion in nontechnical terms. Be sure to address the original claim.

7) A cereal company claims that the mean weight of the cereal in its packets is 14 oz. Assuming that a hypothesis test of the claim has been conducted and that the conclusion is to reject the null hypothesis, state the conclusion in nontechnical terms.

   A) There is sufficient evidence to warrant rejection of the claim that the mean weight is less than 14 oz.

   B) There is not sufficient evidence to warrant rejection of the claim that the mean weight is 14 oz.

   C) There is sufficient evidence to warrant rejection of the claim that the mean weight is 14 oz.

   D) There is not sufficient evidence to warrant rejection of the claim that the mean weight is less than 14 oz.

Assume that a hypothesis test of the given claim will be conducted. Identify the type II error for the test.

8) A skeptical paranormal researcher claims that the proportion of Americans that have seen a UFO, p, is less than 3 in every one thousand.

   A) The error of rejecting the hypothesis that the true proportion is 3 in one thousand when it really is 3 in one thousand.

   B) The error of failing to reject the hypothesis that the true proportion is 3 in one thousand when it is actually less than 3 in one thousand.

   C) The error of rejecting the hypothesis that the true proportion is less than 3 in one thousand when it really is less than 3 in one thousand.

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Solve the problem.

9) Suppose that you wish to use a hypothesis test to test a claim made by a juice bottling company regarding the mean amount of juice in its 16 oz bottles. Why does the original claim sometimes become the null hypothesis, and why does it sometimes become the alternative hypothesis? Give an example of a claim which would become the null hypothesis and an example of a claim would become the alternative hypothesis.

Identify the null hypothesis, alternative hypothesis, test statistic, P–value, conclusion about the null hypothesis, and final conclusion that addresses the original claim.

10) An article in a journal reports that 34% of American fathers take no responsibility for child care. A researcher claims that the figure is higher for fathers in the town of Littleton. A random sample of 234 fathers from Littleton yielded 97 who did not help with child care. Test the researcher's claim at the 0.05 significance level.

11) A poll of 1,068 adult Americans reveals that 48% of the voters surveyed prefer the Democratic candidate for the presidency. At the 0.05 level of significance, test the claim that less than half of all voters prefer the Democrat.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Find the P–value for the indicated hypothesis test.

12) In a sample of 88 children selected randomly from one town, it is found that 8 of them suffer from asthma. Find the P–value for a test of the claim that the proportion of all children in the town who suffer from asthma is equal to 11%.

   A) 0.2157   B) 0.2843   C) –0.2843   D) 0.5686

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Identify the null hypothesis, alternative hypothesis, test statistic, P–value, conclusion about the null hypothesis, and final conclusion that addresses the original claim.

13) The health of employees is monitored by periodically weighing them. A sample of 54 employees has a mean weight of 183.9 lb. Assuming that σ is known to be 121.2 lb, use a 0.10 significance level to test the claim that the population mean weight of all such employees is less than 200 lb.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Determine whether the hypothesis test involves a sampling distribution of means that is a normal distribution, Student t distribution, or neither.

14) Claim: $\mu = 111$. Sample data: $n = 10$, $\bar{x} = 101$, $s = 15.3$. The sample data appear to come from a normally distributed population with unknown μ and σ.

   A) Normal   B) Student t   C) Neither

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Assume that a simple random sample has been selected from a normally distributed population. Find the test statistic, P–value, critical value(s), and state the final conclusion.

15) Test the claim that the mean age of the prison population in one city is less than 26 years. Sample data are summarized as $n = 25$, $\bar{x} = 24.4$ years, and $s = 9.2$ years. Use a significance level of $\alpha = 0.05$.

Test the given claim using the traditional method of hypothesis testing. Assume that the sample has been randomly selected from a population with a normal distribution.

16) A test of sobriety involves measuring the subject's motor skills. Twenty randomly selected sober subjects take the test and produce a mean score of 41.0 with a standard deviation of 3.7. At the 0.01 level of significance, test the claim that the true mean score for all sober subjects is equal to 35.0.

17) A public bus company official claims that the mean waiting time for bus number 14 during peak hours is less than 10 minutes. A college student took bus number 14 during peak hours on 18 different occasions. Her mean waiting time was 7.4 minutes with a standard deviation of 1.7 minutes. At the 0.01 significance level, test the claim that the mean is less than 10 minutes.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Find the critical value or values of x^2 based on the given information.

18) H_1: $\sigma < 0.629$

n = 19

$\alpha = 0.025$

     A) 8.231   B) 7.015   C) 31.526   D) 8.907

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Use the traditional method to test the given hypothesis. Assume that the population is normally distributed and that the sample has been randomly selected.

19) When 12 bolts are tested for hardness, their indexes have a standard deviation of 41.7. Test the claim that the standard deviation of the hardness indexes for all such bolts is greater than 30.0. Use a 0.025 level of significance.

20) A machine dispenses a liquid drug into bottles in such a way that the standard deviation of the contents is 81 milliliters. A new machine is tested on a sample of 24 containers and the standard deviation for this sample group is found to be 26 milliliters. At the 0.05 level of significance, test the claim that the amounts dispensed by the new machine have a smaller standard deviation.

Answer Key
Testname: ELEMENTARY STATISTICS CHAPTER 7 TEST FORM B

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

1) Alternate: The sample data either supports or does not support. Null: The sample evidence warrants rejection or does not warrant rejection.
2) If the roulette wheel were fair, one could easily obtain 23 blacks in 40 spins by chance–this is not improbable. Therefore, by the rare event rule, we have no reason to reject the claim that the roulette wheel is fair.
3) The claim is that the new teaching method is more effective than the old method and that on average students will score higher when she uses the new teaching method than when she uses the old teaching method. The small difference in the two means is not strong evidence that the new method is more effective. Even if both methods were equally effective, such a difference could easily occur by chance.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

4) B
5) C
6) D
7) C
8) B

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

9) The null hypothesis must always contain the condition of equality. If the original claim contains equality, it becomes the null hypothesis, if it does not contain equality, it becomes the alternative hypothesis. Examples of claims will vary. A claim such as "the mean is 16 oz" will become the null hypothesis while a claim such as "the mean is greater than 16 oz" will become the alternative hypothesis.
10) H_0: p = 0.34. H_1: p > 0.34. Test statistic: z = 2.41. P–value = 0.0080.

    Critical value: z = 1.645. Reject null hypothesis. The sample data support the researcher's claim that the proportion for fathers in Littleton is higher than 34%.
11) H_0: p = 0.5. H_1: p < 0.5. Test statistic: z = –1.31. P–value = 0.0951.

    Critical value: z = –1.645. Fail to reject null hypothesis. There is not sufficient sample evidence to support the claim that less than half of all voters prefer the Democrat.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

12) D

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

13) H_0: μ = 200; H_1: μ < 200; Test statistic: z = –0.98. Critical value: z = –1.28. P–value: 0.1635. Fail to reject H_0. There is not sufficient sample evidence to support the claim that the population mean weight is less than 200 pounds.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

14) B

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

15) $\alpha = 0.05$
Test statistic: t = –0.870. P–value = 0.1966.
Critical value: t = –1.711.
Because the test statistic is greater than the critical value and the P–value is greater than the alpha level, we fail to reject the null hypothesis. There is not sufficient sample evidence to support the claim that the mean age is less than 26 years.

16) Test statistic: t = 7.252. Critical values: t = ± 2.861. Reject the null hypothesis. There is sufficient evidence to warrant rejection of the claim that the true mean is equal to 35.0.

17) Test statistic: t =–6.489. Critical value: t = –2.567. Reject H_0: μ = 10 minutes. The sample data support the claim that the mean waiting time is less than 10 minutes.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

18) A

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

19) Test statistic: X^2 = 21.253. Critical value: X^2 = 21.920. Fail to reject the null hypothesis. There is not sufficient sample evidence to support the claim that the standard deviation of all such bolts is greater than 30.0.

20) Test statistic: X^2 = 2.370. Critical value: X^2 = 13.091. Reject the null hypothesis. The sample data support the claim that the new machine produces a lower standard deviation.

Elementary Statistics   Chapter 7 Test – Form C

Name:_____ Course Number: _____ Section Number: _____

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Provide an appropriate response.

1) When testing hypotheses about a mean, the decision must be made as to the distribution to be used. Discuss the decision process used to decide whether z or t or neither is the proper distribution.

Solve the problem.

2) What do you conclude about the claim below? Do not use formal procedures or exact calculations. Use only the rare event rule and make a subjective estimate to determine whether the event is likely.

Claim: A company claims that the proportion of defectives among a particular model of computers is 4%. In a shipment of 200 such computers, there are 10 defectives.

3) Write the claim that is suggested by the given statement, then write a conclusion about the claim. Do not use symbolic expressions or formal procedures; use common sense.

Of a group of 1000 people suffering from arthritis, 500 receive acupuncture treatment and 500 receive a placebo. Among those in the placebo group, 24% noticed an improvement, while of those receiving acupuncture, 44% noticed an improvement.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Identify the null hypothesis H_0 and the alternative hypothesis H_1.

4) A researcher claims that the amounts of acetaminophen in a certain brand of cold tablets have a standard deviation different from the $\sigma = 3.3$ mg claimed by the manufacturer.

A) $H_0: \sigma \geq 3.3$ mg   B) $H_0: \sigma \leq 3.3$ mg   C) $H_0: \sigma \neq 3.3$ mg   D) $H_0: \sigma = 3.3$ mg
   $H_1: \sigma < 3.3$ mg $H_1: \sigma > 3.3$ mg $H_1: \sigma = 3.3$ mg $H_1: \sigma \neq 3.3$ mg

Assume that the data has a normal distribution and the number of observations is greater than fifty. Find the critical z value used to test a null hypothesis.

5) $\alpha = 0.08$; H_1 is $\mu \neq 3.24$

A) 1.41   B) ±1.41   C) ±1.75   D) 1.75

Find the value of the test statistic z using $z = \dfrac{\hat{p} - p}{\sqrt{\dfrac{pq}{n}}}$.

6) The claim is that the proportion of drowning deaths of children attributable to beaches is more than 0.25, and the sample statistics include $n = 622$ drowning deaths of children with 30% of them attributable to beaches.

A) 2.72   B) –2.88   C) –2.72   D) 2.88

Formulate the indicated conclusion in nontechnical terms. Be sure to address the original claim.

7) The owner of a football team claims that the average attendance at games is over 532, and he is therefore justified in moving the team to a city with a larger stadium. Assuming that a hypothesis test of the claim has been conducted and that the conclusion is failure to reject the null hypothesis, state the conclusion in nontechnical terms.

   A) There is not sufficient evidence to support the claim that the mean attendance is greater than 532.

   B) There is sufficient evidence to support the claim that the mean attendance is greater than than 532.

   C) There is not sufficient evidence to support the claim that the mean attendance is less than 532.

   D) There is sufficient evidence to support the claim that the mean attendance is less than 532.

Assume that a hypothesis test of the given claim will be conducted. Identify the type I error for the test.

8) The manufacturer of a refrigerator system for beer kegs produces refrigerators that are supposed to maintain a true mean temperature, μ, of 46°F, ideal for a certain type of German pilsner. The owner of the brewery does not agree with the refrigerator manufacturer, and claims he can prove that the true mean temperature is incorrect.

   A) The error of failing to reject the hypothesis that the mean temperature equals 46°F when it is really different from 46°F.

   B) The error of rejecting the hypothesis that the mean temperature equals 46°F when it is really different from 46°F.

   C) The error of rejecting the hypothesis that the mean temperature equals 46°F when it really does equal 46°F.

Solve the problem.

9) In a hypothesis test, which of the following will cause a decrease in β, the probability of making a type II error?

   A: Increasing α while keeping the sample size n, fixed
   B: Increasing the sample size n, while keeping α fixed
   C: Decreasing α while keeping the sample size n, fixed
   D: Decreasing the sample size n, while keeping α fixed

   A) A and B   B) A and D   C) C and D   D) B and C

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Identify the null hypothesis, alternative hypothesis, test statistic, P–value, conclusion about the null hypothesis, and final conclusion that addresses the original claim.

10) According to a recent poll 53% of Americans would vote for the incumbent president. If a random sample of 100 people results in 45% who would vote for the incumbent, test the claim that the actual percentage is 53%. Use a 0.10 significance level.

11) In a sample of 163 children selected randomly from one town, it is found that 37 of them suffer from asthma. At the 0.05 significance level, test the claim that the proportion of all children in the town who suffer from asthma is 11%.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Find the P–value for the indicated hypothesis test.

12) A manufacturer claims that fewer than 6% of its fax machines are defective. In a random sample of 97 such fax machines, 5% are defective. Find the P–value for a test of the manufacturer's claim.

   A) 0.1736   B) 0.3264   C) 0.1591   D) 0.3409

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Identify the null hypothesis, alternative hypothesis, test statistic, P–value, conclusion about the null hypothesis, and final conclusion that addresses the original claim.

13) A random sample of 100 pumpkins is obtained and the mean circumference is found to be 40.5 cm. Assuming that the population standard deviation is known to be 1.6 cm, use a 0.05 significance level to test the claim that the mean circumference of all pumpkins is equal to 39.9 cm.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Determine whether the hypothesis test involves a sampling distribution of means that is a normal distribution, Student t distribution, or neither.

14) Claim: $\mu = 77$. Sample data: n = 20, $\overline{x}$ = 110, s = 15.2. The sample data appear to come from a population with a distribution that is very far from normal, and σ is unknown.

   A) Student t   B) Normal   C) Neither

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Assume that a simple random sample has been selected from a normally distributed population. Find the test statistic, P–value, critical value(s), and state the final conclusion.

15) Test the claim that the mean lifetime of car engines of a particular type is greater than 220,000 miles. Sample data are summarized as n = 23, $\overline{x}$ = 226,450 miles, and s = 11,500 miles. Use a significance level of $\alpha = 0.01$.

Test the given claim using the traditional method of hypothesis testing. Assume that the sample has been randomly selected from a population with a normal distribution.

16) A manufacturer makes ball bearings that are supposed to have a mean weight of 30 g. A retailer suspects that the mean weight is actually less than 30 g. The mean weight for a random sample of 16 ball bearings is 29.5 g with a standard deviation of 4.1 g. At the 0.05 significance level, test the claim that the mean is less than 30 g.

17) In tests of a computer component, it is found that the mean time between failures is 520 hours. A modification is made which is supposed to increase the time between failures. Tests on a random sample of 10 modified components resulted in the following times (in hours) between failures.

   518   548   561   523   536
   499   538   557   528   563

At the 0.05 significance level, test the claim that for the modified components, the mean time between failures is greater than 520 hours.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Find the critical value or values of x^2 based on the given information.

18) H_1: $\sigma \neq 9.3$
   $n = 28$
   $\alpha = 0.05$

   A) 14.573, 43.194   B) –14.573, 14.573   C) –40.113, 40.113   D) 16.151, 40.113

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Use the traditional method to test the given hypothesis. Assume that the population is normally distributed and that the sample has been randomly selected.

19) A manufacturer uses a new production method to produce steel rods. A random sample of 17 steel rods resulted in lengths with a standard deviation of 2.4 cm. At the 0.10 significance level, test the claim that the new production method has lengths with a standard deviation different from 3.5 cm, which was the standard deviation for the old method.

20) Heights of men aged 25 to 34 have a standard deviation of 2.9 inches.
   Use a 0.05 significance level to test the claim that the heights of women aged 25 to 34 have a different standard deviation. The heights (in inches) of 16 randomly selected women aged 25 to 34 are listed below.

62.13	65.09	64.18	66.72	63.09	61.15	67.50	64.65
63.80	64.21	60.17	68.28	66.49	62.10	65.73	64.72

Answer Key
Testname: ELEMENTARY STATISTICS CHAPTER 7 TEST FORM C

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

1) Use the z distribution for $n \leq 30$, if the parent population is normally distributed and σ is known; or for $n > 30$, if σ is known. Use the t distribution for $n \leq 30$, if the parent population is normally distributed and σ is not known; or for $n > 30$ if σ is not known. However, if the parent population is not normally distributed and $n \leq 30$, neither distribution should be used.

2) If the defective rate were really 4%, one could easily obtain 10 defectives among 200 computers by chance; this is not improbable. Therefore, by the rare event rule, we have no reason to reject the claim that the rate of defectives is 4%.

3) The claim is that the proportion who notice an improvement in the treatment group is greater than the proportion who notice an improvement in the placebo group, i.e., that acupuncture is more effective than a placebo. If the acupuncture treatment and the placebo were equally effective, it would be very unlikely that the percentage of people in the group who notice an improvement in the acupuncture group would be so much greater than the percentage of people who notice an improvement in the placebo group. The claim that acupuncture is more effective than a placebo therefore seems reasonable.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

4) D
5) C
6) D
7) A
8) C
9) A

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

10) H_0: $p = 0.53$. H_1: $p \neq 0.53$. Test statistic: $z = -1.60$. P-value = 0.1096.

Critical value: $z = \pm 1.645$. Fail to reject null hypothesis. There is not sufficient evidence to warrant rejection of the claim that the actual percentage is 53%.

11) H_0: $p = 0.11$. H_1: $p \neq 0.11$. Test statistic: $z = 4.77$. P-value = 0.0002.

Critical values: $z = \pm 1.96$. Reject null hypothesis. There is sufficient evidence to warrant rejection of the claim that the proportion of all children in the town who suffer from asthma is 11%.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

12) D

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

13) H_0: $\mu = 39.9$; H_1: $\mu \neq 39.9$. Test statistic: $z = 3.75$. P-value: 0.0002. Reject H_0. There is sufficient evidence to warrant rejection of the claim that the mean of all pumpkins equals 39.9 cm.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

14) C

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

15) $\alpha = 0.05$
Test statistic: $t = 2.690$. $0.005 < $ P-value < 0.01.
Critical value: $t = 2.508$.
Because the test statistic exceeds the critical value and the P-value is less than the alpha level, we reject the null hypothesis. The sample data support the claim that $\mu > 220{,}000$ miles.

16) Test statistic: t = –0.488. Critical value: t = –1.753. Fail to reject H_0. There is not sufficient sample evidence to support the claim that the mean is less than 30 g.

17) Test statistic: t = 2.612. Critical value: t = 1.833. Reject H_0. The sample data support the claim that the mean is greater than 520 hours.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

18) A

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

19) Test statistic: $X^2 = 7.523$. Critical values: $X^2 = 7.962, 26.296$. Reject H_0. The sample data support the claim that the standard deviation is different from 3.5.

20) Test statistic: $X^2 = 9.260$. Critical values: $X^2 = 6.262, 27.488$. Fail to reject H_0. There is not sufficient sample evidence to support the claim that heights of women aged 25 to 34 have a standard deviation different from 2.9 in.

Elementary Statistics   Chapter 8 Test – Form A

Name:_____ Course Number: _____ Section Number: _____

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Provide an appropriate response.

1) How does finding the error estimate and confidence intervals for dependent samples compare to the methods for one mean from Chapter 7?

2) Define independent and dependent samples and give an example of each.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Find the number of successes x suggested by the given statement.

3) A computer manufacturer randomly selects 2360 of its computers for quality assurance and finds that 2.54% of these computers are found to be defective.

   A) 63   B) 58   C) 65   D) 60

From the sample statistics, find the value of $\overline{p}$ used to test the hypothesis that the population proportions are equal.

4) $n_1 = 507$ $n_2 = 2258$

   $x_1 = 194$ $x_2 = 693$

   A) 0.642   B) 0.566   C) 0.257   D) 0.321

Compute the test statistic used to test the null hypothesis that $p_1 = p_2$.

5) In a vote on the Clean Water bill, 41% of the 205 Democrats voted for the bill while 40% of the 230 Republicans voted for it.

   A) 0.212   B) 0.127   C) 0.233   D) 0.180

Find the appropriate P–value to test the null hypothesis, H_0: $p_1 = p_2$, using a significance level of 0.05.

6) $n_1 = 100$ $n_2 = 140$

   $x_1 = 41$ $x_2 = 35$

   A) .0086   B) .0512   C) .0021   D) .4211

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Use the traditional method to test the given hypothesis. Assume that the samples are independent and that they have been randomly selected

7) A marketing survey involves product recognition in New York and California. Of 558 New Yorkers surveyed, 193 knew the product while 196 out of 614 Californians knew the product. At the 0.05 significance level, test the claim that the recognition rates are the same in both states.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Construct the indicated confidence interval for the difference between population proportions $p_1 - p_2$. Assume that the samples are independent and that they have been randomly selected.

8) In a random sample of 500 people aged 20–24, 22% were smokers. In a random sample of 450 people aged 25–29, 14% were smokers. Construct a 95% confidence interval for the difference between the population proportions $p_1 - p_2$.

    A) $0.048 < p_1 - p_2 < 0.112$ B) $0.035 < p_1 - p_2 < 0.125$

    C) $0.025 < p_1 - p_2 < 0.135$ D) $0.032 < p_1 - p_2 < 0.128$

Determine whether the samples are independent or consist of matched pairs.

9) The effectiveness of a new headache medicine is tested by measuring the amount of time before the headache is cured for patients who use the medicine and another group of patients who use a placebo drug.

    A) Matched pairs   B) Independent samples

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Test the indicated claim about the means of two populations. Assume that the two samples are independent and that they have been randomly selected.

10) A researcher wishes to determine whether people with high blood pressure can reduce their blood pressure by following a particular diet. Use the sample data below to test the claim that the treatment population mean μ_1 is smaller than the control population mean μ_2. Test the claim using a significance level of 0.01.

Treatment Group	Control Group
$n_1 = 85$	$n_2 = 75$
$\overline{x}_1 = 189.1$	$\overline{x}_2 = 203.7$
$s_1 = 38.7$	$s_2 = 39.2$

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Construct the indicated confidence interval for the difference between the two population means. Assume that the two samples are independent and that they have been randomly selected.

11) Two types of flares are tested for their burning times (in minutes) and sample results are given below.

Brand X	Brand Y
$n = 35$	$n = 40$
$\bar{x} = 19.4$	$\bar{x} = 15.1$
$s = 1.4$	$s = 0.8$

Construct a 95% confidence interval for the differences $\mu_X - \mu_Y$ based on the sample data.

A) $3.5 < \mu_X - \mu_Y < 5.1$ 　　　　　　　　　　B) $3.2 < \mu_X - \mu_Y < 5.4$

C) $3.8 < \mu_X - \mu_Y < 4.8$ 　　　　　　　　　　D) $3.6 < \mu_X - \mu_Y < 5.0$

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Use the computer display to solve the problem.

12) When testing for a difference between the means of a treatment group and a placebo group, the computer display below is obtained. Using a 0.05 significance level, is there sufficient evidence to support the claim that the treatment group (variable 1) comes from a population with a mean that is different from the mean for the placebo population? Explain.

	t-Test: Two Sample for Means		
1		Variable 1	Variable 2
2	Mean	65.10738	66.18251
3	Known Variance	8.102938	10.27387
4	Observations	50	50
5	Hypothesized Mean Difference	0	
6	t	-1.773417	
7	P(T<=t) one-tail	0.0384	
8	T Critical one-tail	1.644853	
9	P(T<=t) two-tail	0.0768	
10	t Critical two-tail	1.959961	

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

The two data sets are dependent. Find $\bar{d}$ to the nearest tenth.

13)

X	12.9	11.3	10.7	12.9	12.9
Y	12.6	12.6	10.0	10.7	12.3

A) 0.6 　　　　　　　　B) 0.5 　　　　　　　　C) 0.7 　　　　　　　　D) 0.3

Find s_d.

14) The differences between two sets of dependent data are –3 –21 –12 –3 –27. Round to the nearest tenth.

    A) 21.4   B) 13.9   C) 10.7   D) 8.6

Assume that you want to test the claim that the paired sample data come from a population for which the mean difference is $\mu_d = 0$. Compute the value of the t test statistic.

15)

x	11	5	13	5	9
y	8	7	9	6	4

    A) t = 2.890   B) t =1.292   C) t = 0.415   D) t = 0.578

Determine the decision criterion for rejecting the null hypothesis in the given hypothesis test; i.e., describe the values of the test statistic that would result in rejection of the null hypothesis.

16) Suppose you wish to test the claim that μ_d, the mean value of the differences d for a population of paired data, is different from 0. Given a sample of n = 23 and a significance level of $\alpha = 0.05$, what criterion would be used for rejecting the null hypothesis?

    A) Reject null hypothesis if test statistic > 2.074 or < –2.074.

    B) Reject null hypothesis if test statistic > 1.717 or < –1.717.

    C) Reject null hypothesis if test statistic > 2.069 or < –2.069.

    D) Reject null hypothesis if test statistic > 1.717.

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Use the traditional method of hypothesis testing to test the given claim about the means of two populations. Assume that two dependent samples have been randomly selected from normally distributed populations.

17) Five students took a math test before and after tutoring. Their scores were as follows.

Subject	A	B	C	D	E
Before	78	76	67	80	67
After	82	85	65	83	79

Using a 0.01 level of significance, test the claim that the tutoring has an effect on the math scores.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Construct a confidence interval for μ_d, the mean of the differences d for the population of paired data. Assume that the population of paired differences is normally distributed.

18) A test of writing ability is given to a random sample of students before and after they completed a formal writing course. The results are given below. Construct a 99% confidence interval for the mean difference between the before and after scores.

Before	70	80	92	99	93	97	76	63	68	71	74
After	69	79	90	96	91	95	75	64	62	64	76

    A) $-0.2 < \mu_d < 4.2$ B) $1.2 < \mu_d < 2.8$ C) $-0.5 < \mu_d < 4.5$ D) $-0.1 < \mu_d < 4.1$

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Test the indicated claim about the variances or standard deviations of two populations. Assume that the populations are normally distributed. Assume that the two samples are independent and that they have been randomly selected.

19) A random sample of 16 women resulted in blood pressure levels with a standard deviation of 22.8 mm Hg. A random sample of 17 men resulted in blood pressure levels with a standard deviation of 19.9 mm Hg. Use a 0.025 significance level to test the claim that blood pressure levels for women have a larger variance than those for men.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Solve the problem.

20) When performing a hypothesis test for the ratio of two population variances, the upper critical F value is denoted F_R. The lower critical F value, F_L, can be found as follows: interchange the degrees of freedom, and then take the reciprocal of the resulting F value found in table A–5. F_R can be denoted $F_{\alpha/2}$ and F_L can be denoted $F_{1-\alpha/2}$.

