Math 1530 Final Exam
December 6, 2008

Name _____
Section # _____
Instructor _____

There are five possible responses to each of the following multiple choice questions. There is only one "BEST" answer. Be sure to read all possible choices before selecting your answer. You may mark on this examination. You should use a calculator, but it is not required. However, a calculator manual cannot be used.

FORM A

1. An investigator has a computer file showing family incomes for 1,000 subjects in a certain study. These range from $5,800 a year to $98,600 a year. By accident, the lowest income in the file gets changed to $580. Which of the following is correct?

   (A) The mean, median, standard deviation and the IQR will all be affected.

   (B) The mean, median, standard deviation and IQR will not be affected.

   (C) The median and IQR will decrease but the mean and standard deviation will not be affected.

   (D) The mean will decrease, the standard deviation will increase but the median and the IQR will not be affected.

   (E) The mean and standard deviation will both decrease.

2. You look at real estate ads for houses in Sarasota, Florida. There are many houses ranging from $200,000 to $400,000 in price. The few houses on the water, however, have prices up to $15 million. The distribution of house prices will be

   (A) roughly symmetric. (B) skewed left. (C) normally distributed. (D) skewed right. (E) a stemplot.

   Use the following for the next 3 questions. Environmental Protection Agency fuel economy estimates for automobile models tested predicted a mean of 24.8 miles per gallon (mpg) and a standard deviation of 6.2 mpg for highway driving. Assume that mpg can be approximated by the Normal distribution.

3. About what percent of autos should get less than 31 mpg?

   (A) 16% (B) 32% (C) 68% (D) 50% (E) 84%

4. About what percent of autos should get between 6.2 and 43.4 mpg?

   (A) 99.7% (B) 68% (C) 95% (D) 32% (E) 50%

5. Describe gas mileage of the best 2.5% of all cars.

   (A) above 37.2 mpg (C) less than 18.6 mpg

   (B) less than 12.4 mpg (D) between 12.4 and 37.2 mpg

   (E) less than 6.2 mpg

   Use the following for the next 2 questions. The following data (sorted) are the percents of residents aged 65 and older in the 50 states, according to the 2000 censuses.

5.7	8.5	9.6	9.7	9.9	10.6	11.0	11.2	11.2	11.3	11.3	11.6	11.7
11.7	12.0	12.0	12.1	12.1	12.1	12.1	12.3	12.4	12.4	12.5	12.7	12.8
12.9	13.0	13.0	13.0	13.1	13.2	13.2	13.3	13.3	13.3	13.4	13.5	13.5
13.6	13.8	14.0	14.3	14.4	14.5	14.7	14.9	15.3	15.6	17.6		