Find the critical values F_L and F_R for a two–tailed hypothesis test based on the following values:

$n_1 = 10, n_2 = 16, \alpha = 0.05$

   A) 0.3202, 3.1227   B) 3.1227, 3.7743   C) 0.2653, 3.7743   D) 0.2653, 3.1227

Answer Key
Testname: ELEMENTARY STATISTICS CHAPTER 8 TEST FORM A

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

1) When the samples are dependent, the differences are computed for each pair of values. Then the mean and standard deviation of the differences are computed. The process proceeds exactly like the process in Chapter 7 for computing E and confidence intervals.
2) Independent samples are not related in any way. Dependent samples are related. Examples will vary.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

3) D
4) D
5) A
6) A

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

7) H_0: $p_1 = p_2$. H_1: $p_1 \neq p_2$.
   Test statistic: $z = 0.97$.   Critical values: $z = -1.96, 1.96$.
   Fail to reject the null hypothesis. There is not sufficient evidence to warrant rejection of the claim that the recognition rates are the same in both states.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

8) D
9) B

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

10) H_0: $\mu_1 = \mu_2$. H_1: $\mu_1 < \mu_2$.
    Test statistic $t = -2.365$. Critical value: $t = -2.377$.
    Fail to reject the null hypothesis. There is not sufficient evidence to support the claim that the treatment population mean μ_1 is smaller than the control population mean μ_2.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

11) C

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

12) No, the P-value for a two-tail test is 0.0768, which is greater than the significance level of 0.05. There is not sufficient evidence to support the claim that the two population means are different.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

13) B
14) C
15) B
16) A

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

17) Test statistic: $t = -2.134$. Critical value: $t = -3.747$.
    Fail to reject H_0: $\mu_d = 0$. There is not sufficient evidence to support the claim that the tutoring has an effect.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

18) C

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

19) H_0: $\sigma^2_1 = \sigma^2_2$. H_1: $\sigma^2_1 > \sigma^2_2$.

Test statistic: F = 1.3127.   Critical value: F = 2.7875.

Fail to reject the null hypothesis. There is not sufficient evidence to support the claim that blood pressure levels for women have a larger variance than those for men.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

20) D

Elementary Statistics   Chapter 8 Test – Form B

Name:_____ Course Number: _____ Section Number: _____

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Provide an appropriate response.

1) Compare the technique for decision making about populations using the hypothesis test method and the confidence interval method.

2) What is the effect on the P–value when a test is changed from two–tailed hypothesis with = and $\neq$ to one–tailed hypothesis such as > and < ?

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Find the number of successes x suggested by the given statement.

3) Among 1390 randomly selected car drivers in one city, 7.41% said that they had been involved in an accident during the past year.

    A) 104   B) 103   C) 102   D) 101

From the sample statistics, find the value of $\overline{p}$ used to test the hypothesis that the population proportions are equal.

4) $n_1 = 40$ $n_2 = 445$
   $x_1 = 5$ $x_2 = 268$

    A) 0.675   B) 0.225   C) 0.563   D) 0.450

Compute the test statistic used to test the null hypothesis that $p_1 = p_2$.

5) A report on the nightly news broadcast stated that 15 out of 150 households with pet dogs were burglarized and 25 out of 204 without pet dogs were burglarized.

    A) –0.265   B) –0.662   C) –0.001   D) –1.125

Find the appropriate P–value to test the null hypothesis, H_0: $p_1 = p_2$, using a significance level of 0.05.

6) $n_1 = 50$ $n_2 = 75$
   $x_1 = 20$ $x_2 = 15$

    A) .1201   B) .0001   C) .0032   D) .0146

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Use the traditional method to test the given hypothesis. Assume that the samples are independent and that they have been randomly selected

7) In a random sample of 500 people aged 20–24, 22% were smokers. In a random sample of 450 people aged 25–29, 14% were smokers. Test the claim that the proportion of smokers in the two age groups is the same. Use a significance level of 0.01.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Determine whether the samples are independent or consist of matched pairs.

8) The effectiveness of a headache medicine is tested by measuring the intensity of a headache in patients before and after drug treatment. The data consist of before and after intensities for each patient.

    A) Matched pairs   B) Independent samples

Construct the indicated confidence interval for the difference between population proportions $p_1 - p_2$. Assume that the samples are independent and that they have been randomly selected.

9) A marketing survey involves product recognition in New York and California. Of 558 New Yorkers surveyed, 193 knew the product while 196 out of 614 Californians knew the product. Construct a 99% confidence interval for the difference between the two population proportions.

    A) $-0.0034 < p_1 - p_2 < 0.0566$ B) $0.0247 < p_1 - p_2 < 0.0286$

    C) $-0.0177 < p_1 - p_2 < 0.1243$ D) $-0.0443 < p_1 - p_2 < 0.0976$

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Test the indicated claim about the means of two populations. Assume that the two samples are independent and that they have been randomly selected.

10) Two types of flares are tested for their burning times (in minutes) and sample results are given below.

Brand X	Brand Y
$n = 35$	$n = 40$
$\overline{x} = 19.4$	$\overline{x} = 15.1$
$s = 1.4$	$s = 0.8$

Refer to the sample data to test the claim that the two populations have equal means. Use a 0.05 significance level.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Construct the indicated confidence interval for the difference between the two population means. Assume that the two samples are independent and that they have been randomly selected.

11) A researcher wishes to determine whether people with high blood pressure can reduce their blood pressure by following a particular diet. Use the sample data below to construct a 99% confidence interval for $u_1 - u_2$ where u_1 and u_2 represent the mean for the treatment group and the control group respectively.

Treatment Group	Control Group
$n_1 = 85$	$n_2 = 75$
$\overline{x}_1 = 189.1$	$\overline{x}_2 = 203.7$
$s_1 = 38.7$	$s_2 = 39.2$

A) $-29.0 < \mu_1 - \mu_2 < -0.2$ B) $-1.3 < \mu_1 - \mu_2 < 30.5$

C) $-26.7 < \mu_1 - \mu_2 < -2.5$ D) $-30.5 < \mu_1 - \mu_2 < 1.3$

The two data sets are dependent. Find $\overline{d}$ to the nearest tenth.

12)

X	8.5 5.9 9.1 6.7 6.8 5.7
Y	8.6 8.9 8.9 8.9 8.1 9.3

A) –10.2   B) –1.0   C) –1.7   D) –2.2

Find s_d.

13) The differences between two sets of dependent data are 0.42 0.42 0.51 0.54 0.6. Round to the nearest hundredth.

A) 0.08   B) 0.24   C) 0.12   D) 0.04

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Use the computer display to solve the problem.

14) When testing for a difference between the means of a treatment group and a placebo group, the computer display below is obtained. Using a 0.05 significance level, is there sufficient evidence to support the claim that the treatment group (variable 1) comes from a population with a mean that is less than the mean for the placebo population? Explain.

	t-Test: Two Sample for Means		
1		Variable 1	Variable 2
2	Mean	65.10738	66.18251
3	Known Variance	8.102938	10.27387
4	Observations	50	50
5	Hypothesized Mean Difference	0	
6	t	-1.773417	
7	P(T<=t) one-tail	0.0384	
8	T Critical one-tail	1.644853	
9	P(T<=t) two-tail	0.0768	
10	t Critical two-tail	1.959961	

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Assume that you want to test the claim that the paired sample data come from a population for which the mean difference is $\mu_d = 0$. Compute the value of the t test statistic.

15) A farmer has decided to use a new additive to grow his crops. He divided his farm into 10 plots and kept records of the corn yield (in bushels) before and after using the additive. The results are shown below.

Plot: 1 2 3 4 5 6 7 8 9 10
Before 9 9 8 7 6 8 5 9 10 11
After 10 9 9 8 7 10 6 10 10 12

You wish to test the following hypothesis at the 10 percent level of significance.

H_O: $\mu_D = 0$ against H_1: $\mu_D \neq 0$.

What is the value of the appropriate test statistic?

A) 5.014   B) 2.033   C) 1.584   D) 2.536

Determine the decision criterion for rejecting the null hypothesis in the given hypothesis test; i.e., describe the values of the test statistic that would result in rejection of the null hypothesis.

16) Suppose you wish to test the claim that μ_d, the mean value of the differences d for a population of paired data, is greater than 0. Given a sample of n = 15 and a significance level of $\alpha = 0.01$, what criterion would be used for rejecting the null hypothesis?

A) Reject null hypothesis if test statistic < 2.624.

B) Reject null hypothesis if test statistic > 2.602.

C) Reject null hypothesis if test statistic > 2.977 or < –2.977.

D) Reject null hypothesis if test statistic > 2.624.

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Use the traditional method of hypothesis testing to test the given claim about the means of two populations. Assume that two dependent samples have been randomly selected from normally distributed populations.

17) A test of abstract reasoning is given to a random sample of students before and after they completed a formal logic course. The results are given below. At the 0.05 significance level, test the claim that the mean score is not affected by the course.

Before 74 83 75 88 84 63 93 84 91 77
After   73 77 70 77 74 67 95 83 84 75

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Construct a confidence interval for μ_d, the mean of the differences d for the population of paired data. Assume that the population of paired differences is normally distributed.

18) Ten different families are tested for the number of gallons of water a day they use before and after viewing a conservation video. Construct a 90% confidence interval for the mean of the differences.

Before 33 33 38 33 35 35 40 40 40 31

After   34 28 25 28 35 33 31 28 35 33

   A) $2.5 < \mu_d < 7.1$ B) $1.5 < \mu_d < 8.1$ C) $3.8 < \mu_d < 5.8$ D) $1.8 < \mu_d < 7.8$

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Test the indicated claim about the variances or standard deviations of two populations. Assume that the populations are normally distributed. Assume that the two samples are independent and that they have been randomly selected.

19) Two types of flares are tested for their burning times (in minutes) and sample results are given below. Use a 0.05 significance level to test the claim that the two brands have equal variances.

Brand X	Brand Y
$n = 35$	$n = 40$
$\overline{x} = 19.4$	$\overline{x} = 15.1$
$s = 1.4$	$s = 0.8$

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Solve the problem.

20) When performing a hypothesis test for the ratio of two population variances, the upper critical F value is denoted F_R. The lower critical F value, F_L, can be found as follows: interchange the degrees of freedom, and then take the reciprocal of the resulting F value found in table A-5. F_R can be denoted $F_{\alpha/2}$ and F_L can be denoted $F_{1-\alpha/2}$.

Find the critical values F_L and F_R for a two–tailed hypothesis test based on the following values:

$n_1 = 9, n_2 = 7, \alpha = 0.05$

   A) 0.2150, 5.5996   B) 0.2150, 4.8232   C) 0.3931, 4.1468   D) 0.2411, 4.1468

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

1) In the hypothesis test method, the comparison is made between a test statistic from the sample data and the critical value from the table. The conclusion is either to reject or fail to reject the null hypothesis based on whether or not the test statistic is in the reject region. With the confidence interval method, the confidence interval is constructed and the population mean is compared against the interval. The conclusion is made based on whether or not the population mean is within the confidence interval.

2) The P–value is cut in half.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

3) B

4) C

5) B

6) D

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

7) H_0: $p_1 = p_2$. H_1: $p_1 \neq p_2$.

Test statistic: $z = 3.19$.   Critical values: $z = -2.575, 2.575$.

Reject the null hypothesis. There is sufficient evidence to warrant rejection of the claim that the proportion of smokers in the two age groups is the same.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

8) A

9) D

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

10) H_0: $\mu_1 = \mu_2$. H_1: $\mu_1 \neq \mu_2$.

Test statistic $t = 16.025$. Critical values: $t = 2.032, -2.032$.

Reject the null hypothesis. There is sufficient evidence to warrant rejection of the claim that the two populations have equal means.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

11) D

12) C

13) A

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

14) Yes, the P–value for a one–tail test is 0.0384, which is smaller than the significance level of 0.05. There is sufficient evidence to support the claim that the mean for the treatment group is smaller than the mean for the placebo group.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

15) A

16) D

Answer Key
Testname: ELEMENTARY STATISTICS CHAPTER 8 TEST FORM B

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

17) Test statistic t = 2.366. Critical values: t = ± 2.262.
    Reject the null hypothesis. There is sufficient evidence to warrant rejection of the claim that the mean is not affected by the course.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

18) D

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

19) $H_0: \sigma_1^2 = \sigma_2^2.$ $H_1: \sigma_1^2 \neq \sigma_2^2.$
    Test statistic: F = 3.0625. Critical value: F = 1.9429.
    Reject the null hypothesis. There is sufficient evidence to warrant rejection of the claim that the two brands have equal variances.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

20) A

Elementary Statistics   Chapter 8 Test – Form C

Name:_____ Course Number: _____ Section Number: _____

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Provide an appropriate response.

1) The test statistic for testing a hypothesis about two variances is $F = \dfrac{s_1{}^2}{s_2{}^2}$ where $s_1{}^2 > s_2{}^2$.

   Describe the numeric possibilities for this test statistic. Explain the circumstances under which the conclusion would be either that the variances are equal or that the variances are not equal.

2) Describe the process for testing a hypothesis about two means when the random samples are independent and large. Compare this process to the methods of hypothesis testing for one mean in Chapter 7.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Find the number of successes x suggested by the given statement.

3) Among 740 people selected randomly from among the eligible voters in one city, 55.5% were homeowners

   A) 416   B) 415   C) 411   D) 407

From the sample statistics, find the value of $\bar{p}$ used to test the hypothesis that the population proportions are equal.

4) $n_1 = 256$ $n_2 = 421$
   $x_1 = 80$ $x_2 = 50$

   A) 0.192   B) 0.134   C) 0.096   D) 0.173

Compute the test statistic used to test the null hypothesis that $p_1 = p_2$.

5) Information about movie ticket sales was printed in a movie magazine. Out of fifty PG–rated movies, 36% had ticket sales in excess of $3,000,000. Out of thirty–five R–rated movies, 23% grossed over $3,000,000.

   A) 3.965   B) 2.558   C) 2.046   D) 1.279

Find the appropriate P–value to test the null hypothesis, H_0: $p_1 = p_2$, using a significance level of 0.05.

6) $n_1 = 200$ $n_2 = 100$
   $x_1 = 11$ $x_2 = 8$

   A) .0012   B) .4010   C) .0201   D) .1011

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Use the traditional method to test the given hypothesis. Assume that the samples are independent and that they have been randomly selected.

7) A researcher finds that of 1,000 people who said that they attend a religious service at least once a week, 31 stopped to help a person with car trouble. Of 1,200 people interviewed who had not attended a religious service at least once a month, 22 stopped to help a person with car trouble. At the 0.05 significance level, test the claim that the two proportions are equal.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Construct the indicated confidence interval for the difference between population proportions $p_1 - p_2$. Assume that the samples are independent and that they have been randomly selected.

8) In a random sample of 300 women, 48% favored stricter gun control legislation. In a random sample of 200 men, 27% favored stricter gun control legislation. Construct a 98% confidence interval for the difference between the population proportions $p_1 - p_2$.

A) $0.123 < p_1 - p_2 < 0.297$ B) $0.126 < p_1 - p_2 < 0.294$

C) $0.100 < p_1 - p_2 < 0.320$ D) $0.111 < p_1 - p_2 < 0.309$

Determine whether the samples are independent or consist of matched pairs.

9) The effect of caffeine as an ingredient is tested with a sample of regular soda and another sample with decaffeinated soda.

A) Independent samples B) Matched pairs

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Test the indicated claim about the means of two populations. Assume that the two samples are independent and that they have been randomly selected.

10) Two types of engines are tested for fuel efficiency based on miles per gallon.

Brand X	Brand Y
n = 31	n = 31
x = 20.9	x = 17.6
s = 1.8	s = 1.2

Refer to the sample data to test the claim that the two populations have equal means. Use a 0.05 significance level.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Construct the indicated confidence interval for the difference between the two population means. Assume that the two samples are independent and that they have been randomly selected.

11) Independent samples from two different populations yield the following data. $\overline{x}_1 = 193$, $\overline{x}_2 = 128$, $s_1 = 27$, $s_2 = 88$. The sample size is 465 for both samples. Find the 85 percent confidence interval for $\mu_1 - \mu_2$.

   A) $49 < \mu_1 - \mu_2 < 81$ B) $57 < \mu_1 - \mu_2 < 73$

   C) $59 < \mu_1 - \mu_2 < 71$ D) $65 < \mu_1 - \mu_2 < 65$

The two data sets are dependent. Find $\overline{d}$ to the nearest tenth.

12)
A	70 55 70 63 51
B	29 26 29 25 22

   A) 46.3   B) 21.4   C) 44.5   D) 35.6

Find s_d.

13) Consider the set of differences between two dependent sets: 84, 85, 83, 63, 61, 100, 98. Round to the nearest tenth.

   A) 13.1   B) 15.3   C) 16.2   D) 15.7

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Use the computer display to solve the problem.

14) When testing for a difference between the means of a treatment group and a placebo group, the computer display below is obtained. Using a 0.04 significance level, is there sufficient evidence to support the claim that the treatment group (variable 1) comes from a population with a mean that is different from the mean for the placebo population? Explain.

	t-Test: Two Sample for Means		
1		Variable 1	Variable 2
2	Mean	171.6392	168.7718
3	Known Variance	47.51672	41.08293
4	Observations	50	50
5	Hypothesized Mean Difference	0	
6	t	2.154057	
7	P(T>=t) one-tail	0.0158	
8	T Critical one-tail	1.644853	
9	P(T>=t) two-tail	0.0316	
10	t Critical two-tail	1.959961	

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Assume that you want to test the claim that the paired sample data come from a population for which the mean difference is $\mu_d = 0$. Compute the value of the t test statistic.

15) The following table shows the weights of nine subjects before and after following a particular diet for two months. You wish to test the claim that the diet is effective in helping people lose weight. What is the value of the appropriate test statistic?

Subject	A	B	C	D	E	F	G	H	I
Before	168	180	157	132	202	124	190	210	171
After	162	178	145	125	171	126	180	195	163

A) 9.468   B) 0.351   C) 3.156   D) 1.052

Determine the decision criterion for rejecting the null hypothesis in the given hypothesis test; i.e., describe the values of the test statistic that would result in rejection of the null hypothesis.

16) We wish to compare the means of two populations using paired observations. Suppose that $\overline{d} = 3.125$, $S_d = 2.911$, and $n = 8$, and that you wish to test the following hypothesis at the 5 percent level of significance:

$H_0: \mu_d = 0$ against $H_1: \mu_d > 0$.

What decision rule would you use?

A) Reject H_0 if test statistic is greater than –1.895 and less than 1.895.

B) Reject H_0 if test statistic is greater than 1.895.

C) Reject H_0 if test statistic is less than 1.895.

D) Reject H_0 if test statistic is greater than –1.895.

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Use the traditional method of hypothesis testing to test the given claim about the means of two populations. Assume that two dependent samples have been randomly selected from normally distributed populations.

17) A coach uses a new technique to train gymnasts. 7 gymnasts were randomly selected and their competition scores were recorded before and after the training. The results are shown below.

Subject	A	B	C	D	E	F	G
Before	9.4	9.7	9.6	9.5	9.7	9.6	9.7
After	9.5	9.9	9.6	9.4	9.8	9.9	9.5

Using a 0.01 level of significance, test the claim that the training technique is effective in raising the gymnasts' scores.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Construct a confidence interval for μ_d, the mean of the differences d for the population of paired data. Assume that the population of paired differences is normally distributed.

18) A test of abstract reasoning is given to a random sample of students before and after they completed a formal logic course. The results are given below. Construct a 95% confidence interval for the mean difference between the before and after scores.

Before 74 83 75 88 84 63 93 84 91 77

After   73 77 70 77 74 67 95 83 84 75

A) $1.2 < \mu_d < 5.7$ B) $0.8 < \mu_d < 6.6$ C) $0.2 < \mu_d < 7.2$ D) $1.0 < \mu_d < 6.4$

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Test the indicated claim about the variances or standard deviations of two populations. Assume that the populations are normally distributed. Assume that the two samples are independent and that they have been randomly selected.

19) Test the claim that populations A and B have different variances. Use a significance level of 0.10.

Sample A	Sample B
n = 28	n = 41
$x_1 = 19.2$	$x_2 = 23.7$
s = 4.56	s = 5.66

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Solve the problem.

20) When performing a hypothesis test for the ratio of two population variances, the upper critical F value is denoted F_R. The lower critical F value, F_L, can be found as follows: interchange the degrees of freedom, and then take the reciprocal of the resulting F value found in table A-5. F_R can be denoted $F_{\alpha/2}$ and F_L can be denoted $F_{1-\alpha/2}$.

Find the critical values F_L and F_R for a two–tailed hypothesis test based on the following values:

$n_1 = 4$, $n_2 = 8$, $\alpha = 0.05$

A) 0.1211, 4.3541   B) 0.1703, 5.8898   C) 0.0684, 5.8898   D) 0.1112, 5.0453

Answer Key
Testname: ELEMENTARY STATISTICS CHAPTER 8 TEST FORM C

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

1) The value for the test statistic F will be 1 or greater. If the value is reasonably close to 1, the conclusion is that the two variances are equal. If the value is significantly greater than 1, the conclusion is that the two variances are not equal.

2) When the samples are independent, the differences between the sample means, $\overline{x1} - \overline{x2}$ is computed. The process proceeds exactly like the process in Chapter 7 for testing hypotheses about one mean with the z–distribution. The test statistic is $t = \dfrac{(\overline{x1} - \overline{x2}) - (\mu_1 - \mu_2)}{\sqrt{\dfrac{s_1^2}{n_1} + \dfrac{s_2^2}{n_2}}}$. The hypotheses are $H_0: \mu_1 - u_2 = 0$.

$H_1: \mu_1 - u_2 \neq 0$. The process includes drawing the distribution, shading the reject region(s), finding the critical values, computing the test statistic, rejecting or failing to reject the null hypothesis, and writing the conclusion.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

3) C
4) A
5) D
6) B

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

7) $H_0: p_1 = p_2.$ $H_1: p_1 \neq p_2.$
Test statistic: $z = 1.93.$ Critical values: $z = 1.96, -1.96.$
Fail to reject the null hypothesis. There is not sufficient evidence to warrant rejection of the claim that the two proportions are equal.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

8) D
9) A

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

10) $H_0: \mu_1 = \mu_2.$ $H_1: \mu_1 \neq \mu_2.$
Test statistic $t = 8.493.$ Critical values: $t = 2.042, -2.042.$
Reject the null hypothesis. There is sufficient evidence to warrant rejection of the claim that the two populations have equal means.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

11) B
12) D
13) B

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

14) Yes, the P–value for a two–tail test is 0.0316, which is smaller than the significance level of 0.04. There is sufficient evidence to support the claim that the two population means are different.

**MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.**

15) C

16) B

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

17) Test statistic $t = -0.880$. Critical value: $t = -3.143$.

Fail to reject H_0: $\mu_d = 0$. There is not sufficient evidence to support the claim that the technique is effective in raising the gymnasts' scores.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

18) C

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

19) H_0: $\sigma^2_1 = \sigma^2_2$. H_1: $\sigma^2_1 \neq \sigma^2_2$.

Test statistic: $F = 1.541$. Critical value: $F = 1.836$.

Fail to reject the null hypothesis. There is not sufficient evidence to support the claim that populations A and B have different variances.

**MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.**

20) C

Elementary Statistics   Chapter 9 Test – Form A

Name:_____ Course Number: _____ Section Number: _____

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Provide an appropriate response.

1) Suppose data are collected concerning the weight of a person in pounds and the number of
calories burned in 30 minutes of walking on a treadmill at 3.5 mph. How would the value of the
correlation coefficient, r, change if all of the weights were converted to kilograms?

2) Suppose that statisticians determine that there is a significant positive correlation between the
grade earned in the class College Reading Skills and the grade earned in Statistics. Does
achieving a high grade in reading **cause** an individual to earn a high grade in Statistics? Explain
your answer with reference to the term **lurking variable**.

**MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the
question.**

**Given the linear correlation coefficient r and the sample size n, determine the critical values of r and use
your finding to state whether or not the given r represents a significant linear correlation. Use a
significance level of 0.05.**

3) r = –0.568, n = 25

A) Critical values: r = ±0.487, no significant linear correlation

B) Critical values: r = ±0.396, significant linear correlation

C) Critical values: r = ±0.487, significant linear correlation

D) Critical values: r = ±0.396, no significant linear correlation

Find the value of the linear correlation coefficient r.

4) The paired data below consist of the costs of advertising (in thousands of dollars) and the
number of products sold (in thousands):

Cost	9	2	3	4	2	5	9	10
Number	85	52	55	68	67	86	83	73

A) –0.071   B) 0.708   C) 0.246   D) 0.235

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Describe the error in the stated conclusion.

5) Given: There is a significant linear correlation between the number of homicides in a town and
the number of movie theaters in a town.

Conclusion: Building more movie theaters will cause the homicide rate to rise.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Construct a scatter diagram for the given data.

6)

x	–4	2	8	6	11	9	–2	–1	–4
y	3	6	12	10	10	7	7	2	3
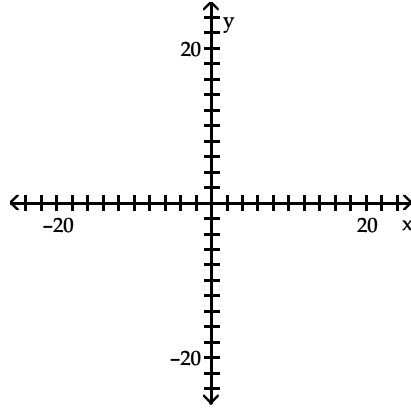
A)
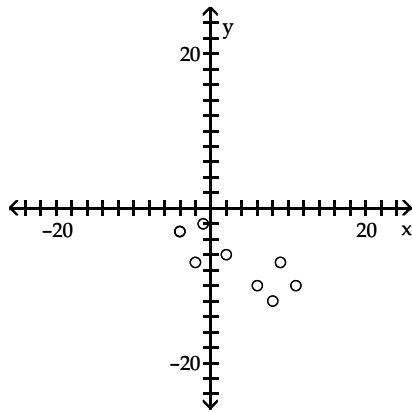
B)
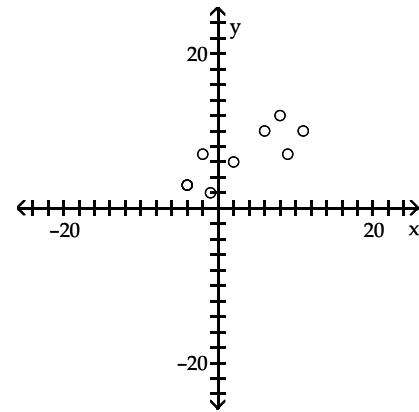
C)
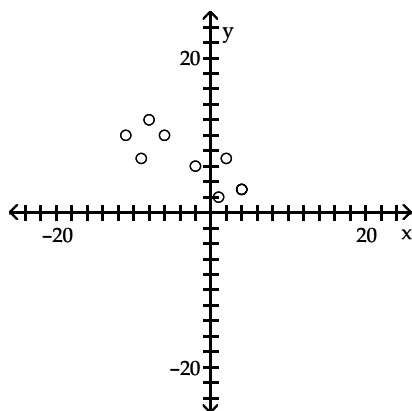
D)
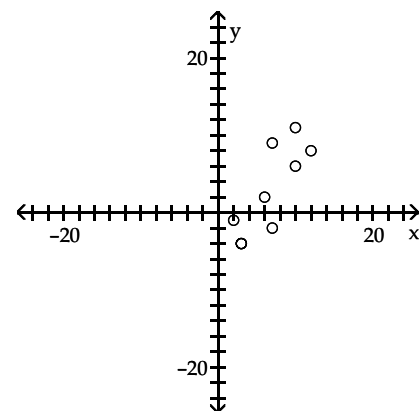
Determine which plot shows the strongest linear correlation.

7)

A)
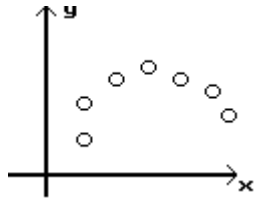
B)
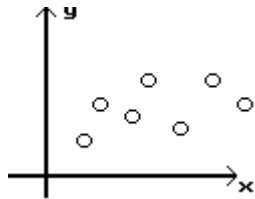
C)
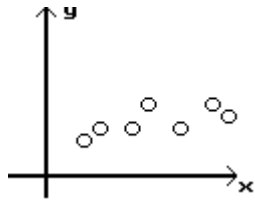
Find the best predicted value of y corresponding to the given value of x.

8) Four pairs of data yield r = 0.942 and the regression equation $\hat{y} = 3x$. Also, $\bar{y} = 12.75$. What is the best predicted value of y for x = 2.5?

  A) 7.5 B) 2.826 C) 12.75 D) 0.942

9) The regression equation relating attitude rating (x) and job performance rating (y) for the employees of a company is $\hat{y} = 11.7 + 1.02x$. Ten pairs of data were used to obtain the equation. The same data yield r = 0.863 and $\bar{y} = 80.1$. What is the best predicted job performance rating for a person whose attitude rating is 70?

  A) 83.1 B) 81.9 C) 12.6 D) 80.1

Use the given data to find the equation of the regression line. Round the final values to three significant digits, if necessary.

10)

x	2	4	5	6
y	7	11	13	20

  A) $\hat{y} = 3.0x$ B) $\hat{y} = 0.15 + 3.0x$ C) $\hat{y} = 2.8x$ D) $\hat{y} = 0.15 + 2.8x$

Is the data point, P, an outlier, an influential point, both, or neither?

11)
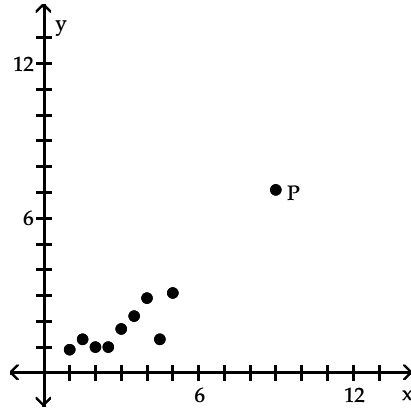
A) Outlier   B) Both

C) Influential point   D) Neither

Use the given information to find the coefficient of determination.

12) Find the coefficient of determination, given that the value of the linear correlation coefficient, r, is
–0.721.

A) 0.721   B) 0.520   C) 0.480   D) 0.279

Use the computer display to answer the question.

13) A collection of paired data consists of the number of years that students have studied Spanish
and their scores on a Spanish language proficiency test. A computer program was used to obtain
the least squares linear regression line and the computer output is shown below. Along with the
paired sample data, the program was also given an x value of 2 (years of study) to be used for
predicting test score.

The regression equation is

Score = 31.55 + 10.90 Years.

Predictor	Coef	StDev	T	P
Constant	31.55	6.360	4.96	0.000
Years	10.90	1.744	6.25	0.000

S = 5.651   R–Sq = 83.0%   R–Sq (Adj) = 82.7%

Predicted values

Fit	StDev Fit	95.0% CI	95.0% PI
53.35	3.168	(42.72, 63.98)	(31.61, 75.09)

If a person studies 4.5 years, what is the single value that is the best predicted test score?
Assume that there is a significant linear correlation between years of study and test score.

A) 53.35   B) 49.1   C) 83.0   D) 80.6

Find the explained variation for the paired data.

14) The equation of the regression line for the paired data below is $\hat{y} = 3x$. Find the explained variation.

x	2	4	5	6
y	7	11	13	20

    A) 10.00   B) 88.75   C) 78.75   D) 72.45

Construct the indicated prediction interval for an individual y.

15) The equation of the regression line for the paired data below is $\hat{y} = 3x$ and the standard error of estimate is $s_e = 2.2361$. Find the 90% prediction interval of y for x = 3.

x	2	4	5	6
y	7	11	13	20

    A) $7.1 < y < 10.9$ B) $6.8 < y < 11.2$ C) $4.5 < y < 13.5$ D) $1.2 < y < 16.8$

Construct a scatterplot and identify the mathematical model that best fits the data. Assume that the model is to be used only for the scope of the given data and consider only linear, quadratic, logarithmic, exponential, and power models. Use a calculator or computer to obtain the regression equation of the model that best fits the data. You may need to fit several models and compare the values of R^2.

16)

x	1	2	3	4	5	6
y	9	13	25	27	31	46

    A) $y = 3.14 + 6.59\,x$ B) $y = 4.87 + 18.5\,\ln x$

    C) $y = 8.34\,x^{0.88}$ D) $y = 1.07 + 6.89\,x$

Use computer software to find the regression equation. Can the equation be used for prediction?

17) FPEA, the Farm Production Enhancement Agency, regressed corn output against acreage, rainfall, and a trend line. The trend line is proxy for technological advancement in farming from improved pest control, fertilization, land management, and farming implements.

CORNPROD	ACRES	RAINFALL	TREND
456	9896	29.1	1
421	9680	42.3	2
653	10449	29.8	3
573	10811	26.0	4
546	10014	34.3	5
499	10293	22.7	6
504	9413	24.2	7
611	9860	31.6	8
646	9782	25.6	9
789	12139	37.9	10
773	12166	33.9	11
753	9976	37.4	12
852	10645	27.0	13
755	9738	31.5	14
815	9933	39.9	15
902	10132	25.3	16
986	11145	30.4	17
909	9775	32.7	18
945	9549	35.0	19
866	10077	33.8	20
1178	11550	29.4	21
1230	10600	37.1	22
1207	11280	42.9	23
968	12100	32.2	24
1118	12420	30.5	25

A) CORNPROD = −21.1 + .036ACRES + 2.62RAINFALL + 27.6TREND; No, because the P−value is low

B) CORNPROD = −21.1 + .036ACRES + 2.62RAINFALL + 27.6TREND; Yes, because the R^2 is high

C) CORNPROD = −.9 + 1.68ACRES + .79RAINFALL + 10.2TREND; Yes, because the adjusted R^2 is high

D) CORNPROD = −16.3 + 2.6ACRES + 3.9RAINFALL + 21.3TREND; Yes, because the the R^2 is high

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Use computer software to obtain the regression and identify R^2, adjusted R^2, and the P–value.

18) A visitor to Yellowstone National Park sat down one day and observed Old Faithful, which faithfully spurts throughout the day, day in and day out. He surmised that the height of a given spurt was caused by the pressure build–up during the interval between spurts and by the momentum build–up during the duration of the spurt. He wrote down the data to test his hypothesis, but he didn't know what to do with his data. Can you help him out with his theory? Interpret the statistics.

HEIGHT	INTERVAL	DURATION
150	86	240
154	86	237
140	62	122
140	104	267
160	62	113
140	95	258
150	79	232
150	62	105
160	94	276
155	79	248
125	86	243
136	85	241
140	86	214
155	58	114
130	89	272
125	79	227
125	83	237
139	82	238
125	84	203
140	82	270
140	82	270
140	78	218
135	87	270
140	70	241
100	56	102
105	81	271

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Use computer software to obtain the regression equation. Use the estimated equation to find the predicted value.

19) A wildlife analyst gathered the data in the table to develop an equation to predict the weights of bears. He used WEIGHT as the dependent variable and CHEST, LENGTH, and SEX as the independent variables. For SEX, he used male = 1 and female = 2. He took his equation "to the forest" and found a male bear whose chest measured 70.3 inches and who was 64.0 inches long.

WEIGHT	CHEST	LENGTH	SEX
344	45.0	67.5	1
416	54.0	72.0	1
220	41.0	70.0	2
360	49.0	68.5	1
332	44.0	73.0	1
140	32.0	63.0	2
436	48.0	72.0	1
132	33.0	61.0	2
356	48.0	64.0	2
150	35.0	59.0	1
202	40.0	63.0	2
365	50.0	70.5	1

A) 635.72 pounds   B) 601.83 pounds   C) 615.18 pounds   D) 674.30 pounds

Use computer software to find the best regression equation to explain the variation in the dependent variable, Y, in terms of the independent variables, X_1 and X_2.

20)

Y	X_1	X_2
15	1.2	16
15	1.2	16
17	1.0	16
6	0.8	9
1	0.1	1
8	0.8	8
10	0.8	10
17	1.0	16
15	1.2	15
11	0.7	9
18	1.4	18
16	1.0	15
10	0.8	9
7	0.5	5
18	1.1	16

CORRELATION COEFFICIENT

$Y / X_1 = .886$

$Y / X_2 = .965$

COEFFICIENTS OF DETERMINATION

$Y / X_2 = .932$

$Y / X_2, X_1 = .977$

A) $\hat{Y} = 1.3 - 1.3\ X_2$

B) $\hat{Y} = 1.25 - 1.55\ X_1 + 5.79\ X_2$

C) $\hat{Y} = 1.37 - 5.50\ X_1$

D) $\hat{Y} = 1.37 - 5.53\ X_1 + 1.33\ X_2$

Answer Key
Testname: ELEMENTARY STATISTICS CHAPTER 9 TEST FORM A

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

1) The value of r would remain the same as a change of scale does not affect the value of r.
2) A high grade in the College Reading Skills class does not necessarily cause a high grade in Statistics.
   These two variables could be related by an underlying relationship. Students who earn high grades in
   one class tend to earn high grades in other classes perhaps because of a lurking variable ‒‒ for example,
   motivation to achieve.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

3) B
4) B

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

5) Significant correlation does not imply causality. Both variables are affected by a third variable (a
   lurking variable) , namely the population of the town.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

6) B
7) C
8) C
9) A
10) A
11) B
12) B
13) D
14) C
15) D
16) D
17) B

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

18) In the order requested by the question, the answers are: .025, ‒.060, and .750. The negative adjusted
    coefficient of determination and the high P‒value indicate that the variation in height cannot be
    explained by pressure build‒up during the intervals and duration of the spurt.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

19) C
20) D

Elementary Statistics   Chapter 9 Test – Form B

Name:_____ Course Number: _____ Section Number: _____

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Provide an appropriate response.

1) When testing to determine if correlation is significant, we use the hypotheses $H_0: \rho = 0$. $H_1: \rho \neq 0$. Suppose the conclusion is to reject the null hypothesis. What does that tell us about the linear regression equation?

2) Describe the standard error of estimate, s_e. How do smaller values of s_e relate to the dispersion of data points about the line determined by the linear regression equation? What does it mean when s_e is 0?

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Given the linear correlation coefficient r and the sample size n, determine the critical values of r and use your finding to state whether or not the given r represents a significant linear correlation. Use a significance level of 0.05.

3) $r = 0.827$, $n = 5$

   A) Critical values: $r = \pm 0.950$, no significant linear correlation
   B) Critical values: $r = 0.950$, significant linear correlation
   C) Critical values: $r = \pm 0.878$, significant linear correlation
   D) Critical values: $r = \pm 0.878$, no significant linear correlation

Find the value of the linear correlation coefficient r.

4) The paired data below consist of the test scores of 6 randomly selected students and the number of hours they studied for the test.

Hours	5	10	4	6	10	9
Score	64	86	69	86	59	87

   A) –0.678   B) 0.678   C) –0.224   D) 0.224

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Describe the error in the stated conclusion.

5) Given: The linear correlation coefficient between scores on a math test and scores on a test of athletic ability is negative and close to zero.

   Conclusion: People who score high on the math test tend to score lower on the test of athletic ability.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.
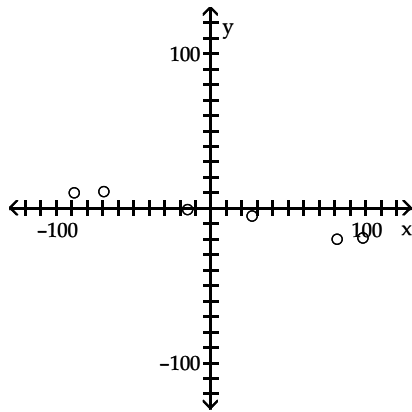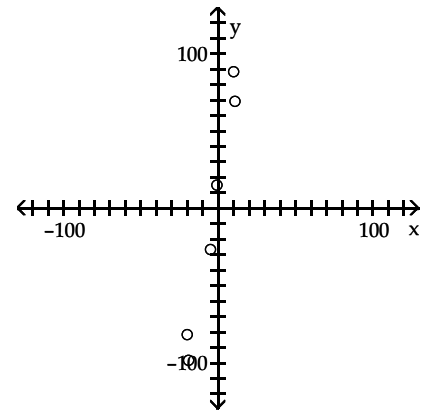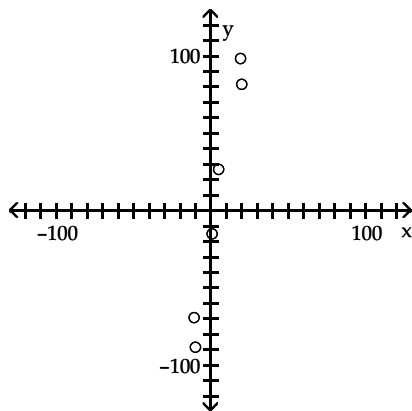
Construct a scatter diagram for the given data.

6)

x	10	−5	−20	11	−19	−1
y	−88	27	82	−69	98	−15
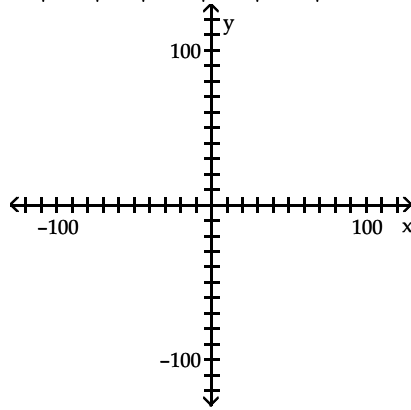
A)

B)

C)

D)
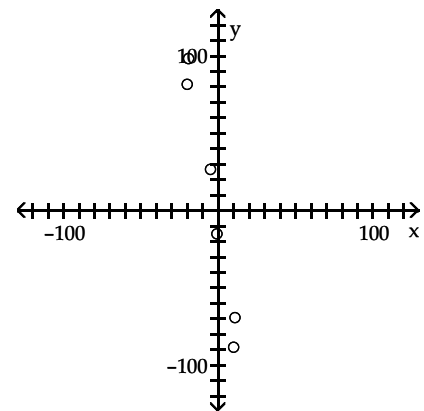
Determine which plot shows the strongest linear correlation.

7)

A)
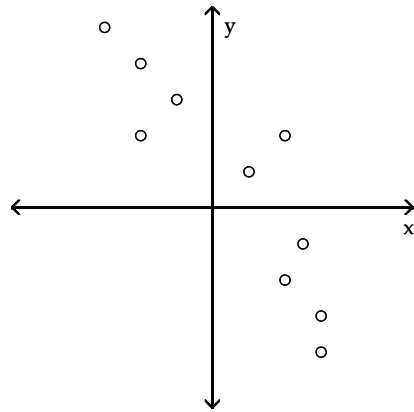
B)
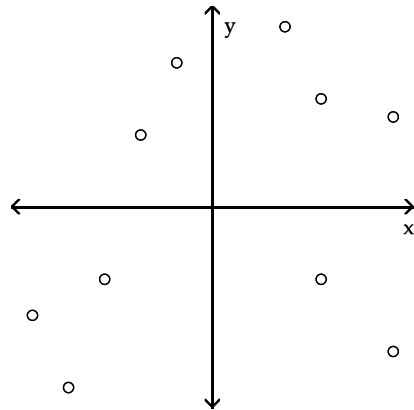
C)
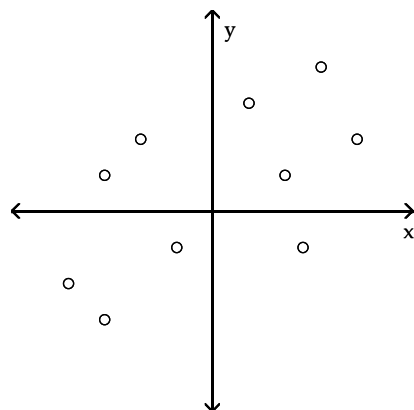
Use the given data to find the equation of the regression line. Round the final values to three significant digits, if necessary.

8)

x	0	3	4	5	12
y	8	2	6	9	12

A) $\hat{y} = 4.98 + 0.425x$ 　　　　　　　　B) $\hat{y} = 4.88 + 0.625x$

C) $\hat{y} = 4.88 + 0.525x$ 　　　　　　　　D) $\hat{y} = 4.98 + 0.725x$

Find the best predicted value of y corresponding to the given value of x.

9) Nine pairs of data yield r = 0.867 and the regression equation $\hat{y} = 19.4 + 0.93x$. Also, $\bar{y} = 64.7$. What is the best predicted value of y for x = 44?

A) 57.8   B) 64.7   C) 79.6   D) 60.3

10) Six pairs of data yield r = 0.444 and the regression equation $\hat{y} = 5x + 2$. Also, $\bar{y} = 18.3$. What is the best predicted value of y for x = 5?

A) 4.22   B) 27   C) 18.3   D) 93.5

Is the data point, P, an outlier, an influential point, both, or neither?

11)
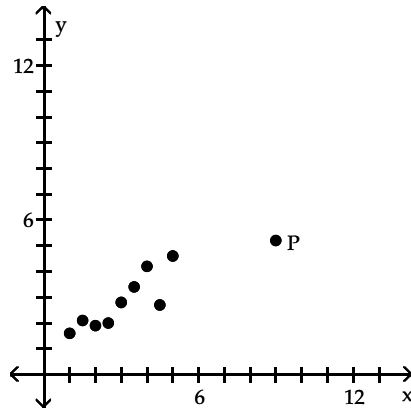
A) Influential point   B) Outlier

C) Neither   D) Both

Use the given information to find the coefficient of determination.

12) A regression equation is obtained for a collection of paired data. It is found that the total variation is 22.657, the explained variation is 15.841, and the unexplained variation is 6.816. Find the coefficient of determination.

A) 0.301   B) 1.430   C) 0.699   D) 0.430

Use the computer display to answer the question.

13) A collection of paired data consists of the number of years that students have studied Spanish and their scores on a Spanish language proficiency test. A computer program was used to obtain the least squares linear regression line and the computer output is shown below. Along with the paired sample data, the program was also given an x value of 2 (years of study) to be used for predicting test score.

The regression equation is

Score = 31.55 + 10.90 Years.

Predictor   Coef   StDev   T   P
Constant   31.55   6.360   4.96   0.000
Years   10.90   1.744   6.25   0.000

S = 5.651   R–Sq = 83.0%   R–Sq (Adj) = 82.7%

Predicted values

Fit   StDev Fit   95.0% CI   95.0% PI
53.35   3.168   (42.72, 63.98)   (31.61, 75.09)

What percentage of the total variation in test scores can be explained by the linear relationship between years of study and test scores?

A) 83.0%   B) 91.1%   C) 17.0%   D) 82.7%

Find the explained variation for the paired data.

14) The paired data below consists of test scores and hours of preparation for 5 randomly selected students. The equation of the regression line is $\hat{y} = 44.8447 + 3.52427x$. Find the explained variation.

x Hours of preparation	5	2	9	6	10
y Test of score	64	48	72	73	80

A) 511.724   B) 498.103   C) 87.4757   D) 599.2

Construct the indicated prediction interval for an individual y.

15) The paired data below consists of test scores and hours of preparation for 5 randomly selected students. The equation of the regression line is $\hat{y} = 44.845 + 3.524x$ and the standard error of estimate is $s_e = 5.40$. Find the 99% prediction interval for the test score of a person who spent 7 hours preparing for the test.

x Hours of preparation	5	2	9	6	10
y Test score	64	48	72	73	80

A) $62 < y < 78$ B) $32 < y < 107$ C) $35 < y < 104$ D) $58 < y < 82$

Use computer software to find the regression equation. Can the equation be used for prediction?

16) An anti–smoking group used data in the table to relate the carbon monoxide of various brands of cigarettes to their tar and nicotine content.

CO	TAR	NICOTINE
15	1.2	16
15	1.2	16
17	1.0	16
6	0.8	9
1	0.1	1
8	0.8	8
10	0.8	10
17	1.0	16
15	1.2	15
11	0.7	9
18	1.4	18
16	1.0	15
10	0.8	9
7	0.5	5
18	1.1	16

A) CO = 1.25 + 1.55TAR – 5.79NIC;
   Yes, because the P–value is too low

B) CO = 1.37 + 5.50TAR – 1.38NIC;
   Yes, because the P–value is high

C) CO = 1.3 + 5.5TAR – 1.3NIC;
   Yes, because the adjusted R^2 is high

D) CO = 1.37 – 5.53TAR + 1.33NIC;
   Yes, because the R^2 is high

Use computer software to obtain the regression and identify R^2, adjusted R^2, and the P–value.

17) A wildlife analyst gathered the data in the table to develop an equation to predict the weights of bears. He used WEIGHT as the dependent variable and CHEST, LENGTH, and SEX as the independent variables. For SEX, he used male=1 and female=2.

WEIGHT	CHEST	LENGTH	SEX
344	45.0	67.5	1
416	54.0	72.0	1
220	41.0	70.0	2
360	49.0	68.5	1
332	44.0	73.0	1
140	32.0	63.0	2
436	48.0	72.0	1
132	33.0	61.0	2
356	48.0	64.0	2
150	35.0	59.0	1
202	40.0	63.0	2
365	50.0	70.5	1

A) .971, .723, .000   B) .891, .926, .003   C) .927, .900, .000   D) .725, .961, .014

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Use computer software to obtain the regression equation. Use the estimated equation to find the predicted value.

18) A health specialist gathered the data in the table to see if pulse rates can be explained by exercise and smoking. For exercise, he assigns 1 for yes, 2 for no. For smoking, he assigns 1 for yes, 2 for no. He then used his results to predict the pulse rate of a person whose exercise value was 1 and whose smoking value was 2. Is his prediction valid?   Explain.

PULSE	EXERCISE	SMOKE
97	2	2
88	1	2
69	1	2
67	1	2
83	1	2
77	1	2
66	2	2
78	2	2
73	1	1
67	1	1
55	1	2
82	1	1
70	1	2
55	1	2
76	1	2

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Construct a scatterplot and identify the mathematical model that best fits the data. Assume that the model is to be used only for the scope of the given data and consider only linear, quadratic, logarithmic, exponential, and power models. Use a calculator or computer to obtain the regression equation of the model that best fits the data. You may need to fit several models and compare the values of R^2.

19)

x	1	2	3	4	5
y	7	17	20	25	28

A) $y = 6.81\ e^{0.316x}$

B) $y = 7.19 + 12.8 \ln x$

C) $y = 4.40 + 5.00\ x$

D) $y = 7.82\ x^{0.844}$

Use computer software to find the best regression equation to explain the variation in the dependent variable, Y, in terms of the independent variables, X_1 and X_2.

20)

Y	X_1	X_2
98.6	87.4	108.5
101.2	97.6	110.1
102.4	96.7	110.4
100.9	98.2	104.3
102.3	99.8	107.2
101.5	100.5	105.8
101.6	103.2	107.8
101.6	107.8	103.4
99.8	96.6	102.7
100.3	88.9	104.1
97.6	75.1	99.2
97.2	76.9	99.7
97.3	84.6	102.0
96.0	90.6	94.3
99.2	103.1	97.7
100.3	105.1	101.1
100.3	96.4	102.3
104.1	104.4	104.4
105.3	110.7	108.5
107.6	127.1	111.3

CORRELATION COEFFICIENTS

$$Y / X_1 = .850$$
$$Y / X_2 = .742$$

COEFFICIENT OF DETERMINATION

$$Y / X_1 = .723$$
$$Y / X_2 = .550$$
$$Y / X_1, X_2 = .867$$

A) $\hat{Y} = 57.6 + .153\ X_1 + .270\ X_2$

B) $\hat{Y} = 48.0 + .398\ X_1 + .228\ X_2$

C) $\hat{Y} = 58.9 + .612\ X_1$

D) $\hat{Y} = 52.6 + .462\ X_2$

Answer Key
Testname: ELEMENTARY STATISTICS CHAPTER 9 TEST FORM B

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

1) It tells us the correlation is significant and it would be appropriate to use the linear regression equation for prediction (for appropriate values of the dependent variable).

2) The standard error of estimate, s_e, is a measure of the distances between the observed sample y values and the predicted values $\hat{y}$. Smaller values of s_e indicate that the actual values of y will be closer to the regression line, whereas larger values of s_e indicate a greater dispersion of the y values from the regression line. When the standard error of estimate is 0, the y values lie on the regression line.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

3) D
4) D

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

5) Because the linear correlation coefficient is close to zero and is probably not significant, no conclusion can be reached regarding the relationship between scores on the math test and scores on the test of athletic ability.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

6) D
7) A
8) C
9) D
10) C
11) B
12) C
13) A
14) A
15) C
16) D
17) C

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

18) No. The adjusted coefficient of determination, −0.0436, shows that the independent variables cannot explain the variation in pulse rate. Further, the high P−value, 0.5123, confirms that the multiple regression equation cannot be used for prediction.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

19) B
20) A

Elementary Statistics   Chapter 9 Test – Form C

Name:_____ Course Number: _____ Section Number: _____

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Provide an appropriate response.

1) When testing to determine if linear correlation is significant, we use the hypothesis H_0: $\rho = 0$. H_1: $\rho \neq 0$. What does the the symbol ρ represent? Explain the meaning for the null and alternative hypotheses.

2) Discuss the guidelines under which the linear regression equation should be used for prediction. Refer to the correlation coefficient, the type of data used to create the linear regression, and the predicting value.

3) Define the term independent, or predictor, variable and the term dependent, or response, variable. Give examples for each.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Given the linear correlation coefficient r and the sample size n, determine the critical values of r and use your finding to state whether or not the given r represents a significant linear correlation. Use a significance level of 0.05.