6. Which of the following best describes the distribution?

   (A) double peaked (C) strongly skewed right

   (B) strongly skewed left (D) 5-number summary with an outlier

   (E) ignoring the outliers, it is close to symmetric

7. The center of the distribution is close to

   (A) 13.5% (B) 5.7% to 17.6% (C) 12.7% (D) 138% (E) 11.0%

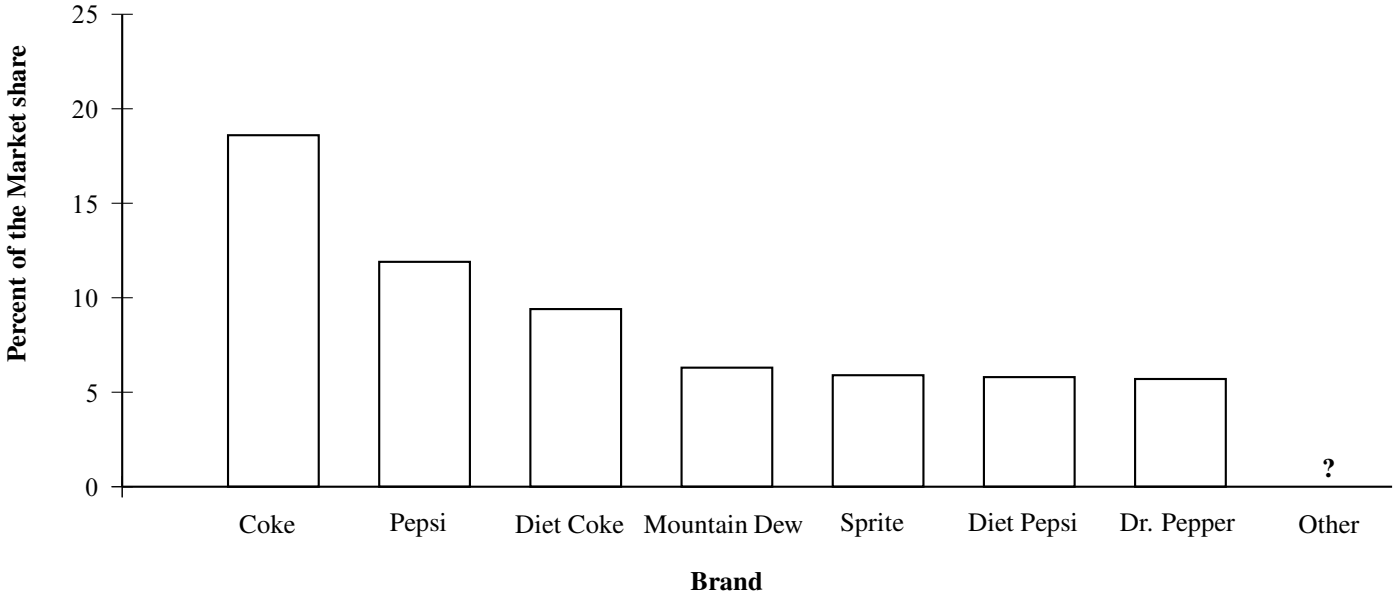
Use the following for the next 2 questions. Here are the IQ test scores of 10 randomly chosen fifth-grade students:

145 139 126 122 125 130 96 110 118 118

8. The five-number summary of the 10 IQ scores is
   (A) 96, 114, 125, 134.5, 145. (C) 96, 118, 123.5, 130, 145.
   (B) 96, 118, 122, 130, 145. (D) 145, 126, 127.5, 110, 118.
   (E) 96, 118, 122.9, 130, 145.

9. The mean of these 10 IQ scores is
   (A) 123.5. (B) 122.9. (C) 136.6. (D) 127.5. (E) 13.95.

Use the following for the next 2 questions. The following bar graph shows the percents of market share of the best-selling brands of carbonated soft drinks in 2003.



10. About what percent of the soft drink market is held by all **other** brands?
    (A) 36% (B) 12.5% (C) 64% (D) 0% (E) 100%

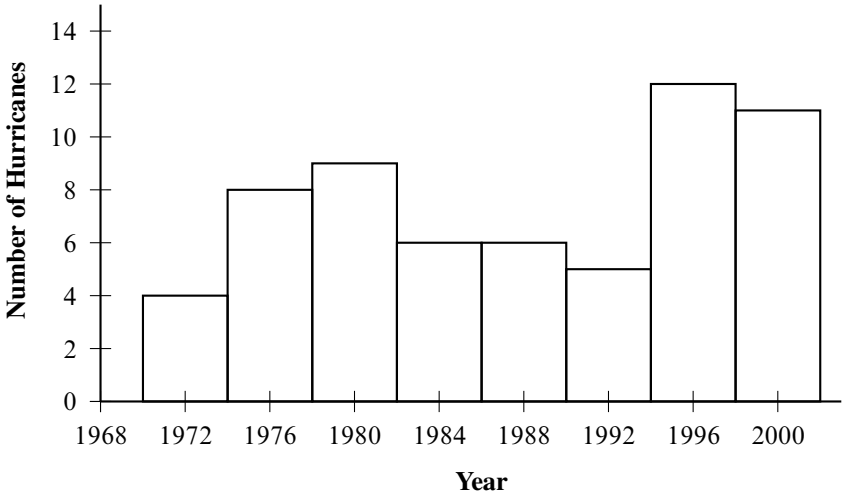
11. Comment on this graph.
    (A) The distribution is skewed right.
    (B) Ignoring all **other** brands, Coke has the largest market share.
    (C) The center of this graph is Mountain Dew.
    (D) The distribution is U-shaped.
    (E) The distribution is nearly symmetric.

12. To illustrate a talk you are giving, you want to make a graph to compare the percents of adults in several countries who have completed an undergraduate degree. For example, this percent is 9% in France and 24% in the United States. You should make a
    (A) histogram. (B) bar graph. (C) pie chart. (D) boxplot. (E) a stemplot.