4) r = 0.282, n = 90

   A) Critical values: r = ±0.217, no significant linear correlation

   B) Critical values: r = 0.217, significant linear correlation

   C) Critical values: r = ±0.207, significant linear correlation

   D) Critical values: r = ±0.207, no significant linear correlation

Find the value of the linear correlation coefficient r.

5) The paired data below consist of the temperatures on randomly chosen days and the amount a certain kind of plant grew (in millimeters):

Temp	62	76	50	51	71	46	51	44	79
Growth	36	39	50	13	33	33	17	6	16

   A) 0.256   B) 0   C) 0.196   D) −0.210

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Describe the error in the stated conclusion.

6) Given: Each school in a state reports the average SAT score of its students. There is a significant linear correlation between the average SAT score of a school and the average annual income in the district in which the school is located.
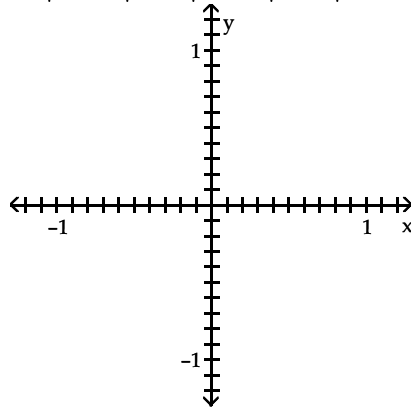
   Conclusion: There is a significant linear correlation between individual SAT scores and family income.

1

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.
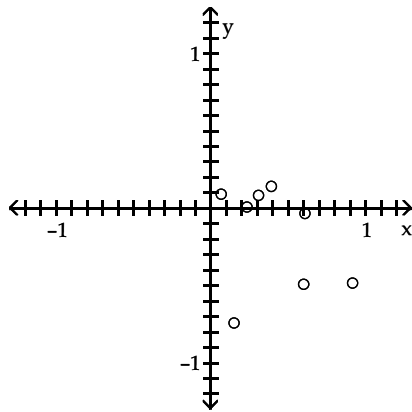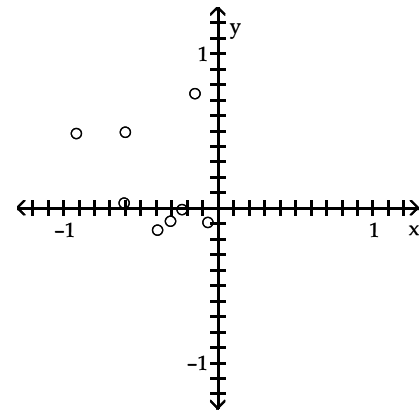
Construct a scatter diagram for the given data.

7)

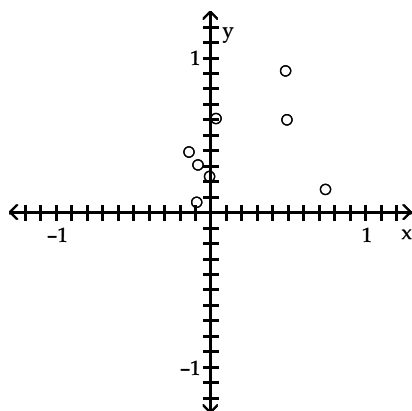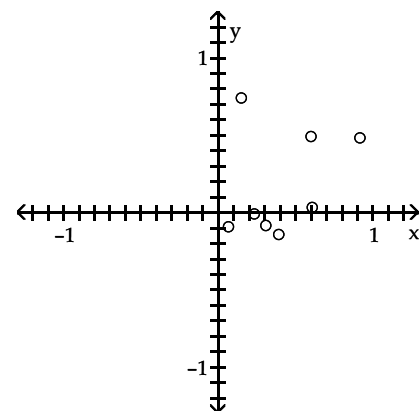| x	0.23	0.92	0.31	0.6	0.39	0.15	0.61	0.07
y	−0.01	0.48	−0.08	0.49	−0.14	0.74	0.03	−0.09

A)

B)

C)

D)

Find the best predicted value of y corresponding to the given value of x.

8) Eight pairs of data yield r = 0.708 and the regression equation $\hat{y} = 55.8 + 2.79x$. Also, $\bar{y} = 71.125$. What is the best predicted value of y for x = 4.8?

A) 71.13   B) 69.19   C) 57.80   D) 270.63

9) Based on the data from six students, the regression equation relating number of hours of preparation (x) and test score (y) is $\hat{y} = 67.3 + 1.07x$. The same data yield r = 0.224 and $\bar{y}$ = 75.2. What is the best predicted test score for a student who spent 7 hours preparing for the test?

A) 74.8   B) 75.2   C) 59.7   D) 78.1

Use the given data to find the equation of the regression line. Round the final values to three significant digits, if necessary.
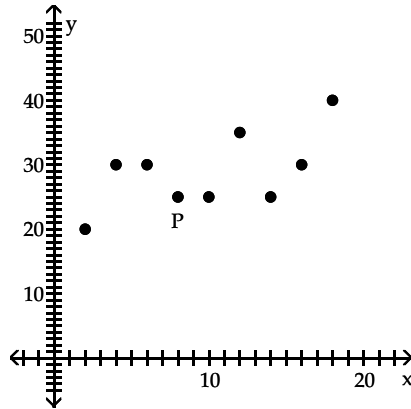
10)

x	6	8	20	28	36
y	2	4	13	20	30

A) $\hat{y} = -3.79 + 0.898x$ B) $\hat{y} = -2.79 + 0.898x$

C) $\hat{y} = -2.79 + 0.950x$ D) $\hat{y} = -3.79 + 0.801x$

Is the data point, P, an outlier, an influential point, both, or neither?

11)

A) Both   B) Influential point

C) Neither   D) Outlier

Use the given information to find the coefficient of determination.

12) A regression equation is obtained for a collection of paired data. It is found that the total variation is 113.3, the explained variation is 77.7, and the unexplained variation is 35.6. Find the coefficient of determination.

A) 0.458   B) 0.686   C) 1.458   D) 0.314

Use the computer display to answer the question.

13) A collection of paired data consists of the number of years that students have studied Spanish and their scores on a Spanish language proficiency test. A computer program was used to obtain the least squares linear regression line and the computer output is shown below. Along with the paired sample data, the program was also given an x value of 2 (years of study) to be used for predicting test score.

The regression equation is

Score = 31.55 + 10.90 Years.

Predictor	Coef	StDev	T	P
Constant	31.55	6.360	4.96	0.000
Years	10.90	1.744	6.25	0.000

$S = 5.651$ R–Sq = 83.0%   R–Sq (Adj) = 82.7%

Predicted values

Fit	StDev Fit	95.0% CI	95.0% PI
53.35	3.168	(42.72, 63.98)	(31.61, 75.09)

What percentage of the total variation in test scores is unexplained by the linear relationship between years of study and test scores?

A) 82.7%   B) 83.0%   C) 8.9%   D) 17.0%

Find the explained variation for the paired data.

14) The paired data below consists of heights and weights of 6 randomly selected adults. The equation of the regression line is $\hat{y} = -181.342 + 144.46x$. Find the explained variation.

x Height (meters)	1.61	1.72	1.78	1.80	1.67	1.88
y Weight (kg)	54	62	70	84	61	92

A) 979.44   B) 1149.2   C) 100.06   D) 1079.5

Construct the indicated prediction interval for an individual y.

15) The paired data below consists of heights and weights of 6 randomly selected adults. The equation of the regression line is $\hat{y} = -181.342 + 144.46x$ and the standard error of estimate is $s_e = 5.0015$. Find the 95% prediction interval for the weight of a person whose height is 1.75 m.

x Height (meters)	1.61	1.72	1.78	1.80	1.67	1.88
y Weight (kg)	54	62	70	84	61	92

A) $65.4 < y < 77.6$ B) $58.5 < y < 84.5$ C) $56.5 < y < 86.5$ D) $52.1 < y < 90.9$

Use computer software to find the regression equation. Can the equation be used for prediction?

16) A wildlife analyst gathered the data in the table to develop an equation to predict the weights of bears. He used WEIGHT as the dependent variable and CHEST, LENGTH, and SEX as the independent variables. For SEX, he used male=1 and female=2.

WEIGHT	CHEST	LENGTH	SEX
344	45.0	67.5	1
416	54.0	72.0	1
220	41.0	70.0	2
360	49.0	68.5	1
332	44.0	73.0	1
140	32.0	63.0	2
436	48.0	72.0	1
132	33.0	61.0	2
356	48.0	64.0	2
150	35.0	59.0	1
202	40.0	63.0	2
365	50.0	70.5	1

A) WEIGHT = 196 + 2.35CHEST + 3.40LENGTH + 25SEX;

Yes, because the R^2 is high

B) WEIGHT = 442.6 + 12.1CHEST + 4.2LENGTH – 21SEX;

Yes, because the P–value is low

C) WEIGHT = –320 + 10.6CHEST + 7.3LENGTH – 10.7SEX;

Yes, because the P–value is high

D) WEIGHT = –442.6 + 12.1CHEST + 3.6LENGTH – 23.8SEX;

Yes, because the adjusted R^2 is high

Use computer software to obtain the regression and identify R^2, adjusted R^2, and the P–value.

17) An anti–smoking group used data in the table to relate the carbon monoxide of various brands of cigarettes to their tar and nicotine content.

CO	TAR	NICOTINE
15	1.2	16
15	1.2	16
17	1.0	16
6	0.8	9
1	0.1	1
8	0.8	8
10	0.8	10
17	1.0	16
15	1.2	15
11	0.7	9
18	1.4	18
16	1.0	15
10	0.8	9
7	0.5	5
18	1.1	16

A) .976, .921, .002   B) .931, .902, .000   C) .861, .900, .015   D) .943, .934, .000

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Use computer software to obtain the regression equation. If the accompanying statistics confirm use of the equation for prediction, use the estimated equation to find the predicted value; otherwise, explain why the equation should not be used.

18) A study of food consumption in the country related the level of food consumed to an index of food prices and an index of personal disposable income. Next year, the income index number is expected to be 100.2, and the price index is expected to be 108.3. These numbers would indicate a predicted value for food consumption.

FOODCONS	INCOME	PRICE
98.6	87.4	108.5
101.2	97.6	110.1
102.4	96.7	110.4
100.9	98.2	104.3
102.3	99.8	107.2
101.5	100.5	105.8
101.6	103.2	107.8
101.6	107.8	103.4
99.8	96.6	102.7
100.3	88.9	104.1
97.6	75.1	99.2
97.2	76.9	99.7
97.3	84.6	102.0
96.0	90.6	94.3
99.2	103.1	97.7
100.3	105.1	101.1
100.3	96.4	102.3
104.1	104.4	104.4
105.3	110.7	108.5
107.6	127.1	111.3

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Use computer software to find the best regression equation to explain the variation in the dependent variable, Y, in terms of the independent variables, X_1, X_2, X_3.

19)

Y	X_1	X_2	X_3
344	45.0	67.5	1
416	54.0	72.0	1
220	41.0	70.0	2
360	49.0	68.5	1
332	44.0	73.0	1
140	32.0	63.0	2
436	48.0	72.0	1
132	33.0	61.0	2
356	48.0	64.0	2
150	35.0	59.0	1
202	40.0	63.0	2
365	50.0	70.5	1

CORRELATION COEFFICIENTS

$Y / X_1 = .951$
$Y / X_2 = .789$
$Y / X_3 = -.616$

COEFFICIENTS OF DETERMINATION

$Y / X_1 = .905$
$Y / X_1, X_2 = .919$
$Y / X_1, X_2, X_3 = .927$

A) $\hat{Y} = -412 + 13.6 \ X_1 + 3.15 \ X_2$

B) $\hat{Y} = -543 + 12.8 \ X_1 + 4.15 \ X_2$

C) $\hat{Y} = -355 + 14.9 \ X_1$

D) $\hat{Y} = -442 + 12.1 \ X_1 + 3.58 \ X_2 -23.8 \ X_3$

Construct a scatterplot and identify the mathematical model that best fits the data. Assume that the model is to be used only for the scope of the given data and consider only linear, quadratic, logarithmic, exponential, and power models. Use a calculator or computer to obtain the regression equation of the model that best fits the data. You may need to fit several models and compare the values of R^2.

20) The table below shows the population of a city (in millions) in each year during the period 1990 – 1995. Using the number of years since 1990 as the independent variable, find the regression equation of the best model.

x	1990	1991	1992	1993	1994	1995
y	1.08	1.37	1.68	2.19	2.73	3.34

A) $y = 1.27 \ x^{0.550}$

B) $y = 1.08 \ e^{0.228 \ x}$

C) $y = 0.930 + 0.454 \ x$

D) $y = 0.05 \ x^2 + 0.27 \ x + 1.06$

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

1) The symbol ρ represents the population correlation as opposed to the sample correlation r. The null hypothesis means that the population correlation is 0; that is, there is no significant linear correlation between the two variables. The alternative hypothesis states that there is significant linear correlation.

2) The linear regression equation should be used only if the correlation is significant. Provided the correlation is significant, the linear regression equation should be used only when the predicting value x is within the scope of the data used to create the equation.

3) The independent variable is x, representing values we will use for the prediction; the dependent variable is y, representing values we want to predict based on the values of the independent variable. Examples will vary.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

4) C
5) C

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

6) Averages suppress individual variation and tend to inflate the correlation coefficient. The fact that there is significant linear correlation between average SAT scores and average incomes in the district does not necessarily imply that there is significant linear correlation between individual SAT scores and family incomes.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

7) D
8) B
9) B
10) A
11) C
12) B
13) D
14) A
15) C
16) D
17) D

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

18) The regression equation is $\hat{y} = 57.7 + 0.153\ x_1 + 0.270\ x_2$. Since the adjusted coefficient of determination is 85.2% and the P–value is 0.0000, the regression equation can be used for prediction. The predicted food consumption is 102.3.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

19) C
20) B

Elementary Statistics   Chapter 10 Test – Form A

Name:_____ Course Number: _____ Section Number: _____

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Provide an appropriate response.

1) Describe the test of homogeneity. What characteristic distinguishes a test of homogeneity from a test of independence?

2) Define categorical data and give an example.

Perform the indicated goodness–of–fit test.

3) A company manager wishes to test a union leader's claim that absences occur on the different week days with the same frequencies. Test this claim at the 0.05 level of significance if the following sample data have been compiled.

Day	Mon	Tue	Wed	Thur	Fri
Absences	37	15	12	23	43

4) In studying the responses to a multiple–choice test question, the following sample data were obtained. At the 0.05 significance level, test the claim that the responses occur with the same frequency.

Response	A	B	C	D	E
Frequency	12	15	16	18	19

5) Using the data below and a 0.05 significance level, test the claim that the responses occur with percentages of 15%, 20%, 25%, 25%, and 15% respectively.

Response	A	B	C	D	E
Frequency	12	15	16	18	19

Provide an appropriate response.

6) An observed frequency distribution is as follows:

Number of successes	0	1	2
Frequency	47	98	55

i) Assuming a binomial distribution with $n = 2$ and $p = 1/2$, use the binomial formula to find the probability corresponding to each category of the table.
ii) Using the probabilities found in part (i), find the expected frequency for each category.
iii) Use a 0.05 level of significance to test the claim that the observed frequencies fit a binomial distribution for which $n = 2$ and $p = 1/2$.

Elementary Statistics   Chapter 10 Test – Form A

Use a χ^2 test to test the claim that in the given contingency table, the row variable and the column variable are independent.

7) Tests for adverse reactions to a new drug yielded the results given in the table. At the 0.05 significance level, test the claim that the treatment (drug or placebo) is independent of the reaction (whether or not headaches were experienced).

	Drug	Placebo
Headaches	11	7
No headaches	73	91

8) Responses to a survey question are broken down according to employment status and the sample results are given below. At the 0.10 significance level, test the claim that response and employment status are independent.

	Yes	No	Undecided
Employed	30	15	5
Unemployed	20	25	10

Solve the problem.

9) At a high school debate tournament, half of the teams were asked to wear suits and ties and the rest were asked to wear jeans and t–shirts. The results are given in the table below. Test the hypothesis at the 0.05 level that the proportion of wins is the same for teams wearing suits as for teams wearing jeans and t–shirts.

	Win	Loss
Suit	22	28
T–shirt	28	22

Provide an appropriate response.

10) A survey conducted in a small business yielded the results shown in the table.

	Men	Women
Health insurance	39	24
No health insurance	36	22

i) Test the claim that health care coverage is independent of gender. Use a 0.05 significance level.

ii) Using Yates' correction, replace $\sum \frac{(O - E)^2}{E}$ with $\sum \frac{(\mid O - E \mid - 0.5)^2}{E}$ and repeat the test. What effect does Yates' correction have on the value of the test statistic?

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

1) The test of homogeneity tests the claim that different populations have the same proportions of some characteristics. In the test of homogeneity, there are predetermined totals for either the rows or columns of the contingency table. In the test of independence, there is one big sample drawn so that the row and column totals are determined randomly. In the test of homogeneity, predetermined sample sizes are used for each population.

2) Categorical data are data that can be separated into different nonnumeric categories. Examples will vary.

3) H_0: The proportions of absences are all the same, $p = .20$.

   H_1: The proportions of absences are not all the same.

   Test statistic: $\chi^2 = 28.308$. Critical value: $\chi^2 = 9.488$. Reject the null hypothesis. There is sufficient evidence to warrant rejection of the claim that absences occur on the different week days with the same frequency.

4) H_0: The proportions of responses are all equal, $p = .20$.

   H_1: The proportions of responses are not all equal.

   Test statistic: $\chi^2 = 1.875$. Critical value: $\chi^2 = 9.488$. Fail to reject the null hypothesis. There is not sufficient evidence to warrant rejection of the claim that the responses occur with the same frequency.

5) H_0: The responses occur according to the stated percentages.

   H_1: The responses do not occur according to the stated percentages.

   Test statistic: $\chi^2 = 5.146$. Critical value: $\chi^2 = 9.488$. Fail to reject the null hypothesis. There is not sufficient evidence to warrant rejection of the claim that the responses occur according to the stated percentages.

6) i)

Number of successes	0	1	2
Probability	0.25	0.50	0.25

   ii)

Number of successes	0	1	2
Expected frequency	50	100	50

   iii) H_0: $p_0 = 0.25$, $p_1 = 0.50$, $p_3 = 0.25$; H_1: At least one of the above probabilities is different from the claimed value. The value of the test statistic is $\chi^2 = 0.72$, which is less than the critical value of $\chi^2 = 5.991$. We fail to reject the null hypothesis.

7) H_0: Treatment and reaction are independent.

   H_1: Treatment and reaction are dependent.

   Test statistic: $\chi^2 = 1.798$. Critical value: $\chi^2 = 3.841$.
   Fail to reject the null hypothesis. There is not sufficient evidence to warrant rejection of the claim that treatment and reaction are independent.

8) H_0: Employment status and response are independent.

   H_1: Employment status and response are dependent.

   Test statistic: $\chi^2 = 5.942$. Critical value: $\chi^2 = 4.605$.
   Reject the null hypothesis. There is sufficient evidence to warrant rejection of the claim that response and employment status are independent.

9) H_0: The proportion of wins is the same for teams wearing suits as for teams wearing jeans and t–shirts.

   H_1: The proportions are different.

   Test statistic: $\chi^2 = 1.440$. Critical value: $\chi^2 = 3.841$.
   Fail to reject the null hypothesis. There is not sufficient evidence to warrant rejection of the claim that the proportion of wins is the same for teams wearing suits as for teams wearing jeans and t–shirts.

10) i) H_0: Gender is independent of the health care coverage.

H_1: Gender and health care coverage are dependent.

The value of the test statistic is $\chi^2 = 0.000346$, which is less than the critical value of 3.841. We fail to reject the null hypothesis.

ii) The value of the test statistic is $\chi^2 = 0.028510$, which is still less than the critical value of 3.841. We still fail to reject the null hypothesis. Yates' correction typically decreases the value of the test statistic. However, due to the close fit of the O and E values in this problem, the Yates' correction increased the calculated test statistic.

Elementary Statistics   Chapter 10 Test – Form B

Name:_____ Course Number: _____ Section Number: _____

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Provide an appropriate response.

1) Describe a goodness–of–fit test. What assumptions are made when using a goodness–of–fit test?

2) Describe the null hypothesis for the test of independence. List the assumptions for the χ^2 test of independence. What is the major difference between the assumptions for this test and the assumptions for the previous tests we have studied?

Perform the indicated goodness–of–fit test.

3) In studying the occurrence of genetic characteristics, the following sample data were obtained. At the 0.05 significance level, test the claim that the characteristics occur with the same frequency.

Characteristic	A	B	C	D	E	F
Frequency	28	30	45	48	38	39

4) You roll a die 48 times with the following results.

Number	1	2	3	4	5	6
Frequency	2	14	13	3	14	2

Use a significance level of 0.05 to test the claim that the die is fair.

Use a χ^2 test to test the claim that in the given contingency table, the row variable and the column variable are independent.

5) Responses to a survey question are broken down according to gender and the sample results are given below. At the 0.05 significance level, test the claim that response and gender are independent.

	Yes	No	Undecided
Male	25	50	15
Female	20	30	10

6) 160 students who were majoring in either math or English were asked a test question, and the researcher recorded whether they answered the question correctly. The sample results are given below. At the 0.10 significance level, test the claim that response and major are independent.

	Correct	Incorrect
Math	27	53
English	43	37

Provide an appropriate response.

7) An observed frequency distribution of exam scores is as follows:

Exam Score	Under 60	60 – 69	70 – 79	80 – 89	90 – 100
Frequency	36	75	85	70	34

i) Assuming a normal distribution with $\mu = 75$ and $\sigma = 15$, find the probability of a randomly selected subject belonging to each class. (Use boundaries of 59.5, 69.5, 79.5, 89.5.)

ii) Using the probabilities found in part (i), find the expected frequency for each category.

iii) Use a 0.05 significance level to test the claim that the exam scores were randomly selected from a normally distributed population with $\mu = 75$ and $\sigma = 15$.

8) An observed frequency distribution is as follows:

Number of successes	0	1	2
Frequency	41	93	66

i) Assuming a binomial distribution with $n = 2$ and $p = 1/2$, use the binomial formula to find the probability corresponding to each category of the table.

ii) Using the probabilities found in part (i), find the expected frequency for each category.

iii) Use a 0.05 level of significance to test the claim that the observed frequencies fit a binomial distribution for which $n = 2$ and $p = 1/2$.

Solve the problem.

9) A researcher wishes to test the effectiveness of a flu vaccination. 150 people are vaccinated, 180 people are vaccinated with a placebo, and 100 people are not vaccinated. The number in each group who later caught the flu was recorded. The results are shown below.

	Vaccinated	Placebo	Control
Caught the flu	8	19	21
Did not catch the flu	142	161	79

Use a 0.05 significance level to test the claim that the proportion of people catching the flu is the same in all three groups.

Provide an appropriate response.

10) A survey conducted in a small town yielded the results shown in the table.

	Men	Women
Plan to vote	105	87
Do not plan to vote	312	246

i) Test the claim that the intention to vote in the next presidential election is independent of the gender of the person being surveyed. Use a 0.05 significance level.

ii) Using Yates' correction, replace $\sum \frac{(O - E)^2}{E}$ with $\sum \frac{(|O - E| - 0.5)^2}{E}$ and repeat the test. What effect does Yates' correction have on the value of the test statistic?

Answer Key
Testname: ELEMENTARY STATISTICS CHAPTER 10 TEST FORM B

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

1) A goodness–of–fit test is used to test the hypothesis that an observed frequency distribution fits some claimed distribution. The assumptions are 1) the sample data are randomly selected and the data consist of frequency counts for the different categories; and 2) for each of the categories, the expected frequency is at least 5.

2) The null hypothesis is that the row and column variables in a contingency table are independent; that is, they are not related. The assumptions are 1) the null hypothesis is that the row and column variables are independent while the alternate hypothesis is that the row and column variables are dependent; 2) the sample data are randomly selected; and 3) each cell in the contingency table has an expected frequency E of at least 5. The major difference is that these assumptions do not require that the parent population be normally distributed.

3) H_0: The proportions of occurrences are all equal, $p = 1/6$.

   H_1: Those proportions are not all equal.

   Test statistic: $\chi^2 = 8.263$. Critical value: $\chi^2 = 11.071$. Fail to reject the null hypothesis. There is not sufficient evidence to warrant rejection of the claim that the characteristics occur with the same frequency.

4) H_0: The die is fair (all numbers occur with equal frequency).

   H_1: The die is not fair.

   Test statistic: $\chi^2 = 24.25$. Critical value: $\chi^2 = 11.071$. Reject the null hypothesis. There is sufficient evidence to warrant rejection of the claim that the die is fair.

5) H_0: Gender and response are independent.

   H_1: Gender and response are dependent.

   Test statistic: $\chi^2 = 0.579$. Critical value: $\chi^2 = 5.991$.
   Fail to reject the null hypothesis. There is not sufficient evidence to warrant rejection of the claim that response and gender are independent.

6) H_0: Major and response are independent.

   H_1: Major and response are dependent.

   Test statistic: $\chi^2 = 6.502$. Critical value: $\chi^2 = 2.706$.
   Reject the null hypothesis. There is sufficient evidence to warrant rejection of the claim that response and major are independent.

7) i)

Exam Score	Under 60	60 – 69	70 – 79	80 – 89	90 – 100
Probability	0.1515	0.2042	0.2622	0.2161	0.1185

ii)

Exam Score	Under 60	60 – 69	70 – 79	80 – 89	90 – 100
Expected Frequency	45.45	61.26	78.66	64.83	35.55

iii) The value of the test statistic is $\chi^2 = 6.037$, which is less than the critical value of $\chi^2 = 9.488$. We fail to reject the null hypothesis that the exam scores are from a normally distributed population.

8) i)

Number of successes	0	1	2
Probability	0.25	0.50	0.25

ii)

Number of successes	0	1	2
Expected frequency	50	100	50

iii) H_0: $p_0 = 0.25$, $p_1 = 0.50$, $p_3 = 0.25$; H_1: At least one of the above probabilities is different from the claimed value. The value of the test statistic is $\chi^2 = 7.23$, which is greater than the critical value of $\chi^2 = 5.991$. We reject the null hypothesis.

9) H_0: The proportion of people catching the flu is the same in all three groups.

   H_1: The proportions are different.

   Test statistic: $\chi^2 = 14.965$. Critical value: $\chi^2 = 5.991$.
   Reject the null hypothesis. There is sufficient evidence to warrant rejection of the claim that the proportion of people catching the flu is the same in all three groups.

10) i) H_0: Gender is independent of the intention to vote.

   H_1: Gender and the intention to vote are dependent.

   The value of the test statistic is $\chi^2 = 0.087$, which is less than the critical value of 3.841. We fail to reject the null hypothesis.

   ii) The value of the test statistic is $\chi^2 = 0.044$, which is less than the critical value of 3.841. We still fail to reject the null hypothesis. Yates' correction decreases the value of the test statistic.

Elementary Statistics   Chapter 10 Test – Form C

Name:_____ Course Number: _____ Section Number: _____

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Provide an appropriate response.

1) In the chi–square test of independence, the formula used is $\chi^2 = \dfrac{\Sigma(O - E)^2}{E}$. Discuss the meaning

   of O and E and explain the circumstances under which the χ^2 values will be smaller or larger. What is the relationship between a significant χ^2 value and the values of O and E?

2) Explain the computation of expected values for contingency tables in terms of probabilities. Refer to the assumptions of the null hypothesis as part of your explanation. You might give a brief example to illustrate.

3) Draw an example of a representative chi–square distribution and discuss three characteristics of a chi–square distribution. Show an example of the special case of the chi–square distribution for only 1 or 2 degrees of freedom.

Perform the indicated goodness–of–fit test.

4) Among the four northwestern states, Washington has 51% of the total population, Oregon has 30%, Idaho has 11%, and Montana has 8%. A market researcher selects a sample of 1000 subjects, with 450 in Washington, 340 in Oregon, 150 in Idaho, and 60 in Montana. At the 0.05 significance level, test the claim that the sample of 1000 subjects has a distribution that agrees with the distribution of state populations.

Provide an appropriate response.

5) An observed frequency distribution of exam scores is as follows:

Exam Score	Under 60	60 – 69	70 – 79	80 – 89	90 – 100
Frequency	30	30	140	60	40

   i) Assuming a normal distribution with $\mu = 75$ and $\sigma = 15$, find the probability of a randomly selected subject belonging to each class. (Use boundaries of 59.5, 69.5, 79.5, 89.5.)
   ii) Using the probabilities found in part (i), find the expected frequency for each category.
   iii) Use a 0.05 significance level to test the claim that the exam scores were randomly selected from a normally distributed population with $\mu = 75$ and $\sigma = 15$.

6) The following table shows the number of employees who called in sick at a business for different days of a particular week.

Day	Sun	Mon	Tues	Wed	Thurs	Fri	Sat
Number sick	8	12	7	11	9	11	12

   i) At the 0.05 level of significance, test the claim that sick days occur with equal frequency on the different days of the week.
   ii) Test the claim after changing the frequency for Saturday to 152. Describe the effect of this outlier on the test.

Use a χ^2 test to test the claim that in the given contingency table, the row variable and the column variable are independent.

7) Use the sample data below to test whether car color affects the likelihood of being in an accident. Use a significance level of 0.01.

	Red	Blue	White
Car has been in accident	28	33	36
Car has not been in accident	23	22	30

8) The table below shows the age and favorite type of music of 668 randomly selected people.

	Rock	Pop	Classical
15–25	50	85	73
25–35	68	91	60
35–45	90	74	77

Use a 5 percent level of significance to test the null hypothesis that age and preferred music type are independent.

Solve the problem.

9) Use a 0.01 significance level to test the claim that the proportion of men who plan to vote in the next election is the same as the proportion of women who plan to vote. 300 men and 300 women were randomly selected and asked whether they planned to vote in the next election. The results are shown below.

	Men	Women
Plan to vote	170	185
Do not plan to vote	130	115

10) A researcher wishes to test whether the proportion of college students who smoke is the same in four different colleges. She randomly selects 100 students from each college and records the number that smoke. The results are shown below.

	College A	College B	College C	College D
Smoke	17	26	11	34
Don't smoke	83	74	89	66

Use a 0.01 significance level to test the claim that the proportion of students smoking is the same at all four colleges.

SHORT ANSWER. **Write the word or phrase that best completes each statement or answers the question.**

1) The O represents the observed frequencies. The E represents the expected frequencies based on the assumption of independence. The χ^2 value will be smaller when the difference between observed and expected frequencies is small and will be larger when the difference between observed and expected values is large. The χ^2 value will be significant when there is a significant difference between the observed and expected values.

2) Suppose A and B are two categories in a contingency table. In probability computations, the P(A and B) would be computed as P(A)•P(B), provided A and B are independent. The assumption of the null hypothesis is that A and B are in fact independent, so we use the formula P(A and B) = P(A)•P(B).

Since $P(A) = \dfrac{\text{\# occurrences A}}{\text{total occurrences}}$ and $P(B) = \dfrac{\text{\# occurrences B}}{\text{total occurrences}}$, then

$P(A \text{ and } B) = \dfrac{\text{\# occurrences A}}{\text{total occurrences}} \cdot \dfrac{\text{\# occurrences B}}{\text{total occurrences}}$.

Then the expected number of outcomes for A and B would be

P(A and B) • total occurrences

$= \dfrac{\text{\# occurrences A}}{\text{total occurrences}} \cdot \dfrac{\text{\# occurrences B}}{\text{total occurrences}} \cdot \text{total occurrences}$.

or P(A and B) • total occurrences

$= \dfrac{\text{\# occurrences A} \cdot \text{\# occurrences B}}{\text{total occurrences}}$

This is also the formula for the expected frequency for each cell in a contingency table,

$E = \dfrac{\text{\# occurrences A} \cdot \text{\# occurrences B}}{\text{total occurrences}}$.

So the computation of the expected values is based on the assumption of independence. Examples may be given and will vary.

3) Any drawing such as that shown in Figure 10–1 will suffice. The chi–square distribution is not symmetric. The values of a chi–square distribution can be 0 or positive, but they cannot be negative. The chi–square distribution is different for each number of degrees of freedom. Examples will vary. Possibilities are a 2 x 2 contingency table for one degree of freedom and a goodness–of–fit test of three categories for two degrees of freedom.

4) H_0: The distribution of the sample agrees with the population distribution.

H_1: It does not agree.

Test statistic: $\chi^2 = 31.938$. Critical value: $\chi^2 = 7.815$. Reject the null hypothesis. There is sufficient evidence to warrant rejection of the claim that the distribution of the sample agrees with the distribution of the state populations.

5) i)

Exam Score	Under 60	60 – 69	70 – 79	80 – 89	90 – 100
Probability	0.1515	0.2042	0.2622	0.2161	0.1185

ii)

Exam Score	Under 60	60 – 69	70 – 79	80 – 89	90 – 100
Expected Frequency	45.45	61.26	78.66	64.83	35.55

iii) The value of the test statistic is $\chi^2 = 69.954$, which is greater than the critical value of $\chi^2 = 9.488$. We reject the null hypothesis that the exam scores are from a normally distributed population.

6) i) H_0: $p_0 = p_1 = \ldots = p_7 = 1/7$. H_1: At least one of these probabilities is different from the others. The value of the test statistic is $\chi^2 = 2.4$, which is less than the critical value of $\chi^2 = 12.59$. We fail to reject the null hypothesis.

ii) The value of the test statistic is $\chi^2 = 579.5$, which is greater than the critical value of $\chi^2 = 12.59$. We reject the null hypothesis. An outlier has a significant effect on the χ^2 test statistic.

7) H_0: Car color and being in an accident are independent.

H_1: Car color and being in an accident are dependent.

Test statistic: $\chi^2 = 0.4287$. Critical value: $\chi^2 = 9.210$.
Fail to reject the null hypothesis. There is not sufficient evidence to warrant rejection of the claim that car color and being in an accident are independent.

8) H_0: Age and preferred music type are independent.

H_1: Age and preferred music type are dependent.

Test statistic: $\chi^2 = 12.954$. Critical value: $\chi^2 = 9.488$.
Reject the null hypothesis. There is sufficient evidence to warrant rejection of the claim that age and preferred music type are independent.

9) H_0: The proportion of men who plan to vote in the next election is the same as the proportion of women who plan to vote.

H_1: The proportions are different.

Test statistic: $\chi^2 = 1.552$. Critical value: $\chi^2 = 6.635$.
Fail to reject the null hypothesis. There is not sufficient evidence to warrant rejection of the claim that the proportion of men who plan to vote in the next election is the same as the proportion of women who plan to vote.

10) H_0: The proportion of students smoking is the same at all four colleges.

H_1: The proportions are different.

Test statistic: $\chi^2 = 17.832$. Critical value: $\chi^2 = 11.345$.
Reject the null hypothesis. There is sufficient evidence to warrant rejection of the claim that the proportion of students smoking is the same at all four colleges.

Elementary Statistics   Chapter 11 Test – Form A

Name:_____ Course Number: _____ Section Number: _____

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Provide an appropriate response.

1) Describe the null and alternative hypotheses for one–way ANOVA. Give an example.

2) When using statistical software packages, the critical value is typically not given. What method is used to determine whether you reject or fail to reject the null hypothesis?

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Given below are the analysis of variance results from a Minitab display. Assume that you want to use a 0.05 significance level in testing the null hypothesis that the different samples come from populations with the same mean.

3)
Source	DF	SS	MS	F	p
Factor	3	13.500	4.500	5.17	0.011
Error	16	13.925	0.870		
Total	19	27.425			

Identify the value of the test statistic.

A) 13.500   B) 5.17   C) 4.500   D) 0.011

4)
Source	DF	SS	MS	F	p
Factor	3	13.500	4.500	5.17	0.011
Error	16	13.925	0.870		
Total	19	27.425			

What can you conclude about the equality of the population means?

A) Accept the null hypothesis since the p–value is less than the significance level.

B) Accept the null hypothesis since the p–value is greater than the significance level.

C) Reject the null hypothesis since the p–value is greater than the significance level.

D) Reject the null hypothesis since the p–value is less than the significance level.

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Test the claim that the samples come from populations with the same mean. Assume that the populations are normally distributed with the same variance.

5) Given the sample data below, test the claim that the populations have the same mean. Use a significance level of 0.05.

Brand A	Brand B	Brand C
$n = 10$	$n = 10$	$n = 10$
$\bar{x} = 31.1$	$\bar{x} = 31.8$	$\bar{x} = 27.3$
$s^2 = 4.29$	$s^2 = 4.84$	$s^2 = 3.73$

6) At the 0.025 significance level, test the claim that the four brands have the same mean if the following sample results have been obtained.

Brand A	Brand B	Brand C	Brand D
17	18	21	22
20	18	24	25
21	23	25	27
22	25	26	29
21	26	29	35
		29	36
			37

Provide an appropriate response.

7) Four independent samples of 100 values each are randomly drawn from populations that are normally distributed with equal variances. You wish to test the claim that $\mu_1 = \mu_2 = \mu_3 = \mu_4$.

i)   If you test the individual claims $\mu_1 = \mu_2$, $\mu_1 = \mu_3$, $\mu_1 = \mu_4$, . . . , $\mu_3 = \mu_4$, how many ways can you pair off the 4 means?

ii)   Assume that the tests are independent and that for each test of equality between two means, there is a 0.99 probability of not making a type I error. If all possible pairs of means are tested for equality, what is the probability of making no type I errors?

iii) If you use analysis of variance to test the claim that $\mu_1 = \mu_2 = \mu_3 = \mu_4$ at the 0.01 level of significance, what is the probability of not making a type I error?

8) At the same time each day, a researcher records the temperature in each of three greenhouses. The table shows the temperatures in degrees Fahrenheit recorded for one week.

Greenhouse #1	Greenhouse #2	Greenhouse #3
73	71	67
72	69	63
73	72	62
66	72	61
68	65	60
71	73	62
72	71	59

i) Use a 0.05 significance level to test the claim that the average temperature is the same in each greenhouse.

ii) How are the analysis of variance results affected if 8° is added to each temperature listed for greenhouse #3?

Use the Minitab display to test the indicated claim.

9) A manager records the production output of three employees who each work on three different machines for three different days. The sample results are given below and the Minitab results follow.

<table>
<tr><td></td><td></td><td colspan="3">Employee</td></tr>
<tr><td></td><td></td><td>A</td><td>B</td><td>C</td></tr>
<tr><td></td><td>I</td><td>23, 27, 29</td><td>30, 27, 25</td><td>18, 20, 22</td></tr>
<tr><td>Machine</td><td>II</td><td>25, 26, 24</td><td>24, 29, 26</td><td>19, 16, 14</td></tr>
<tr><td></td><td>III</td><td>28, 25, 26</td><td>25, 27, 23</td><td>15, 11, 17</td></tr>
</table>

ANALYSIS OF VARIANCE ITEMS

SOURCE	DF	SS	MS
MACHINE	2	34.67	17.33
EMPLOYEE	2	504.67	252.33
INTERACTION	4	26.67	6.67
ERROR	18	98.00	5.44
TOTAL	26	664.00	

Using a 0.05 significance level, test the claim that the interaction between employee and machine has no effect on the number of items produced.

10) A manager records the production output of three employees who each work on three different machines for three different days. The sample results are given below and the Minitab results follow.

<table>
<tr><td></td><td></td><td colspan="3">Employee</td></tr>
<tr><td></td><td></td><td>A</td><td>B</td><td>C</td></tr>
<tr><td></td><td>I</td><td>16, 18, 19</td><td>15, 17, 20</td><td>14, 18, 16</td></tr>
<tr><td>Machine</td><td>II</td><td>20, 27, 29</td><td>25, 28, 27</td><td>29, 28, 26</td></tr>
<tr><td></td><td>III</td><td>15, 18, 17</td><td>16, 16, 19</td><td>13, 17, 16</td></tr>
</table>

ANALYSIS OF VARIANCE ITEMS

SOURCE	DF	SS	MS
MACHINE	2	588.74	294.37
EMPLOYEE	2	2.07	1.04
INTERACTION	4	15.48	3.87
ERROR	18	98.67	5.48
TOTAL	26	704.96	

Assume that the number of items produced is not affected by an interaction between employee and machine. Using a 0.05 significance level, test the claim that the machine has no effect on the number of items produced.

11) A manager records the production output of three employees who each work on three different machines for three different days. The sample results are given below and the Minitab results follow.

		Employee		
		A	B	C
	I	31, 34, 32	29, 23, 22	21, 20, 24
Machine	II	19, 26, 22	35, 33, 30	25, 19, 23
	III	21, 18, 26	20, 23, 24	36, 37, 31

ANALYSIS OF VARIANCE ITEMS

SOURCE	DF	SS	MS
MACHINE	2	1.19	.59
EMPLOYEE	2	5.85	2.93
INTERACTION	4	710.81	177.70
ERROR	18	160.00	8.89
TOTAL	26	877.85	

Assume that the number of items produced is not affected by an interaction between employee and machine. Using a 0.05 significance level, test the claim that the choice of employee has no effect on the number of items produced.

Use the data in the given table and the corresponding Minitab display to test the hypothesis.

12) The following table entries are the times in seconds for three different drivers racing on four different tracks. Assuming no effect from the interaction between driver and track, test the claim that the three drivers have the same mean time. Use a 0.05 significance level.

	Track 1	Track 2	Track 3	Track 4
Driver 1	72	70	68	71
Driver 2	74	71	66	72
Driver 3	76	69	64	70

Source	DF	SS	MS	F	p
Driver	2	2	1	0.33	0.729
Track	3	98.25	32.75	10.92	0.00763
Error	6	18	3		
Total	11	118.25			

13) The following minitab display results from a study in which three different teachers taught calculus classes of five different sizes. The class average was recorded for each class. Assuming no effect from the interaction between teacher and class size, test the claim that the teacher has no effect on the class average. Use a 0.05 significance level.

Source	DF	SS	MS	F	p
Teacher	2	56.93	28.47	1.018	0.404
Class Size	4	672.67	168.17	6.013	0.016
Error	8	223.73	27.97		
Total	14	953.33			

Provide an appropriate response.

14) The following results are from a statistics package in which all of the F values and P–values are given. Is there a significant effect from the interaction? Should you test to see if there is a significant effect due to either A or B? If the answer is yes, is there a significant effect due to either A or B?

ANOVA Table

Source	DF	Sum squares	Mean square	F test	P–value
A	2	415.87305	207.93652	1.88259	.1637
B	3	2997.47186	999.15729	9.04603	.0001
Interaction	6	707.26626	117.87771	1.06723	.3958
Error	46	5080.81667	110.45254		
Total	57	9201.42784			

15) The following data shows annual income, in thousands of dollars, categorized according to the two factors of gender and level of education. Assume that incomes are not affected by an interaction between gender and level of education, and test the null hypothesis that gender has no effect on income. Use a 0.05 significance level.

	Female	Male
High school	23, 27, 24, 26	25, 26, 22, 24
College	28, 36, 31, 33	35, 32, 39, 28
Advanced degree	41, 38, 43, 49	35, 50, 47, 44

16) The following data contains task completion times, in minutes, categorized according to the gender of the machine operator and the machine used.

	Male	Female
Machine 1	15, 17	16, 17
Machine 2	14, 13	15, 13
Machine 3	16, 18	17, 19

Assume that two–way ANOVA is used to analyze the data. How are the ANOVA results affected if 5 minutes is added to each completion time?

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

1) The null hypothesis for one-way ANOVA is that three or more means are equal. The alternative hypothesis is that the means are not all equal. Examples will vary.

2) The decision to reject or fail to reject is based on P-values. If the P-value is less than or equal to the significance level, you reject the null hypothesis. Otherwise you fail to reject.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

3) B

4) D

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

5) Test statistic: $F = 13.678$. Critical value: $F = 3.35$.
   Reject the claim of equal means. The different brands do not appear to have the same mean.

6) $H_0 : \mu1 = \mu2 = \mu3 = \mu4$. H_1 : The means are not all equal.

   Test statistic: $F = 6.6983$. Critical value: $F = 3.9034$.
   Reject the null hypothesis. There is sufficient evidence to warrant rejection of the claim that the four brands have the same mean.

7) i)   6

   ii) $0.99^6 = 0.9415$

   iii) 0.99

8) i) Reject the claim that the average temperature is the same in each greenhouse since
   $F = 24.3 > F_{0.05}(2, 18) = 3.55$.

   ii) Accept the claim that the average temperature is the same in each greenhouse since
   $F = 0.128 < F_{0.05}(2, 18) = 3.55$.

9) H_0: There is no interaction effect.

   H_1: There is an interaction effect.

   Test statistic: $F = 1.2261$. Critical value: $F = 2.9277$.
   Fail to reject the null hypothesis. There does not appear to be an interaction effect.

10) H_0: There is no machine effect.

    H_1: There is a machine effect.

    Test statistic: $F = 53.7172$. Critical value: $F = 3.5546$.
    Reject the null hypothesis. There does appear to be a machine effect.

11) H_0: There is no employee effect.

    H_1: There is an employee effect.

    Test statistic: $F = 0.3296$. Critical value: $F = 3.5546$.
    Fail to reject the null hypothesis. There does not appear to be an employee effect.

12) H_0: There is no driver effect. H_1: There is a driver effect. The P-value is 0.729, which is greater than 0.05. We fail to reject the null hypothesis; it appears that the driver does not affect the racing times.

13) H_0: There is no teacher effect. H_1: There is a teacher effect. The P-value is 0.404, which is greater than 0.05. We fail to reject the null hypothesis; it appears that the teacher does not affect the class average.

14) Since $P = 0.3958$ for the interaction, you fail to reject the null hypothesis that there is no effect due to the interaction. Yes, it is appropriate to see if there is a significant effect due to either A or B. The P-value for B is $P = 0.0001$, which rejects the null hypothesis that there is no effect due to B. The means for B are not all the same.

15) H_0: Gender has no effect on income. H_1: Gender has an effect on income. The test statistic is
$F = 0.155591$, and the corresponding P-value is 0.697883. Because the P-value is greater than 0.05, we
fail to reject the null hypothesis that gender has no effect on income.

16) The ANOVA results are not affected by adding 5 minutes to each completion time.
The null hypothesis of no interaction between machine and gender is not rejected since the P-value is
0.946. The null hypothesis of no effect from machine is rejected since the P-value is 0.013. The null
hypothesis of no effect from gender is not rejected since the P-value is 0.382.

Elementary Statistics   Chapter 11 Test – Form B

Name:_____ Course Number: _____ Section Number: _____

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Provide an appropriate response.

1) Suppose you are to test for equality of four different means, with $H_0 : \mu_A = \mu_B = \mu_C = \mu_D$. Write the hypotheses for the paired tests. Use methods of probability to explain why the process of ANOVA has a higher degree of confidence than testing each of the pairs separately.

2) Define the term "treatment". What other term means the same thing? Give an example.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

3) Fill in the missing entries in the following partially completed one–way ANOVA table.

Source	df	SS	MS=SS/df	F-statistic
Treatment	3			11.17
Error		13.72	0.686	
Total				

A)

Source	df	SS	MS=SS/df	F-statistic
Treatment	3	2.55	7.66	11.17
Error	20	13.72	0.686	
Total	23	16.27		

B)

Source	df	SS	MS=SS/df	F-statistic
Treatment	3	0.184	0.061	11.17
Error	20	13.72	0.686	
Total	23	13.90		

C)

Source	df	SS	MS=SS/df	F-statistic
Treatment	3	22.97	7.66	11.17
Error	20	13.72	0.686	
Total	23	36.69		

D)

Source	df	SS	MS=SS/df	F-statistic
Treatment	3	48.80	16.27	11.17
Error	20	13.72	0.686	
Total	23	62.52		

Given below are the analysis of variance results from a Minitab display. Assume that you want to use a 0.05 significance level in testing the null hypothesis that the different samples come from populations with the same mean.

4)
Source	DF	SS	MS	F	p
Factor	3	13.500	4.500	5.17	0.011
Error	16	13.925	0.870		
Total	19	27.425			

Identify the p-value.

A) 5.17   B) 4.500   C) 0.870   D) 0.011

5)
Source	DF	SS	MS	F	p
Factor	3	30	10.00	1.6	0.264
Error	8	50	6.25		
Total	11	80			

What can you conclude about the equality of the population means?

A) Reject the null hypothesis since the p-value is greater than the significance level.

B) Accept the null hypothesis since the p-value is less than the significance level.

C) Accept the null hypothesis since the p-value is greater than the significance level.

D) Reject the null hypothesis since the p-value is less than the significance level.

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Test the claim that the samples come from populations with the same mean. Assume that the populations are normally distributed with the same variance.

6) A consumer magazine wants to compare the lifetimes of ballpoint pens of three different types. The magazine takes a random sample of pens of each type. Results are shown in the following table.

Brand 1	Brand 2	Brand 3
260	181	238
218	240	257
184	162	241
219	218	213

Do the data indicate that there is a difference in mean lifetime for the three brands of ballpoint pens? Use $\alpha = 0.01$.

7) At the 0.025 significance level, test the claim that the four brands have the same mean if the following sample results have been obtained.

Brand A	Brand B	Brand C	Brand D
15	20	21	15
25	17	22	15
21	22	20	14
23	23	19	23
22		18	22
20			28
			28

Provide an appropriate response.

8) At the same time each day, a researcher records the temperature in each of three greenhouses. The table shows the temperatures in degrees Fahrenheit recorded for one week.

Greenhouse #1	Greenhouse #2	Greenhouse #3
73	71	67
72	69	63
73	72	62
66	72	61
68	65	60
71	73	62
72	71	59

i) Use a 0.025 significance level to test the claim that the average temperature is the same in each greenhouse.

ii) How are the analysis of variance results affected if the same constant is added to every one of the original sample values?

Use the Minitab display to test the indicated claim.

9) A manager records the production output of three employees who each work on three different machines for three different days. The sample results are given below and the Minitab results follow.

		Employee		
		A	B	C
	I	16, 18, 19	15, 17, 20	14, 18, 16
Machine	II	20, 27, 29	25, 28, 27	29, 28, 26
	III	15, 18, 17	16, 16, 19	13, 17, 16

ANALYSIS OF VARIANCE ITEMS

SOURCE	DF	SS	MS
MACHINE	2	588.74	294.37
EMPLOYEE	2	2.07	1.04
INTERACTION	4	15.48	3.87
ERROR	18	98.67	5.48
TOTAL	26	704.96	

Assume that the number of items produced is not affected by an interaction between employee and machine. Using a 0.05 significance level, test the claim that the choice of employee has no effect on the number of items produced.

10) A manager records the production output of three employees who each work on three different machines for three different days. The sample results are given below and the Minitab results follow.

		Employee		
		A	B	C
	I	16, 18, 19	15, 17, 20	14, 18, 16
Machine	II	20, 27, 29	25, 28, 27	29, 28, 26
	III	15, 18, 17	16, 16, 19	13, 17, 16

ANALYSIS OF VARIANCE ITEMS

SOURCE	DF	SS	MS
MACHINE	2	588.74	294.37
EMPLOYEE	2	2.07	1.04
INTERACTION	4	15.48	3.87
ERROR	18	98.67	5.48
TOTAL	26	704.96	

Using a 0.05 significance level, test the claim that the interaction between employee and machine has no effect on the number of items produced.

11) A manager records the production output of three employees who each work on three different machines for three different days. The sample results are given below and the Minitab results follow.

		Employee		
		A	B	C
	I	31, 34, 32	29, 23, 22	21, 20, 24
Machine	II	19, 26, 22	35, 33, 30	25, 19, 23
	III	21, 18, 26	20, 23, 24	36, 37, 31

ANALYSIS OF VARIANCE ITEMS

SOURCE	DF	SS	MS
MACHINE	2	1.19	.59
EMPLOYEE	2	5.85	2.93
INTERACTION	4	710.81	177.70
ERROR	18	160.00	8.89
TOTAL	26	877.85	

Assume that the number of items produced is not affected by an interaction between employee and machine. Using a 0.05 significance level, test the claim that the machine has no effect on the number of items produced.

Use the data in the given table and the corresponding Minitab display to test the hypothesis.

12) The following table entries are the times in seconds for three different drivers racing on four different tracks. Assuming no effect from the interaction between driver and track, test the claim that the track has no effect on the time. Use a 0.05 significance level.

	Track 1	Track 2	Track 3	Track 4
Driver 1	72	70	68	71
Driver 2	74	71	66	72
Driver 3	76	69	64	70

Source	DF	SS	MS	F	p
Driver	2	2	1	0.33	0.729
Track	3	98.25	32.75	10.92	0.00763
Error	6	18	3		
Total	11	118.25			

13) The following table entries are test scores for males and females at different times of day. Assuming no effect from the interaction between gender and test time, test the claim that time of day does not affect test scores. Use a 0.05 significance level.

	6 a.m. – 9 a.m.	9 a.m. – 12 p.m.	12 p.m. – 3 p.m.	3 p.m. – 6 p.m.
Male	87	89	92	85
Female	72	84	94	89

Source	DF	SS	MS	F	p
Gender	1	24.5	24.5	0.6652	0.4745
Time	3	183	61	1.6561	0.3444
Error	3	110.5	36.83		
Total	7	318			

Provide an appropriate response.