13. A student was given an assignment to make a histogram from data showing the number of hurricanes recorded annually from 1970-2000. Here is the data:

year	’70	’71	’72	’73	’74	’75	’76	’77	’78	’79	’80	’81
number of hurricanes	2	1	0	1	2	3	2	1	2	2	2	3
year	’82	’83	’84	’85	’86	’87	’88	’89	’90	’91	’92	’93
number of hurricanes	1	1	1	3	0	1	3	2	1	2	1	1
year	’94	’95	’96	’97	’98	’99	’00					
number of hurricanes	0	5	6	1	3	5	3					

The student produced the following display. Comment on this graph.



(A) The distribution of hurricanes looks bimodal with a center of 1986 and a spread of 30 years.

(B) The distribution is skewed left.

(C) The distribution is skewed right with a center of 1986.

(D) The distribution is nearly symmetric around 1986.

(E) This is not correct. The horizontal axis should split the number of hurricanes recorded into classes. The vertical axis should show the number of years in each class.

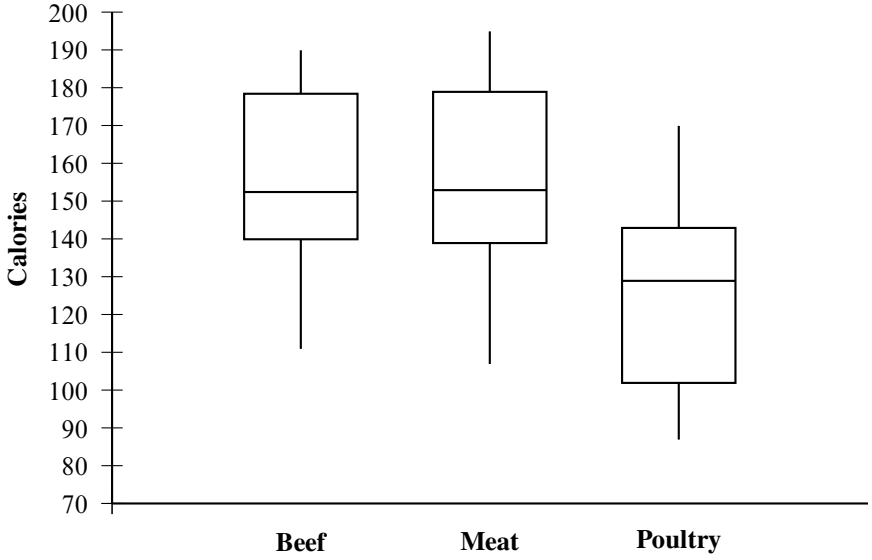
14. Here is a stemplot of the percent of adult males who are illiterate in 142 countries, according to the United Nations. For example, the highest illiteracy rate was 79%, in the African country Niger.

0	00000000000000111111111122223344444444
0	55555566667777788889999
1	0000111123344
1	5677788899
2	0000111234
2	556677899
3	00011344
3	6777888
4	024
4	56668
5	0111234
5	557
6	002
6	
7	1
7	9

The overall shape of this distribution is

(A) somewhat symmetric. (B) strongly skewed left. (C) no clear shape. (D) strongly skewed right. (E) bimodal.

Use the following for the next 3 questions. Here are the boxplots of the number of calories in 20 brands of beef hot dogs, 17 brands of meat hot dogs, and 17 brands of poultry hot dogs.



15. The main advantage of boxplots over stemplots and histograms is

(A) boxplots show more detail about the shape of the distribution.

(B) boxplots use the five-number summary, whereas stemplots and histograms use the mean and standard deviation.

(C) boxplots show skewed distributions, whereas stemplots and histograms show only symmetric distributions.

(D) boxplots show symmetric distributions, whereas stemplots and histograms show only skewed distributions.

(E) boxplots make it easy to compare several distributions, as in this example.

16. This plot shows that

(A) all poultry hot dogs have fewer calories than the median for beef and meat hot dogs.

(B) most poultry hot dog brands have fewer calories than most beef and meat hot dogs, but a few poultry hot dogs have more calories than the median beef and meat hot dog.