14) The following results are from a statistics software package in which all of the F values and P-values are given. Is there a significant effect from the interaction? Should you test to see if there is a significant effect due to either A or B? If the answer is yes, is there a significant effect due to either A or B?

ANOVA Table

Source	DF	Sum squares	Mean square	F test	P-value
A	2	164.020	82.010	25.010	<.0001
B	4	230.786	57.697	18.002	<.0001
Interaction	8	80.879	10.110	3.154	.0031
Error	101	323.708	3.205		
Total	115	799.393			

15) The following data show annual income, in thousands of dollars, categorized according to the two factors of gender and level of education. Test the null hypothesis of no interaction between gender and level of education at a significance level of 0.05.

	Female	Male
High school	23, 27, 24, 26	25, 26, 22, 24
College	28, 36, 31, 33	35, 32, 39, 28
Advanced degree	41, 38, 43, 49	35, 50, 47, 44

16) The following data contains task completion times, in minutes, categorized according to the gender of the machine operator and the machine used.

	Male	Female
Machine 1	15, 17	16, 17
Machine 2	14, 13	15, 13
Machine 3	16, 18	17, 19

Assume that two–way ANOVA is used to analyze the data. How are the ANOVA results affected if the first sample value in the first cell is changed to 30 minutes?

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

1) The six paired hypotheses are $\mu_A = \mu_B$, $\mu_A = \mu_C$, $\mu_A = \mu_D$, $\mu_B = \mu_C$, $\mu_B = \mu_D$, $\mu_C = \mu_D$. Suppose we test each with a 5% significance level (95% confidence level). Then, the degree of confidence for all six would be 0.95^6 or 0.735, yielding an excessively high risk of a type I error. ANOVA maintains the 5% significance level while testing equivalence of all four means.

2) A treatment (also known as a factor) is a property or characteristic that allows us to distinguish the different populations from one another. Examples will vary.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

3) C

4) D

5) C

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

6) Test statistic: $F = 1.620$. Critical value: $F = 8.0215$.
   Fail to reject the claim of equal means. The data do not provide sufficient evidence to conclude that there is a difference in the mean lifetime of the three brands of ballpoint pen.

7) $H_0 : \mu_1 = \mu_2 = \mu_3 = \mu_4$. H_1 : The means are not all equal.
   Test statistic: $F = 0.0555$. Critical value: $F = 3.9539$.
   Fail to reject the null hypothesis. There is not sufficient evidence to warrant rejection of the claim that the four brands have the same mean.

8) i) Reject the claim that the average temperature is the same in each greenhouse since
   $F = 24.3 > F_{0.025}(2, 18) = 4.5597$.
   ii) The analysis of variance results are not affected.

9) H_0: There is no employee effect.
   H_1: There is an employee effect.
   Test statistic: $F = 0.1898$. Critical value: $F = 3.5546$.
   Fail to reject the null hypothesis. There does not appear to be an employee effect.

10) H_0: There is no interaction effect.
    H_1: There is an interaction effect.
    Test statistic: $F = 0.7062$. Critical value: $F = 2.9277$.
    Fail to reject the null hypothesis. There does not appear to be an interaction effect.

11) H_0: There is no machine effect.
    H_1: There is a machine effect.
    Test statistic: $F = 0.0664$. Critical value: $F = 3.5546$.
    Fail to reject the null hypothesis. The type of machine does not appear to have an effect on the number of items produced.

12) H_0: There is no track effect. H_1: There is a track effect. The P-value is 0.00763, which is less than 0.05. We reject the null hypothesis; it appears that the track does effect the racing times.

13) H_0: There is no effect due to the time of day. H_1: There is an effect due to the time of day. The P-value is 0.3444, which is greater than 0.05. We fail to reject the null hypothesis; it appears that the scores are not affected by time of day.

14) Since $P = 0.0031$ for the interaction, you reject the null hypothesis that there is no effect due to the interaction. No, it is not appropriate to see if there is a significant effect due to either A or B. Do not consider the effects of either factor without considering the effects of the other.

15) H_0: There is no interaction between gender and level of education. H_1: There is an interaction between gender and level of education. The test statistic is $F = 0.177472$, and the corresponding P–value is 0.838832. Because the P–value is greater than 0.05, we fail to reject the null hypothesis of no interaction between gender and level of education.

16) If the first sample value is changed to 30 minutes, the ANOVA results are changed. The null hypothesis of no interaction between machine and gender is still not rejected. The null hypothesis of no effect from gender is still not rejected. However, the null hypothesis of no effect from machine is now accepted instead of rejected.
Before the change, the F test statistic = 9.7222. After the change, the F statistic = 2.5956. The F critical value at (2,6), $\alpha = 0.05$ is 5.1433.

Elementary Statistics   Chapter 11 Test – Form C

Name:_____ Course Number: _____ Section Number: _____

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Provide an appropriate response.

1) List the assumptions for testing hypotheses that three or more means are equivalent.

2) The test statistic for one-way ANOVA is $F = \frac{variance\ between\ samples}{variance\ within\ samples}$. Describe variance within

samples and variance between samples. What relationship between variance within samples and variance between samples would result in the conclusion that the value of F is significant?

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Given below are the analysis of variance results from a Minitab display. Assume that you want to use a 0.05 significance level in testing the null hypothesis that the different samples come from populations with the same mean.

3)
Source	DF	SS	MS	F	p
Factor	3	30	10.00	1.6	0.264
Error	8	50	6.25		
Total	11	80			

Find the critical value.

A) 7.59   B) 8.85   C) 1.6   D) 4.07

4)
Source	DF	SS	MS	F	p
Factor	3	30	10.00	1.6	0.264
Error	8	50	6.25		
Total	11	80			

Identify the p-value.

A) 1.6   B) 10.00   C) 6.25   D) 0.264

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Test the claim that the samples come from populations with the same mean. Assume that the populations are normally distributed with the same variance.

5) The data below represent the weight losses for people on three different exercise programs.

Exercise A	Exercise B	Exercise C
2.5	5.8	4.3
8.8	4.9	6.2
7.3	1.1	5.8
9.8	7.8	8.1
5.1	1.2	7.9

At the 1% significance level, does it appear that a difference exists in the true mean weight loss produced by the three exercise programs?

6) At the 0.025 significance level, test the claim that the three brands have the same mean if the following sample results have been obtained.

Brand A	Brand B	Brand C
32	27	22
34	24	25
37	33	32
33	30	22
36		21
39		

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Provide an appropriate response.

7) Fill in the missing entries in the following partially completed one–way ANOVA table.

Source	df	SS	MS=SS/df	F-statistic
Treatment		21.1		
Error	20		3.1	
Total	25			

A)

Source	df	SS	MS=SS/df	F-statistic
Treatment	5	21.1	4.22	1.36
Error	20	62.0	3.1	
Total	25	83.1		

B)

Source	df	SS	MS=SS/df	F-statistic
Treatment	45	21.1	0.47	306.29
Error	20	62.0	3.1	
Total	25	83.1		

C)

Source	df	SS	MS=SS/df	F-statistic
Treatment	5	21.1	4.22	0.73
Error	20	62.0	3.1	
Total	25	83.1		

D)

Source	df	SS	MS=SS/df	F-statistic
Treatment	5	21.1	4.22	1.36
Error	20	62.0	3.1	
Total	25	21.26		

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

8) Use the data given below to verify that the t test for independent samples and the ANOVA method are equivalent.

A	B
85	74
81	72
73	65
91	83
64	59

i) Use a t test with a 0.05 significance level to test the claim that the two samples come from populations with the same means.
ii) Use the ANOVA method with a 0.05 significance level to test the same claim.
iii) Verify that the squares of the t test statistic and the critical value are equal to the F test statistic and critical value.

Use the Minitab display to test the indicated claim.

9) A manager records the production output of three employees who each work on three different machines for three different days. The sample results are given below and the Minitab results follow.

```
                         Employee
                 A            B            C
          I   23, 27, 29   30, 27, 25   18, 20, 22
Machine  II   25, 26, 24   24, 29, 26   19, 16, 14
         III  28, 25, 26   25, 27, 23   15, 11, 17
```

ANALYSIS OF VARIANCE ITEMS

SOURCE	DF	SS	MS
MACHINE	2	34.67	17.33
EMPLOYEE	2	504.67	252.33
INTERACTION	4	26.67	6.67
ERROR	18	98.00	5.44
TOTAL	26	664.00	

Assume that the number of items produced is not affected by an interaction between employee and machine. Using a 0.05 significance level, test the claim that the choice of employee has no effect on the number of items produced.

10) A manager records the production output of three employees who each work on three different machines for three different days. The sample results are given below and the Minitab results follow.

		Employee		
		A	B	C
	I	23, 27, 29	30, 27, 25	18, 20, 22
Machine	II	25, 26, 24	24, 29, 26	19, 16, 14
	III	28, 25, 26	25, 27, 23	15, 11, 17

ANALYSIS OF VARIANCE ITEMS

SOURCE	DF	SS	MS
MACHINE	2	34.67	17.33
EMPLOYEE	2	504.67	252.33
INTERACTION	4	26.67	6.67
ERROR	18	98.00	5.44
TOTAL	26	664.00	

Assume that the number of items produced is not affected by an interaction between employee and machine. Using a 0.05 significance level, test the claim that the machine has no effect on the number of items produced.

11) A manager records the production output of three employees who each work on three different machines for three different days. The sample results are given below and the Minitab results follow.

		Employee		
		A	B	C
	I	31, 34, 32	29, 23, 22	21, 20, 24
Machine	II	19, 26, 22	35, 33, 30	25, 19, 23
	III	21, 18, 26	20, 23, 24	36, 37, 31

ANALYSIS OF VARIANCE ITEMS

SOURCE	DF	SS	MS
MACHINE	2	1.19	.59
EMPLOYEE	2	5.85	2.93
INTERACTION	4	710.81	177.70
ERROR	18	160.00	8.89
TOTAL	26	877.85	

Using a 0.05 significance level, test the claim that the interaction between employee and machine has no effect on the number of items produced.

Use the data in the given table and the corresponding Minitab display to test the hypothesis.

12) The following table shows the mileage for four different cars and three different brands of gas. Assuming no effect from the interaction between car and brand of gas, test the claim that the four cars have the same mean mileage. Use a 0.05 significance level.

	Brand 1	Brand 2	Brand 3
Car 1	22.4	25.2	24.3
Car 2	19	18.6	19.8
Car 3	24.6	25	25.4
Car 4	23.5	23.6	24.1

Source	DF	SS	MS	F	p
Car	3	61.249	20.416	39.033	0.000249
Gas	2	2.222	1.111	2.124	0.200726
Error	6	3.138	0.523		
Total	11	66.609			

13) The following minitab display results from a study in which three different teachers taught calculus classes of five different sizes. The class average was recorded for each class. Assuming no effect from the interaction between teacher and class size, test the claim that the teacher has no effect on the class average. Use a 0.05 significance level.

Source	DF	SS	MS	F	p
Teacher	2	56.93	28.47	1.018	0.404
Class Size	4	672.67	168.17	6.013	0.016
Error	8	223.73	27.97		
Total	14	953.33			

14) The following table shows the mileage for four different cars and three different brands of gas. Assuming no effect from the interaction between car and brand of gas, test the claim that the three brands of gas provide the same mean gas mileage. Use a 0.05 significance level.

	Brand 1	Brand 2	Brand 3
Car 1	22.4	25.2	24.3
Car 2	19	18.6	19.8
Car 3	24.6	25	25.4
Car 4	23.5	23.6	24.1

Source	DF	SS	MS	F	p
Car	3	61.249	20.416	39.033	0.000249
Gas	2	2.222	1.111	2.124	0.200726
Error	6	3.138	0.523		
Total	11	66.609			

Provide an appropriate response.

15) The following data shows annual income, in thousands of dollars, categorized according to the two factors of gender and level of education. Assume that incomes are not affected by an interaction between gender and level of education, and test the null hypothesis that level of education has no effect on income. Use a 0.05 significance level.

	Female	Male
High school	23, 27, 24, 26	25, 26, 22, 24
College	28, 36, 31, 33	35, 32, 39, 28
Advanced degree	41, 38, 43, 49	35, 50, 47, 44

16) The following data contains task completion times, in minutes, categorized according to the gender of the machine operator and the machine used.

	Male	Female
Machine 1	15, 17	16, 17
Machine 2	14, 13	15, 13
Machine 3	16, 18	17, 19

Assume that two–way ANOVA is used to analyze the data. How are the ANOVA results affected if the times are converted to hours?

Answer Key
Testname: ELEMENTARY STATISTICS CHAPTER 11 TEST FORM C

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

1) 1) The populations have approximately normal distributions.
   2) The populations have the same variance σ^2 (or standard deviation σ).
   3) The samples are random and independent of each other.
   4) The different samples are from populations that are categorized in only one way. (The requirements of normality and equal variances are somewhat relaxed.)

2) Variance between samples measures the variation between the sample means of the groups treated differently, that is the variation due to the treatment. The variance within the samples depends solely on the sample variances of the groups treated alike. The F ratio compares the two. If the F ratio is relatively close to 1, the two variances are about the same, and we conclude that there are no significant differences among the sample means. When the value of F is excessively large (that is, greater than 1), we conclude that the variation among the samples is not the same and that the means are not equal.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

3) D
4) D

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

5) Test statistic: F = 1.491. Critical value: F = 6.927.
   Fail to reject the claim of equal means. The data do not provide sufficient evidence to conclude that there is a difference in the true mean weight loss produced by the three exercise programs.

6) $H_0 : \mu 1 = \mu 2 = \mu 3$. H_1 : The means are not all equal.
   Test statistic: F = 12.1230. Critical value: F = 5.0959.
   Reject the null hypothesis. There is sufficient evidence to warrant rejection of the claim that the three brands have the same mean.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

7) A

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

8) i) An F test of homogeneity of variance suggests equal population variances. The F test statistic = 1.3349; the F critical value = 9.6045. Therefore, the pooled variance model applies. Since t = 1.315 < $t_{0.025}(8) = 2.306$, accept the claim that the two samples come from populations with the same means.
   ii) Since F = 1.73 < $F_{0.05}(1, 8) = 5.32$, accept the claim that the two samples come from populations with the same means.
   iii) $t^2 = 1.315^2 = 1.73 = F$ and $t_{0.025}(8)^2 = 2.306^2 = 5.32 = F_{0.05}(1, 8)$

9) H_0: There is no employee effect.
   H_1: There is an employee effect.
   Test statistic: F = 46.3842. Critical value: F = 3.5546.
   Reject the null hypothesis. The employee does appear to have an effect on the number of items produced.

10) H_0: There is no machine effect.
    H_1: There is a machine effect.
    Test statistic: F = 3.1857. Critical value: F = 3.5546.
    Fail to reject the null hypothesis. The type of machine does not appear to have an effect on the number of items produced.

1

11) H_0: There is no interaction effect.

H_1: There is an interaction effect.

Test statistic: F = 19.9888. Critical value: F = 2.9277.
Reject the null hypothesis. There does appear to be an interaction effect.

12) H_0: The cars have the same mean mileage. H_1: The cars do not have the same mean mileage. The

P-value is 0.000249, which is less than 0.05. We reject the null hypothesis; it appears that the cars do not
have the same mean mileage.

13) H_0: There is no teacher effect. H_1: There is a teacher effect. The P-value is 0.404, which is greater than
0.05. We fail to reject the null hypothesis; it appears that the teacher does not affect the class average.

14) H_0: The brands of gas provide the same mean mileage. H_1: The brands of gas do not provide the same
mean mileage. The P-value is 0.200726, which is greater than 0.05. We fail to reject the null hypothesis;
it appears that the brands of gas provide the same mean mileage.

15) H_0: Education level has no effect on income. H_1: Education level has an effect on income. The test
statistic is F = 41.26823, and the corresponding P-value is 0.000000189. Because the P-value is less than
0.05, we reject the null hypothesis that education level has no effect on income. It appears that
education level does have an effect on income.

16) The ANOVA results are not affected by converting the times to hours. The null hypothesis of no
interaction between machine and gender is not rejected since the P-value is 0.946. The null hypothesis
of no effect from machine is rejected since the P-value is 0.013. The null hypothesis of no effect from
gender is not rejected since the P-value is 0.382.

Elementary Statistics   Chapter 12 Test – Form A

Name:_____ Course Number: _____ Section Number: _____

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Provide an appropriate response.

1) Describe the runs test for randomness. What types of hypotheses is it used to test? Does the runs test measure frequency? What is the underlying concept?

2) Describe the Wilcoxon signed–ranks test. What types of hypotheses is it used to test? What assumptions are made for this test?

Use the sign test to test the indicated claim.

3) A standard aptitude test is given to several randomly selected programmers, and the scores are given below for the mathematics and verbal portions of the test. Use the sign test to test the claim that programmers do better on the mathematics portion of the test. Use a 0.05 level of significance.

Mathematics	347 440 327 456 427 349 377 398 425
Verbal	285 378 243 371 340 271 294 322 385

4) A researcher wishes to study whether a particular diet is effective in helping people to lose weight. 92 randomly selected adults were weighed before starting the diet and again after following the diet for one month. 50 people lost weight, 40 gained weight, and 2 observed no change in their weight. At the 0.01 significance level, test the claim that the diet is effective.

Use the Wilcoxon signed–ranks test to test the claim that both samples come from populations having the same distribution.

5) 11 runners are timed at the 100–meter dash and are timed again one month later after following a new training program. The times (in seconds) are shown in the table. Use a significance level of 0.05 to test the claim that the training has no effect on the times.

Before	12.1 12.4 11.7 11.5 11.0 11.8 12.3 10.8 12.6 12.7 10.7
After	11.9 12.4 11.8 11.4 11.2 11.5 12.0 10.9 12.0 12.2 11.1

Use the Wilcoxon rank–sum test to test the claim that the two independent samples come from the same distribution.

6) A teacher uses two different CAI programs to remediate students. Results for each group on a standardized test are listed in a table below. At the 0.05 level of significance, test the hypothesis that the two programs produce different results.

Program I	Program II
60 75 61 63	66 89 68 77
86 69 64 70	84 80 81 87
72 82 59	78 73 91 93
	94 95

Solve the problem.

7) In the sign test procedure the most common approach to handling ties is to exclude the ties. A second approach is to treat half the 0s (representing ties) as positive signs and half as negative signs. In this approach, if the number of ties is odd, one tie is excluded so that they can be divided equally. In a sign test for matched pairs with a claim that the median of the differences is equal to zero, there are 36 positive signs, 56 negative signs, and 23 ties. Identify the test statistic and conclusion for the two different methods. Use a significance level of 0.05.

Use a Kruskal–Wallis test to test the claim that the samples come from identical populations.

8) The table below shows the lifetimes (in hours) of random samples of light bulbs of three different brands. Use a 0.01 significance level to test the claim that the samples come from identical populations.

Brand A	Brand B	Brand C
190	182	203
220	170	210
230	203	199
215	175	200
224	178	196
231	181	197

Use the rank correlation coefficient to test the claim of no correlation between the two variables.

9) Given that the rank correlation coefficient, r_s, for 39 pairs of data is 0.296, test the claim of no correlation between the two variables. Use a significance level of 0.01.

10) The scores of twelve students on the midterm exam and the final exam were as follows.

Student	Midterm	Final
Navarro	93	91
Reaves	89	85
Hurlburt	71	73
Knuth	65	77
Lengyel	62	67
Mcmeekan	74	79
Bolker	77	65
Ammatto	87	83
Pothakos	82	89
Sullivan	81	71
Wahl	91	81
Zurfluh	83	94

Find the rank correlation coefficient and test the claim of no correlation between midterm score and final exam score. Use a significance level of 0.05.

11) Ten trucks were ranked according to their comfort levels and their prices.

Make	Comfort	Price
A	1	6
B	6	2
C	2	3
D	8	1
E	4	4
F	7	8
G	9	10
H	10	9
I	3	5
J	5	7

Find the rank correlation coefficient and test the claim of no correlation between comfort and price. Use a significance level of 0.05.

Use the runs test to determine whether the given sequence is random. Use a significance level of 0.05.

12) A true–false test had the following answer sequence.

T T T T F T F T F T F T T F T
T T F F F F F F F T F T F T F

Test the null hypothesis that the sequence was random.

13) The sequence of numbers below represents the maximum temperature (in degrees Fahrenheit) in July in one U.S. town for 30 consecutive years. Test the sequence for randomness above and below the median.

94 96 97 99 95 90 97 98 100 100
92 95 98 99 102 97 97 101 99 100
98 95 93 99 101 99 101 100 99 103

14) Test the sequence of digits below for randomness above and below the value of 4.5.

0   4   7   3   6   0   9   7   4   8
7   2   8   5   7   3   9   6   4   6
4   7   9   1   6   1   9   5   8   3
7   8   5   7   3   5   2   9   3   8

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Solve the problem.

15) When performing a rank correlation test, one alternative to using Table A–9 to find critical values is to compute them using this approximation:

$$r_s = \pm\sqrt{\frac{t^2}{t^2 + n - 2}}$$

where t is the t–score from Table A–3 corresponding to n – 2 degrees of freedom. Use this approximation to find critical values of r_s for the case where n = 17 and α = 0.05.

A) ± 0.411   B) ± 0.311   C) ± 0.480   D) ± 0.482

Answer Key
Testname: ELEMENTARY STATISTICS CHAPTER 12 TEST FORM A

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

1) The runs test for randomness is a procedure for testing the randomness of data (with only two characteristics) using the concepts of runs. A run is a sequence of data that exhibit the same characteristic. For example, the data set M M M M M F F F M M M F F F F has four runs. The null hypothesis is that the sequence is random and the alternate hypothesis is that the sequence is not random. The runs test is based only on the order in which the data occur; it does not test the frequency of the data. The underlying concept is that if the number of runs is very low or very high, randomness is lacking.

2) The Wilcoxon signed–ranks test is similar to the sign test, but it looks at the magnitude as well as the signs of the differences, and thus has a higher efficiency level than the signs test. The test is used to test claims about differences between two dependent (paired) samples. The Wilcoxon signed–ranks test assumes that the population of the differences (found from the pairs of data) has a distribution that is approximately symmetric and that the pairs have been randomly selected.

3) H_0: The math scores are equal to or less than the verbal scores.

   H_1: The math scores are greater than the verbal scores.

   Test statistic: $x = 0$. Critical value: $x = 1$.
   Reject the null hypothesis. There is sufficient evidence to support the claim that the math scores are greater than the verbal scores.

4) H_0: the diet is not effective. H_1: the diet is effective.

   Convert $x = 40$ to the test statistic $z = -0.95$. Critical value: $z = -2.33$.
   Fail to reject the null hypothesis. There is not sufficient evidence to support the claim that the diet is effective.

5) Test statistic $T = 16.5$. Critical value: $T = 8$.
   Fail to reject the null hypothesis that both samples come from the same population distribution.

6) $\mu_R = 143$, $\sigma_R = 18.2665$, $R = 90$.

   Test statistic: $z = -2.90$. Critical values $z = \pm 1.96$.
   Reject the null hypothesis. There is sufficient evidence to support the hypothesis that the two programs produce different results.

7) Approach 1:
   Test statistic: $z = -1.98$, Critical values: $z = \pm 1.96$.
   Reject the null hypothesis that the median of the differences is zero.
   Approach 2:
   Test statistic: $z = -1.78$, Critical values: $z = \pm 1.96$.
   Do not reject the null hypothesis that the median of the differences is zero.

8) Test statistic: $H = 10.371$. Critical value is 9.210.
   Reject the null hypothesis. There is sufficient evidence to warrant rejection of the claim that the samples come from identical populations.

9) $r_S = 0.296$. Critical values: $r_S = \pm 0.418$.

   No significant correlation. There does not appear to be a correlation between the two variables.

10) $r_S = 0.706$. Critical values: $r_S = \pm 0.591$.

    Significant correlation. There appears to be a correlation between midterm score and final exam score.

11) $r_S = 0.382$. Critical values: $r_S = \pm 0.648$.

    No significant correlation. There does not appear to be a correlation between comfort and price.

12) $n_1 = 15$, $n_2 = 15$, $G = 18$, 5% cutoff values: 10, 22.

    Fail to reject the null hypothesis of randomness.

13) $n_1 = 15$, $n_2 = 15$, $G = 10$, 5% cutoff values: 10, 22.

    Reject the null hypothesis of randomness.

14) $n_1 = 15$, $n_2 = 25$, $G = 28$, $\mu_G = 19.75$, $\sigma_G = 2.9212$.

Test statistic: $z = 2.82$. Critical values: $z = \pm 1.96$.

Reject the null hypothesis of randomness.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

15) D

Elementary Statistics   Chapter 12 Test – Form B

Name:_____ Course Number: _____ Section Number: _____

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Provide an appropriate response.

1) Describe the sign test. What types of hypotheses is it used to test? What is the underlying concept?

2) Describe the Wilcoxon rank–sum test. What type of hypotheses is it used to test? What assumptions are made for this test? What is the underlying concept?

Use the sign test to test the indicated claim.

3) An instructor gives a test before and after a lesson and results from randomly selected students are given below. At the 0.05 level of significance, test the claim that the lesson has no effect on the grade. Use the sign test.

Before	54 61 56 41 38 57 42 71 88 42 36 23 22 46 51
After	82 87 84 76 79 87 42 97 99 74 85 96 69 84 79

4) A researcher wishes to study whether music has any effect on the ability to memorize information. 89 randomly selected adults are given a memory test in a quiet room. They are then given a second memory test while listening to classical music. 66 people received a higher score on the second test, 22 a lower score, and 1 received the same score. At the 0.05 significance level, test the claim that the music has no effect on memorization skills.

Use the Wilcoxon signed–ranks test to test the claim that both samples come from populations having the same distribution.

5) Use the Wilcoxon signed–ranks test and the sample data below. At the 0.05 significance level, test the claim that math and verbal scores are the same.

Mathematics	347 440 327 456 427 349 377 398 425
Verbal	285 378 243 371 340 271 294 322 385

Use the Wilcoxon rank–sum test to test the claim that the two independent samples come from the same distribution.

6) Use the Wilcoxon rank–sum approach to test the claim that students at two colleges achieve the same distribution of grade averages. The sample data is listed below. Use a 0.05 level of significance.

College A	3.2 4.0 2.4 2.6 2.0 1.8 1.3 0.0 0.5 1.4 2.9
College B	2.4 1.9 0.3 0.8 2.8 3.0 3.1 3.1 3.1 3.5 3.5

Solve the problem.

7) The Wilcoxon signed–ranks test can be used to test the claim that a sample comes from a population with a specified median. The procedure used is the same as the one described in this section except that the differences are obtained by subtracting the value of the hypothesized median from each value.

   The sample data below represent the weights (in pounds) of 12 women aged 20–30. Use a Wilcoxon signed–ranks test to test the claim that the median weight of women aged 20–30 is equal to 130 pounds. Use a significance level of 0.05. Be sure to state the hypotheses, the value of the test statistic, the critical values, and your conclusion.

140	116	125	120	153	140
111	127	133	137	132	160

Use a Kruskal–Wallis test to test the claim that the samples come from identical populations.

8) The table below shows the weights (in pounds) of 6 randomly selected women in each of three different age groups. Use a 0.01 significance level to test the claim that the 3 age–group populations of weights are identical.

18-34	35–55	56 and older
119	123	140
134	147	128
114	135	159
125	110	134
153	154	120
138	163	116

Use the rank correlation coefficient to test the claim of no correlation between the two variables.

9) Given that the rank correlation coefficient, r_s, for 71 pairs of data is –0.474, test the claim of no correlation between the two variables. Use a significance level of 0.05.

10) A college administrator collected information on first–semester night–school students. A random sample taken of 12 students yielded the following data on age and GPA during the first semester.

Age	GPA
x	y
18	1.2
26	3.8
27	2.0
37	3.3
33	2.5
47	1.6
20	1.4
48	3.6
50	3.7
38	3.4
34	2.7
22	2.8

   Do the data provide sufficient evidence to conclude that the variables age, x, and GPA, y, are correlated? Apply a rank–correlation test. Use $\alpha = 0.05$.

11) Ten luxury cars were ranked according to their comfort levels and their prices.

Make	Comfort	Price
A	5	1
B	8	7
C	9	3
D	10	5
E	4	4
F	3	2
G	2	10
H	1	9
I	7	6
J	6	8

Find the rank correlation coefficient and test the claim of no correlation between comfort and price. Use a significance level of 0.05.

Use the runs test to determine whether the given sequence is random. Use a significance level of 0.05.

12) The outcomes (odd number or even number) of a roulette wheel are shown below. Test for randomness of odd (O) and even (E) numbers.

O E O E O E O E E O E E

E E O E O O E O E E O E

13) Use a 0.05 level of significance to test the claim that the sequence of computer–generated numbers is random. Test for randomness above and below the mean.

8 7 5 7 3 9 1 8 0 4 3 8 4 6 2 3 9 7 5

14) Test the sequence of digits below for randomness of odd and even digits.

0   4   7   3   6   0   9   7   4   8

7   2   8   5   7   3   9   6   4   6

4   7   9   1   6   1   9   5   8   3

7   8   5   7   3   5   2   9   3   8

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Solve the problem.

15) When performing a rank correlation test, one alternative to using Table A–9 to find critical values is to compute them using this approximation:

$$r_s = \pm\sqrt{\frac{t^2}{t^2 + n - 2}}$$

where t is the t–score from Table A–3 corresponding to n – 2 degrees of freedom. Use this approximation to find critical values of r_s for the case where n = 11 and $\alpha = 0.01$.

A) ± 0.685   B) ± 0.726   C) ± 0.735   D) ± 0.411

Answer Key
Testname: ELEMENTARY STATISTICS CHAPTER 12 TEST FORM B

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

1) The sign test compares the signs (negative or positive) of the differences for data sets, ignoring any ties resulting in a difference of zero. The sign test can be used to test claims involving two dependent samples, claims involving nominal data, and claims about the median of a single population. The underlying concept is that if two sets of data have equal medians, the number of positive signs should be approximately equal to the number of negative signs.

2) The Wilcoxon rank–sum test looks at ranks but not signs for the data points. The test is used to test claims about the differences between two independent samples. The assumptions include: two randomly selected independent samples; testing the null hypothesis that the two independent samples come from the same distribution; and more than 10 scores in each of the samples. The underlying principle is that if two samples are drawn from identical populations and the individual scores are all ranked as one combined collection of values, then the high and low ranks should fall evenly between the two samples. For example, if low ranks are found predominantly in one sample with the high ranks in the other, then we suspect that the two samples are not identical.

3) H_0: There is no difference between before and after grades.

   H_1: There is a difference between before and after grades.

   Test statistic: $x = 0$. Critical value: $x = 2$.
   Reject the null hypothesis of no difference. There is sufficient evidence to warrant rejection of the claim that the lesson has no effect on grade.

4) H_0: the music has no effect on memorization skills.

   H_1: the music has an effect on memorization skills.

   Convert $x = 22$ to the test statistic $z = -4.58$. Critical values: $z = \pm 1.96$.
   Reject the null hypothesis. There is sufficient evidence to warrant rejection of the claim that music has no effect on memorization skills.

5) Test statistic $T = 0$. Critical value: $T = 6$.
   Reject the null hypothesis that both samples come from the same population distribution.

6) $\mu_R = 126.5$, $\sigma_R = 15.2288$, $R = 108.5$.

   Test statistic: $z = -1.18$. Critical values $z = \pm 1.96$.
   Fail to reject the null hypothesis. There is not sufficient evidence to warrant rejection of the claim that the two populations are identical.

7) H_0: The sample comes from a population with a median of 130 pounds.

   H_1: The sample comes from a population with a median different from 130 pounds.

   Test statistic: $T = 32.5$
   Critical value: 14
   Do not reject the null hypothesis. There is not sufficient evidence to reject the hypothesis that the sample comes from a population with a median of 130 pounds.

8) Test statistic: $H = 0.8158$. Critical value is 9.210.
   Fail to reject the null hypothesis. There is not sufficient evidence to warrant rejection of the claim that the samples come from identical populations.

9) $r_S = -0.474$. Critical values: $r_S = \pm 0.234$.

   Significant correlation. There appears to be a correlation between the two variables.

10) $r_S = 0.531$. Critical values: $r_S = \pm 0.591$. (Ranking both variables from lowest to highest).

    No significant correlation. The data do not provide sufficient evidence to indicate that age and GPA are correlated.

11) $r_S = -0.285$. Critical values: $r_S = \pm 0.648$.

    No significant correlation. There does not appear to be a correlation between comfort and price.

12) $n_1 = 10$, $n_2 = 14$, $G = 18$, 5% cutoff values: 7, 18.

Reject the null hypothesis of randomness.

13) $n_1 = 9$, $n_2 = 10$, $G = 14$.

Test statistic: $G = 14$. Critical values: 5, 16.

Fail to reject the null hypothesis of randomness.

14) $n_1 = 17$, $n_2 = 23$, $G = 19$, $\mu_G = 20.550$, $\sigma_G = 3.0494$.

Test statistic: $z = -0.51$. Critical values: $z = \pm 1.96$.

Fail to reject the null hypothesis of randomness.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

15) C

Elementary Statistics   Chapter 12 Test – Form C

Name:_____ Course Number: _____ Section Number: _____

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Provide an appropriate response.

1) Describe the Kruskal–Wallis test. What types of hypotheses is it used to test? What assumptions are made for this test?

2) Describe the rank correlation test. What types of hypotheses is it used to test? How does the rank correlation coefficient r_S differ from the correlation coefficient r found in Chapter 9?

Use the sign test to test the indicated claim.

3) A researcher wishes to test whether a particular diet has an effect on blood pressure. The blood pressure of 25 randomly selected adults is measured. After one month on the diet, each person's blood pressure is again measured. For 18 people, the second blood pressure reading was lower than the first, and for 7 people, the second blood pressure reading was higher than the first. At the 0.01 significance level, test the claim that the diet has an effect on blood pressure.

4) The waiting times (in minutes) of 28 randomly selected customers in a bank are given below. Use a significance level of 0.05 to test the claim that the population median is equal to 5.3 minutes.

8.2	8.0	10.5	3.8	6.4	5.3	7.8
2.9	6.0	7.7	6.1	5.9	1.2	10.4
7.3	6.9	5.8	5.1	6.2	3.1	5.8
11.7	4.5	6.5	9.8	7.4	2.3	7.8

Use the Wilcoxon signed–ranks test to test the claim that both samples come from populations having the same distribution.

5) In a study of the effectiveness of physical exercise in weight reduction, 12 subjects followed a program of physical exercise for two months. Their weights (in pounds) before and after this program are shown in the table. Use a significance level of 0.05 to test the claim that the exercise program has no effect on weight.

Before	162 190 188 152 148 127 195 164 175 156 180 136
After	157 194 179 149 135 130 183 168 168 148 170 138

Use the Wilcoxon rank–sum test to test the claim that the two independent samples come from the same distribution.

6) 11 female employees and 11 male employees are randomly selected from one company and their weekly salaries are recorded. The salaries (in dollars) are shown below. Use a significance level of 0.10 to test the claim that salaries for female and male employees of the company have the same distribution.

Female			Male		
350	420	470	410	460	650
385	675	520	545	720	810
540	400	550	660	500	880
	450	640		700	750

Solve the problem.

7) The Mann–Whitney U test is equivalent to the Wilcoxon rank–sum test for independent samples in the sense that they both apply to the same situations and always lead to the same conclusions. In the Mann–Whitney U test we calculate

$$z = \frac{U - \frac{n_1 n_2}{2}}{\sqrt{\frac{n_1 n_2 (n_1 + n_2 + 1)}{12}}}$$

where

$$U = n_1 n_2 + \frac{n_1(n_1 + 1)}{2} - R$$

For the sample data below, use the Mann–Whitney U test to test the null hypothesis that the two independent samples come from populations with the same distribution. State the hypotheses, the value of the test statistic, the critical values, and your conclusion. Use a significance level of 0.05.

Test scores (men):   70, 96, 77, 90, 81, 45, 55, 68, 74, 99, 88
Test scores (women): 89, 92, 60, 78, 84, 96, 51, 67, 85, 94

Use a Kruskal–Wallis test to test the claim that the samples come from identical populations.

8) SAT scores for students selected randomly from three different schools are shown below. Use a significance level of 0.05 to test the claim that the samples come from identical populations.

School A	School C	School B
550 480 670	500 620 700	460 580 620
400 600 520	550 760	380 600 470
		450

Use the rank correlation coefficient to test the claim of no correlation between the two variables.

9) Given that the rank correlation coefficient, r_s, for 20 pairs of data is 0.720, test the claim of no correlation between the two variables. Use a significance level of 0.05.

10) Given that the rank correlation coefficient, r_s, for 15 pairs of data is –0.602, test the claim of no correlation between the two variables. Use a significance level of 0.01.

11) Use the sample data below to find the rank correlation coefficient and test the claim of no correlation between math and verbal scores. Use a significance level of 0.05.

Mathematics	347	440	327	456	427	349	377	398	425
Verbal	285	378	243	371	340	271	294	322	385

Use the runs test to determine whether the given sequence is random. Use a significance level of 0.05.

12) Answers to a questionnaire were in the following sequence. Test for randomness.

Y Y N Y N N N N Y Y
N N N N Y Y Y N N N

13) A sample of 15 clock radios is selected in sequence from an assembly line. Each radio is examined and judged to be acceptable (A) or defective (D). The results are shown below. Test for randomness at the 0.05 level.

D   D   A   A   A
A   A   A   A   A
A   A   D   D   D

14) A pollster interviews voters and claims that her selection process is random. Listed below is the sequence of voters identified according to gender. At the 0.05 level of significance, test her claim that the sequence is random according to the criterion of gender.

M, M, M, M, M, M, M, M, M, M, M, M, F, F, F, F,
M, M, M, M, M, M, M, M, M, M, F, F, F, F, F, F

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

Solve the problem.

15) When performing a rank correlation test, one alternative to using Table A–9 to find critical values is to compute them using this approximation:

$$r_S = \pm\sqrt{\frac{t^2}{t^2 + n - 2}}$$

where t is the t–score from Table A–3 corresponding to n – 2 degrees of freedom. Use this approximation to find critical values of r_S for the case where n = 7 and $\alpha = 0.05$.

A) ± 0.669   B) ± 0.448   C) ± 0.569   D) ± 0.755

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

1) The Kruskal–Wallis test sums ranks for the sample data ranked as a whole. However, the Kruskal–Wallis test is used to test claims about the differences in means among three or more independent samples, as opposed to the Wilcoxon rank–sum test which looks at claims for two independent samples. The assumptions include: there are at least three random samples; we want to test the null hypothesis that the samples come from the same or identical populations; and each sample has at least five observations.

2) The rank correlation test uses ranks to measure the strength of the relation between two variables. The rank correlation test is used to test the null hypothesis that there is no correlation between the two variables. In Chapter 9, the correlation coefficient r was linear. The rank correlation r_S, also known as Spearman's rank correlation coefficient, detects relationships which are non–linear as well as linear.

3) H_0: The diet does not have an effect on blood pressure.

   H_1: The diet has an effect on blood pressure.

   Test statistic: $x = 7$. Critical value: $x = 5$.
   Fail to reject the null hypothesis. There is not sufficient evidence to support the claim that the diet has an effect on blood pressure.

4) H_0: median is equal to 5.3 minutes.

   H_1: median is not equal to 5.3 minutes.

   Convert $x = 7$ to the test statistic $z = -2.31$. Critical values: $z = \pm 1.96$.
   Reject the null hypothesis. There is sufficient evidence to warrant rejection of the claim that the population median is equal to 5.3 minutes.

5) Test statistic $T = 12.5$. Critical value: $T = 14$.
   Reject the null hypothesis that both samples come from the same population distribution.

6) $\mu_R = 126.5$, $\sigma_R = 15.2288$, $R = 90$.

   Test statistic: $z = -2.40$. Critical values $z = \pm 1.645$.
   Reject the null hypothesis. There is sufficient evidence to warrant rejection of the claim that the two populations are identical.

7) H_0: The two samples come from populations with the same distribution.

   H_1: The two samples come from populations with different distributions.

   Critical values $z = \pm 1.96$, $R = 115.5$.
   Test statistic: $z = 0.39$
   Do not reject the null hypothesis. There is not sufficient evidence to reject the claim that the two samples come from populations with the same distribution.

8) Test statistic: $H = 3.6586$. Critical value is 5.9915.
   Fail to reject the null hypothesis. There is not sufficient evidence to warrant rejection of the claim that the samples come from identical populations.

9) $r_S = 0.720$. Critical values: $r_S = \pm 0.450$.

   Significant correlation. There appears to be a correlation between the two variables.

10) $r_S = -0.602$. Critical values: $r_S = \pm 0.689$.

   No significant correlation. There does not appear to be a correlation between the two variables.

11) $r_S = 0.867$. Critical values: $r_S = \pm 0.683$.

   Significant correlation. There appears to be a correlation between the two variables.

12) $n_1 = 8$, $n_2 = 12$, $G = 8$, 5% cutoff values: 6, 16.

   Fail to reject the null hypothesis of randomness.

13) $n_1 = 5$, $n_2 = 10$, $G = 3$, 5% cutoff values: 3, 12.

   Reject the null hypothesis of randomness.

14) $n_1 = 22$, $n_2 = 10$, $G = 4$, $\mu_G = 14.75$, $\sigma_G = 2.38$.

Test statistic: $z = -4.52$. Critical values: $z = \pm1.96$.

Reject the null hypothesis of randomness. The sequence does not appear to be random.

MULTIPLE CHOICE. Choose the one alternative that best completes the statement or answers the question.

15) D

Elementary Statistics   Chapter 13 Test – Form A

Name:_____ Course Number: _____ Section Number: _____

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Provide an appropriate response.

1) A common goal of quality control is to reduce variation in a product or service. List and describe the two types of variability. Give an example of each.

2) Relate the concept of control charts to the concept of confidence intervals from Chapter 6.

Construct a run chart for individual values corresponding to the given data.

3) A machine is supposed to fill cans that contain 12 oz. Each hour, a sample of four cans is tested; the results of 15 consecutive hours are given below.

S	A				M	R
1	11.2	11.7	11.8	11.7	11.6	0.6
2	11.8	11.3	11.6	11.6	11.575	0.5
3	11.3	12.0	11.8	11.7	11.7	0.7
4	12.1	11.6	12.1	12.0	11.95	0.5
5	11.8	11.8	11.9	11.9	11.85	0.1
6	12.0	11.9	11.8	11.7	11.85	0.3
7	11.6	12.0	11.9	11.8	11.825	0.4
8	11.5	12.1	11.9	12.0	11.875	0.6
9	12.1	12.1	11.7	11.9	11.95	0.4
10	11.7	12.0	11.6	11.9	11.8	0.4
11	12.1	12.4	11.9	12.2	12.15	0.5
12	12.5	12.0	12.4	12.3	12.3	0.5
13	12.5	12.0	12.1	12.1	12.175	0.5
14	12.4	12.0	12.0	12.4	12.2	0.4
15	12.4	12.4	12.6	12.1	12.375	0.5

Construct an R chart and determine whether the process variation is within statistical control.

4) A machine is supposed to fill boxes to a weight of 50 lbs. Every 30 minutes a sample of four boxes is tested; the results are given below.

S	A				M	R
1	49	38	39	45	42.75	11
2	52	51	43	61	51.75	18
3	56	60	32	52	50	28
4	44	59	46	49	49.5	15
5	51	61	48	45	51.25	16
6	45	50	46	48	47.25	5
7	52	51	45	55	50.75	10
8	40	50	53	48	47.75	13
9	48	67	60	51	56.5	19
10	43	50	50	47	47.5	7
11	48	30	38	39	38.75	18
12	50	46	48	53	49.25	7
13	50	58	56	64	57	14
14	47	52	47	49	48.75	5
15	52	57	58	52	54.75	6

Construct a control chart for $\bar{x}$.

5) A machine that is supposed to fill small bottles to contain 20 ml yields the following data from a test of 4 bottles every hour.

S	A				M	R
1	19.9	20.1	20.2	20.3	20.125	0.4
2	20.4	20.0	20.3	20.3	20.25	0.4
3	20.0	20.7	20.4	20.3	20.35	0.7
4	20.4	20.1	20.1	19.9	20.125	0.5
5	19.9	19.8	19.6	19.5	19.7	0.4
6	19.4	19.4	19.6	19.7	19.525	0.3
7	19.8	19.4	19.6	19.7	19.625	0.4
8	19.9	19.8	20.0	20.0	19.925	0.2
9	20.2	20.3	20.1	20.3	20.225	0.2
10	20.0	20.3	20.0	20.2	20.125	0.3
11	20.3	20.5	20.1	20.2	20.275	0.4
12	20.1	19.9	19.8	19.7	19.875	0.4
13	19.5	19.8	19.7	19.6	19.65	0.3
14	19.4	19.8	19.8	19.4	19.4	0.4
15	19.5	19.6	19.6	19.9	19.65	0.4

Examine the given run chart or control chart and determine whether the process is within statistical control. If it is not, identify which of the three out–of–control criteria apply.

6) A control chart for $\bar{x}$ is shown below. Determine whether the process mean is within statistical control. If it is not, identify which of the three out–of–control criteria lead to rejection of a statistically stable mean.

7) A control chart for $\bar{x}$ is shown below. Determine whether the process mean is within statistical control. If it is not, identify which of the three out–of–control criteria lead to rejection of a statistically stable mean.

X Chart for C1

8) A run chart for individual values is shown below. Does there appear to be a pattern suggesting that the process is not within statistical control? If so, describe the pattern.

9)
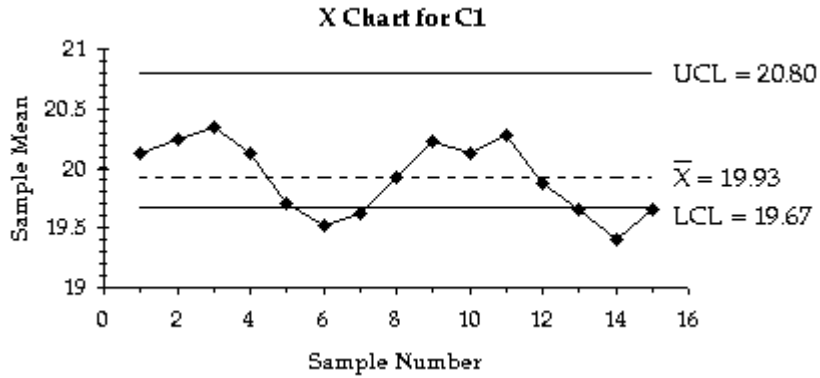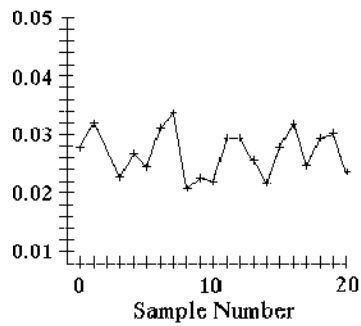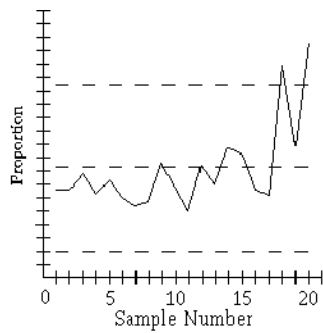
Use the given process data to construct a control chart for p.

10) A manufacturer monitors the level of defects in the television sets that it produces. Each week, 200 television sets are randomly selected and tested and the number of defects is recorded. The results for 12 consecutive weeks are shown below.

4 7 5 6 8 3 12 4 4 5 6 2
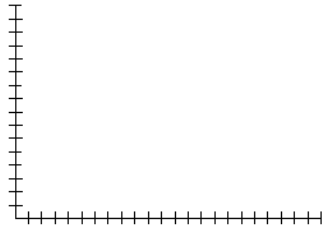
Solve the Problem.

11) A control chart for monitoring variation and center can be based on standard deviations instead of on ranges. An s chart for monitoring variation is made by plotting sample standard deviations with a center line at $\bar{s}$ (the mean of the sample standard deviations) and control limits at $B_4 \bar{s}$ and $B_3 \bar{s}$, where B_4 and B_3 are found in Table 13–2. Construct an s chart for the data below.

A manufacturer of lightbulbs picks 10 lightbulbs at random each day for quality control. The mean, standard deviation, and range (in hours) of the lifetimes of the 10 lightbulbs are calculated. The results for 12 consecutive days are shown in the table below.

Day	$\bar{x}$	Range	s
1	201.1	3.4	1.2
2	203.4	4.7	1.7
3	200.9	3.1	0.9
4	205.6	6.2	2.3
5	201.3	4.7	1.3
6	200.5	3.7	1.7
7	205.8	5.8	2.1
8	203.7	6.2	2.9
9	199.8	2.1	0.8
10	202.7	4.4	1.6
11	200.0	2.7	0.7
12	204.6	7.8	3.0

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

1) Random variation is due to chance, the variation inherent in any process that is not capable of producing each good or service exactly the same way every time. Assignable variation results from causes that can be identified. Examples may vary.

2) Control charts have upper control limits and lower control limits found by processes similar to those in Chapter 6 for finding confidence intervals. Control charts allow us to examine processes to see if they remain within control, that is, within the confidence intervals.

3)
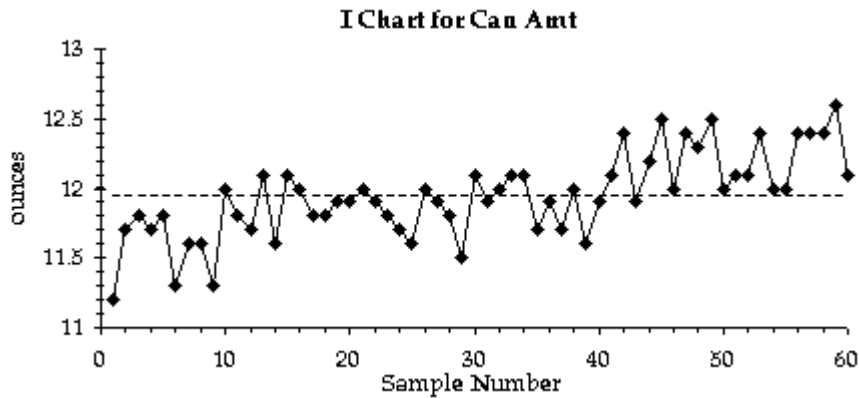
I Chart for Can Amt

4) The process appears to be within statistical control.

R Chart for C1

UCL = 29.20%

$\overline{R}$ = 12.8

LCL = 0.000

5)

X Chart for C1

UCL = 20.80

$\overline{X}$ = 19.93

LCL = 19.67
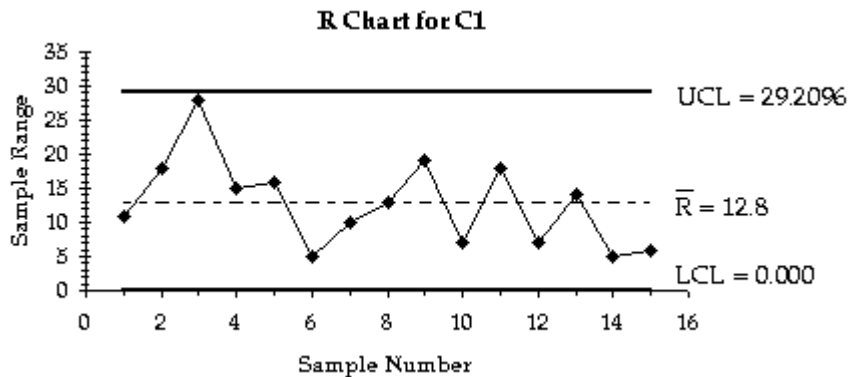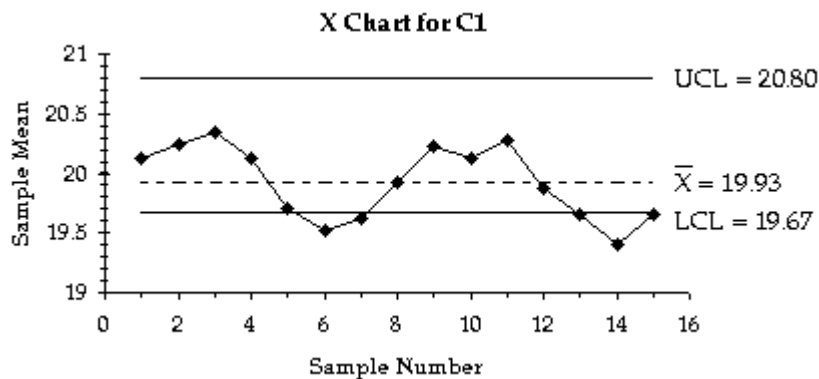
6) Process mean is not within statistical control. One of the points lies above the upper control limit.

7) Process mean is not within statistical control. There are points above and below the control limits. There is a cyclical pattern.
8) Process appears to be in statistical control.
9) Process appears to be out of statistical control. There are points that lie above the upper control limit. There are 8 consecutive points below the center line. There is increasing variation.
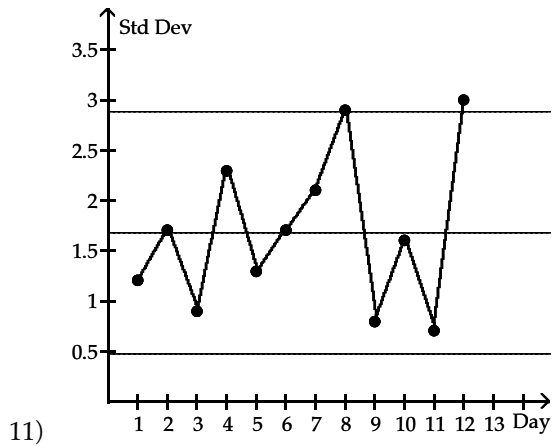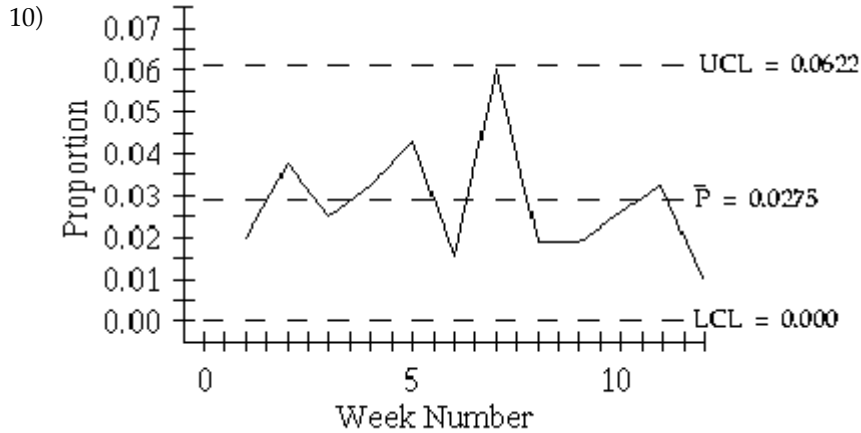
10)

11)

Elementary Statistics   Chapter 13 Test – Form B

Name:_____ Course Number: _____ Section Number: _____

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Provide an appropriate response.

1) Describe what process data are. Why are process data important to businesses? What is a common goal of businesses using quality control?

2) Define statistically stable (or "within statistical control"). Show examples of run charts which illustrate processes which are not statistically controlled. Discuss the pattern which indicates the process is not statistically controlled for each example.

Construct a run chart for individual values corresponding to the given data.

3) A machine that is supposed to fill small bottles to contain 20 ml yields the following data from a test of 4 bottles every hour.

S	A				M	R
1	19.9	20.1	20.2	20.3	20.125	0.4
2	20.4	20.0	20.3	20.3	20.25	0.4
3	20.0	20.7	20.4	20.3	20.35	0.7
4	20.4	20.1	20.1	19.9	20.125	0.5
5	19.9	19.8	19.6	19.5	19.7	0.4
6	19.4	19.4	19.6	19.7	19.525	0.3
7	19.8	19.4	19.6	19.7	19.625	0.4
8	19.9	19.8	20.0	20.0	19.925	0.2
9	20.2	20.3	20.1	20.3	20.225	0.2
10	20.0	20.3	20.0	20.2	20.125	0.3
11	20.3	20.5	20.1	20.2	20.275	0.4
12	20.1	19.9	19.8	19.7	19.875	0.4
13	19.5	19.8	19.7	19.6	19.65	0.3
14	19.4	19.8	19.8	19.4	19.4	0.4
15	19.5	19.6	19.6	19.9	19.65	0.4

Construct an R chart and determine whether the process variation is within statistical control.

4) A machine is supposed to fill cans that contain 12 oz. Each hour, a sample of four cans is tested; the results of 15 consecutive hours are given below.

S	A				M	R
1	11.2	11.7	11.8	11.7	11.6	0.6
2	11.8	11.3	11.6	11.6	11.575	0.5
3	11.3	12.0	11.8	11.7	11.7	0.7
4	12.1	11.6	12.1	12.0	11.95	0.5
5	11.8	11.8	11.9	11.9	11.85	0.1
6	12.0	11.9	11.8	11.7	11.85	0.3
7	11.6	12.0	11.9	11.8	11.825	0.4
8	11.5	12.1	11.9	12.0	11.875	0.6
9	12.1	12.1	11.7	11.9	11.95	0.4
10	11.7	12.0	11.6	11.9	11.8	0.4
11	12.1	12.4	11.9	12.2	12.15	0.5
12	12.5	12.0	12.4	12.3	12.3	0.5
13	12.5	12.0	12.1	12.1	12.175	0.5
14	12.4	12.0	12.0	12.4	12.2	0.4
15	12.4	12.4	12.6	12.1	12.375	0.5

Construct a control chart for x̄.

5) A machine that is supposed to produce ball bearings with a diameter of 7 mm yields the following data from a test of 5 ball bearings every 20 minutes.

S	A					M	R
1	6.3	6.8	6.9	6.8	6.9	6.74	0.6
2	6.3	6.6	6.6	6.3	7.0	6.56	0.7
3	6.8	6.7	7.0	6.5	7.0	6.8	0.5
4	7.0	6.7	6.7	6.8	6.8	6.8	0.3
5	6.8	6.8	6.6	6.5	6.4	6.62	0.4
6	6.8	6.7	6.6	6.3	6.9	6.66	0.6
7	7.3	7.3	7.4	7.4	7.0	7.28	0.4
8	7.2	7.0	7.2	6.9	7.1	7.08	0.3
9	7.3	7.6	7.1	7.4	7.6	7.4	0.5
10	7.2	7.6	7.5	7.6	7.1	7.4	0.5
11	7.2	7.2	7.4	7.0	7.0	7.16	0.4
12	7.5	7.4	7.4	7.6	7.1	7.4	0.5

Examine the given run chart or control chart and determine whether the process is within statistical control. If it is not, identify which of the three out–of–control criteria apply.

6) A control chart for x̄ is shown below. Determine whether the process mean is within statistical control. If it is not, identify which of the three out–of–control criteria lead to rejection of a statistically stable mean.

X Chart for Can Amt

7) A control chart for R is shown below. Determine whether the process variation is within statistical control. If it is not, identify which of the three out–of–control criteria lead to rejection of statistically stable variation.

R Chart for BB Size

8) A run chart for individual values is shown below. Does there appear to be a pattern suggesting that the process is not within statistical control? If so, describe the pattern.

9)

Use the given process data to construct a control chart for p.

10) If the weight of cereal in a particular packet is less than 14 oz, the packet is considered nonconforming. Each week, the manufacturer randomly selects 1,000 cereal packets and determines the number that are nonconforming. The results for 12 consecutive weeks are shown below.

46 32 21 30 47 31 32 52 48 45 62 58
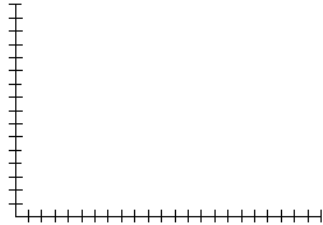
Solve the Problem.

11) An $\bar{x}$ chart based on standard deviations (instead of ranges) is made by plotting sample means with a centerline at $\bar{\bar{x}}$ and control limits at $\bar{\bar{x}} + A_3 \bar{s}$ and $\bar{\bar{x}} - A_3 \bar{s}$ where A_3 is found in Table 13–2 and $\bar{s}$ is the mean of the sample standard deviations. Construct an $\bar{x}$ chart based on standard deviations for the data below.

A manufacturer of high intensity video projector lightbulbs picks 6 lightbulbs at random each day for quality control. The mean, standard deviation, and range (in hours) of the lifetimes of the 6 lightbulbs are calculated. The results for 12 consecutive days are shown in the table below.

Day	$\bar{x}$	Range	s
1	21.1	3.4	1.2
2	23.44.7	1.7	
3	20.9	3.1	0.9
4	25.66.2	2.3	
5	21.3	4.7	1.3
6	20.5	3.7	1.7
7	25.8	5.8	2.1
8	23.76.2	2.9	
9	29.8	2.1	0.8
10	22.7	4.4	1.6
11	20.0	2.7	0.7
12	24.6	7.8	3.0

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

1) Process data are data arranged according to some time sequence. Process data are important to businesses because important characteristics of process data can change over time, and businesses are interested in ensuring quality by controlling these important characteristics. Businesses using quality control are interested in reducing variability in characteristics of their product.

2) A process is statistically stable if it has only natural variation, with no patterns, cycles, or any unusual points. Any of the graphs in Figure 13–2 would apply: graphs with an obvious upward or downward trend, graphs with an upward or downward shift (relatively stable values for the first few, a shift, relatively stable values at the end), graphs with one exceptionally high or low value, graphs with cyclical behavior, or graphs whose variation is increasing over time.

3)
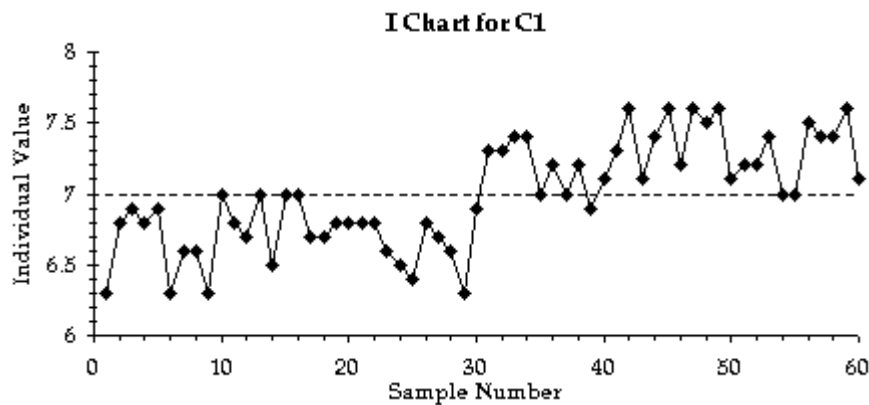
4) The process appears to be within statistical control.
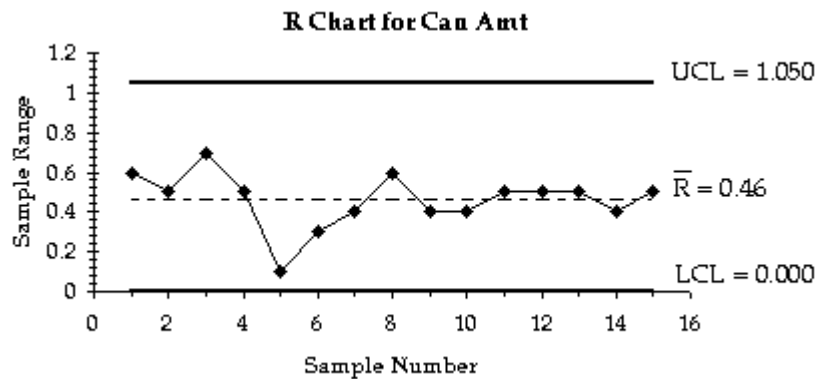
5)
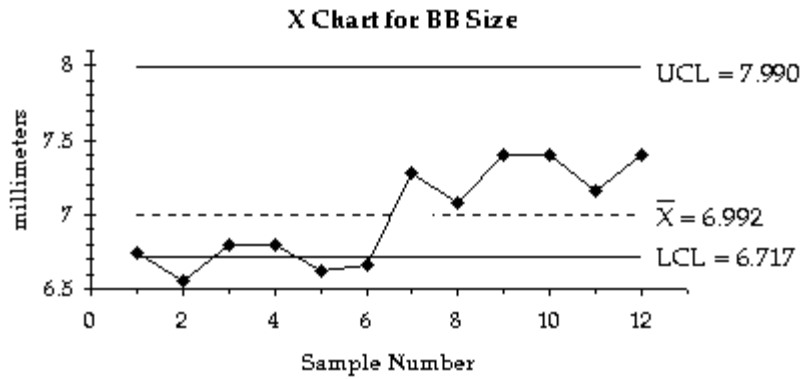
6) Process mean is not within statistical control. There are points above and below the control limits. There is an upward trend. There is a run of 8 values below the center line.

7) Process variation appears to be in statistical control.

8) Process appears to be out of statistical control. The variation is increasing over time.

9) Process is out of statistical control. There is a downward trend.

10)
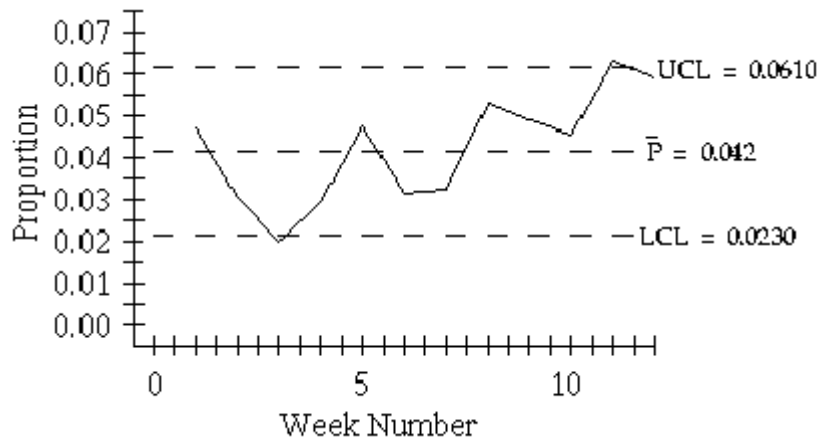
11)
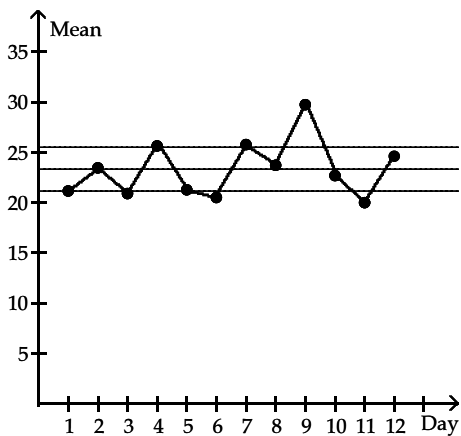
Elementary Statistics   Chapter 13 Test – Form C

Name:_____ Course Number: _____ Section Number: _____

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

Provide an appropriate response.

1) Describe a run chart and give an example. Refer to the values on each of the axes as you describe the run chart.

2) Describe a control chart. Complete the table to identify the important parts of different types of control charts.

	Points plotted	Center line and how to compute	Upper control limit	Lower control limit
Control chart for R				
Control chart for $\overline{X}$				
Control chart for p				

Construct a run chart for individual values corresponding to the given data.

3) A machine is supposed to fill boxes to a weight of 50 lbs. Every 30 minutes a sample of four boxes is tested; the results are given below.

S	A				M	R
1	49	38	39	45	42.75	11
2	52	51	43	61	51.75	18
3	56	60	32	52	50	28
4	44	59	46	49	49.5	15
5	51	61	48	45	51.25	16
6	45	50	46	48	47.25	5
7	52	51	45	55	50.75	10
8	40	50	53	48	47.75	13
9	48	67	60	51	56.5	19
10	43	50	50	47	47.5	7
11	48	30	38	39	38.75	18
12	50	46	48	53	49.25	7
13	50	58	56	64	57	14
14	47	52	47	49	48.75	5
15	52	57	58	52	54.75	6

Construct an R chart and determine whether the process variation is within statistical control.

4) A machine that is supposed to produce ball bearings with a diameter of 7 mm yields the following data from a test of 5 ball bearings every 20 minutes.

S	A					M	R
1	6.3	6.8	6.9	6.8	6.9	6.74	0.6
2	6.3	6.6	6.6	6.3	7.0	6.56	0.7
3	6.8	6.7	7.0	6.5	7.0	6.8	0.5
4	7.0	6.7	6.7	6.8	6.8	6.8	0.3
5	6.8	6.8	6.6	6.5	6.4	6.62	0.4
6	6.8	6.7	6.6	6.3	6.9	6.66	0.6
7	7.3	7.3	7.4	7.4	7.0	7.28	0.4
8	7.2	7.0	7.2	6.9	7.1	7.08	0.3
9	7.3	7.6	7.1	7.4	7.6	7.4	0.5
10	7.2	7.6	7.5	7.6	7.1	7.4	0.5
11	7.2	7.2	7.4	7.0	7.0	7.16	0.4
12	7.5	7.4	7.4	7.6	7.1	7.4	0.5

Construct a control chart for $\overline{x}$.

5) A machine is supposed to fill cans that contain 12 oz. Each hour, a sample of four cans is tested; the results of 15 consecutive hours are given below.

S	A				M	R
1	11.2	11.7	11.8	11.7	11.6	0.6
2	11.8	11.3	11.6	11.6	11.575	0.5
3	11.3	12.0	11.8	11.7	11.7	0.7
4	12.1	11.6	12.1	12.0	11.95	0.5
5	11.8	11.8	11.9	11.9	11.85	0.1
6	12.0	11.9	11.8	11.7	11.85	0.3
7	11.6	12.0	11.9	11.8	11.825	0.4
8	11.5	12.1	11.9	12.0	11.875	0.6
9	12.1	12.1	11.7	11.9	11.95	0.4
10	11.7	12.0	11.6	11.9	11.8	0.4
11	12.1	12.4	11.9	12.2	12.15	0.5
12	12.5	12.0	12.4	12.3	12.3	0.5
13	12.5	12.0	12.1	12.1	12.175	0.5
14	12.4	12.0	12.0	12.4	12.2	0.4
15	12.4	12.4	12.6	12.1	12.375	0.5

Examine the given run chart or control chart and determine whether the process is within statistical control. If it is not, identify which of the three out–of–control criteria apply.

6) A control chart for $\overline{x}$ is shown below. Determine whether the process mean is within statistical control. If it is not, identify which of the three out–of–control criteria lead to rejection of a statistically stable mean.
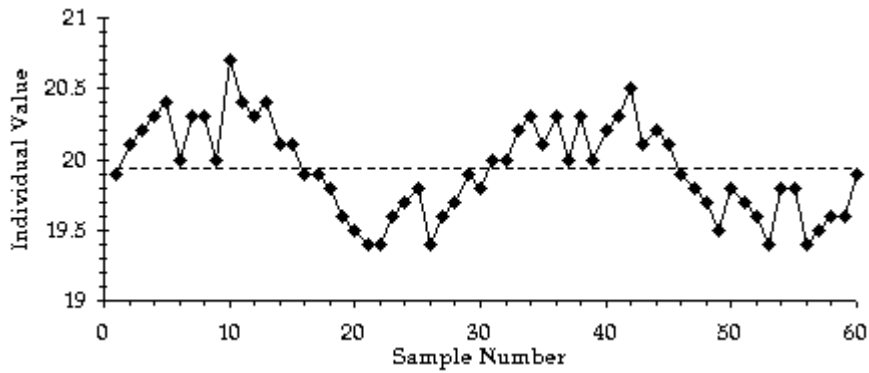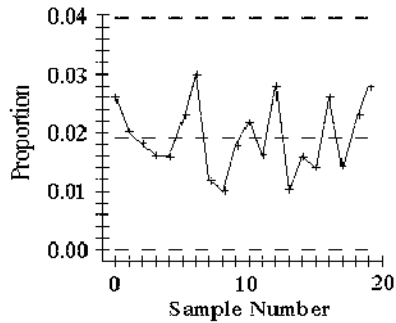

X Chart for BB Size

7) A control chart for R is shown below. Determine whether the process variation is within statistical control. If it is not, identify which of the three out–of–control criteria lead to rejection of statistically stable variation.

8) A run chart for individual values is shown below. Does there appear to be a pattern suggesting that the process is not within statistical control? If so, describe the pattern.
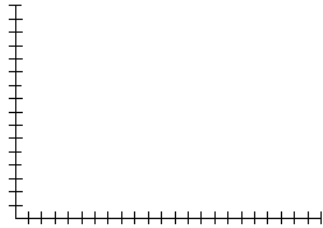

9)

Use the given process data to construct a control chart for p.

10) A drugstore considers a wait of more than 5 minutes to be a defect. Each week 100 customers are randomly selected and timed at the checkout line. The numbers of defects for 20 consecutive weeks are given below.

4 4 5 5 5 5 5 6 6 6 6 12 6 6 6 7 6 7 8 7

Solve the Problem.

11) A control chart for atrributes is to be constructed. Which process would have wider control limits, a process which has been having a 5% rate of nonconforming items, or a process which has been having a 10% of nonconforming items? Assume that both processes have the same sample sizes. For a given sample size, would it be easier to detect a shift from 5% to 10% or a shift from 10% to 15%? Explain your reasoning.

SHORT ANSWER. Write the word or phrase that best completes each statement or answers the question.

1) A run chart is a sequential plot of individual data values over time. The horizontal axis typically is used for the time sequence, and the vertical axis is used for the values of the data.

2) A control chart of a process characteristic (such as a mean or range) consists of values plotted sequentially over time, and it includes a center line, representing a central value of the characteristic measurement, as well as lower and upper control limits, representing boundaries used to separate and identify any points considered to be unusual.

	Points plotted	Center line and how to compute	Upper control limit	Lower control limit
Control chart for R	sample ranges	$\overline{R}$, the average of the sample ranges	$D_4\overline{R}$ D_4 is from a table	$D_3\overline{R}$ D_3 is from a table
Control chart for $\overline{X}$	sample means	$\overline{\overline{X}}$, the average of the sample means	$\overline{\overline{X}} + A_2\overline{R}$ A_2 is from a table	$\overline{\overline{X}} - A_2\overline{R}$ A_2 is from a table
Control chart for p	sample proportions	$\overline{p}$, the pooled estimate of the proportion for all items sampled	$\overline{p} + 3\sqrt{\dfrac{\overline{p} \cdot \overline{q}}{n}}$	$\overline{p} - 3\sqrt{\dfrac{\overline{p} \cdot \overline{q}}{n}}$ If the lower control limit is negative, use 0.

3)
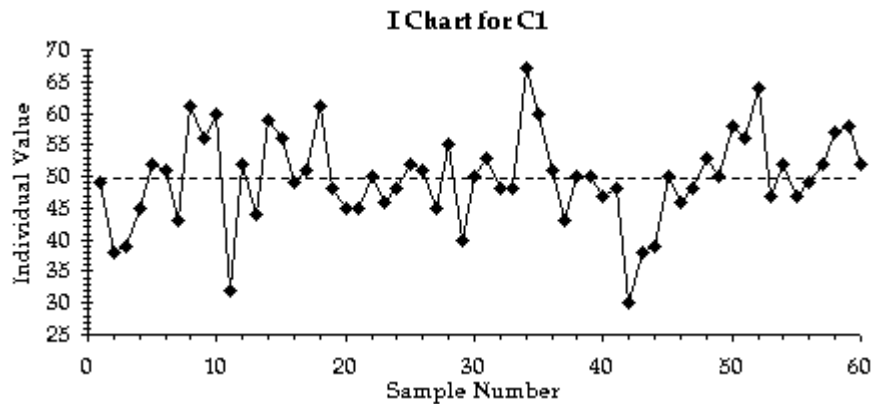
4) The process appears to be within statistical control.

**R Chart for BB Size**

5)

X Chart for Can Amt
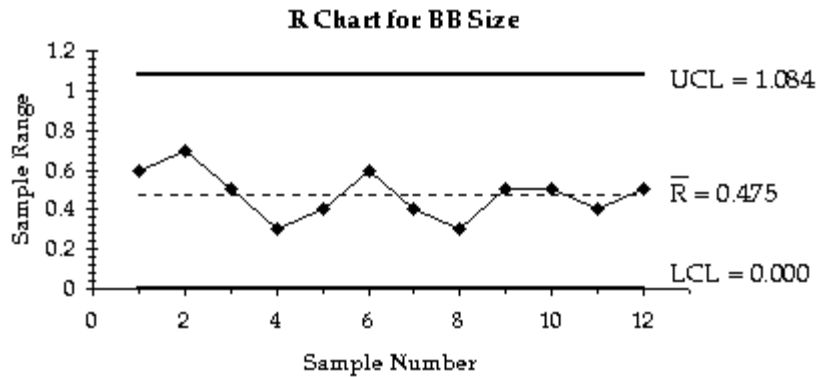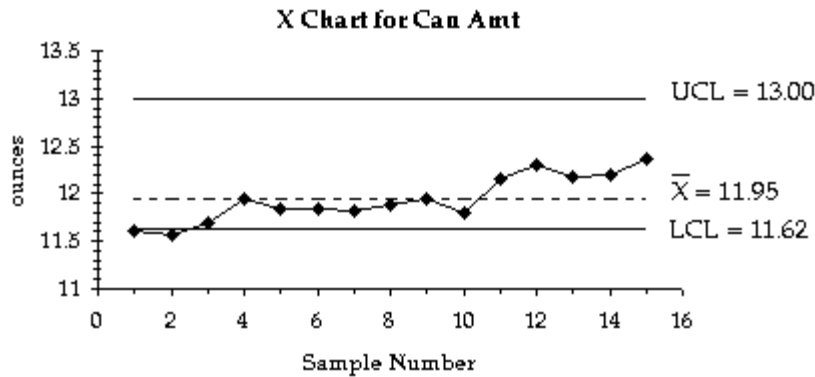
6) Process mean is not within statistical control. There are points above and below the control limits. There is a shift upward.

7) Process variation appears to be out of statistical control . There is an upward trend indicating that variation is increasing. There are points above the upper control limit. There are more than 8 consecutive points below the center line.

8) Process appears to be out of statistical control. There is a cyclical pattern.

9) Process appears to be within statistical control.

10)
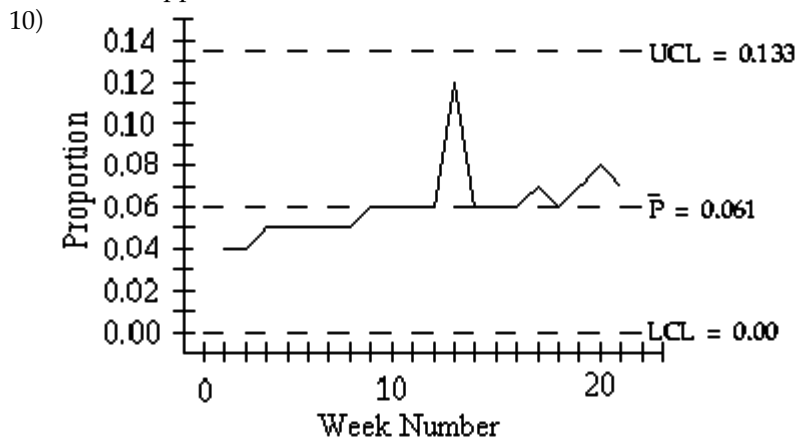
11) The process which has been having a 10% of nonconforming items would have wider control limits. It would be easier to detect a shift from 5% to 10% than a shift from 10% to 15%, because at a 5% rate of nonconforming items, the control limits are narrower, and it thus takes a smaller shift before the proportion falls outside the control limits.