(C) about half of poultry hot dog brands have fewer calories than the median for beef and meat hot dogs.

(D) hot dog type is not helpful in predicting calories, because some hot dogs of each type are high and some of each type are low.

(E) the mean number of calories for poultry hotdogs is 130.

17. We see from the plot that the median number of calories in a beef hot dog is about

(A) 190. (B) 179. (C) 139. (D) 153. (E) 129.

18. There is a positive correlation between the size of a hospital (measured by number of beds) and the median number of days that patients remain in the hospital. Does this mean that you can shorten a hospital stay by choosing to go to a small hospital?

(A) Yes, the data show that stays are shorter in smaller hospitals.

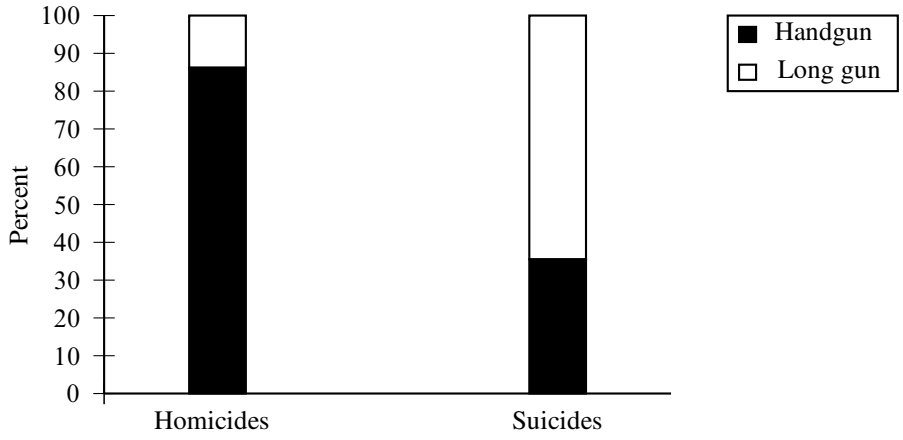
(B) Yes, the correlation can't be just by an accident.

(C) No, a negative correlation would allow that conclusion, but this correlation is positive.

(D) No, this is reverse cause-and-effect.

(E) No, the positive correlation is probably explained by the fact that seriously ill people go to large hospitals.

19. Firearms are second to motor vehicles as a cause of nondisease deaths in the United States. Here are the bar charts from a study of all firearm-related deaths in Wisconsin between 2000 and 2002 for children and youth under the age of 25 where the type of firearm used was known. We want to compare the types of firearms used in homicides and suicides.



What can this study conclude?

(A) The bar charts show that a considerably higher percentage of long-gun deaths were homicides.

(B) The graph is clearly bimodal with the same number of homicides as suicides.

(C) There aren't any differences between the number of homicides and suicides since the bars are of equal height.

(D) There is evidence to suggest that long guns are used more often for suicides than for homicides. We also observe that handguns accounted for 86% of homicides but only about 36% of suicides.

(E) Firearms and deaths are negatively correlated. In other words, as guns get longer the firearm-related deaths go from homicide to suicide.

20. On October 23, 2008 AOL conducted an online poll of their subscribers to see who voters preferred in the presidential race. Approximately 281,000 responses were recorded. Of these 56% picked McCain and 42% picked Obama. Identify the type of sampling used in this example.

(A) simple random sampling (C) voluntary response sampling

(B) systematic sampling (D) stratified random sampling

(E) census

21. In a study of the relationship for senior citizens between physical activity and frequency of colds, participants were asked to monitor their weekly time spent in exercise over a five-year period and frequency of colds. The study demonstrated that a negative statistical relation exists between time spent in exercise and frequency of colds. The investigator concluded that increasing the time spent in exercise is an effective strategy for reducing the frequency of colds for senior citizens. This is an example of

(A) an experiment. (C) an observational study, not an experiment.

(B) a matched pairs experiment. (D) a stratified experiment.

(E) an experiment using a block design.

22. The Pepsi Company designed a study to demonstrate that Coke drinkers prefer Pepsi when they taste both colas blind. The subjects, all people who said that they were Coke drinkers, tasted both colas using cups without brand identification and said which they liked better. Because responses depend on which cola is tasted first, the order of tasting was chosen at random for each subject. This experiment uses

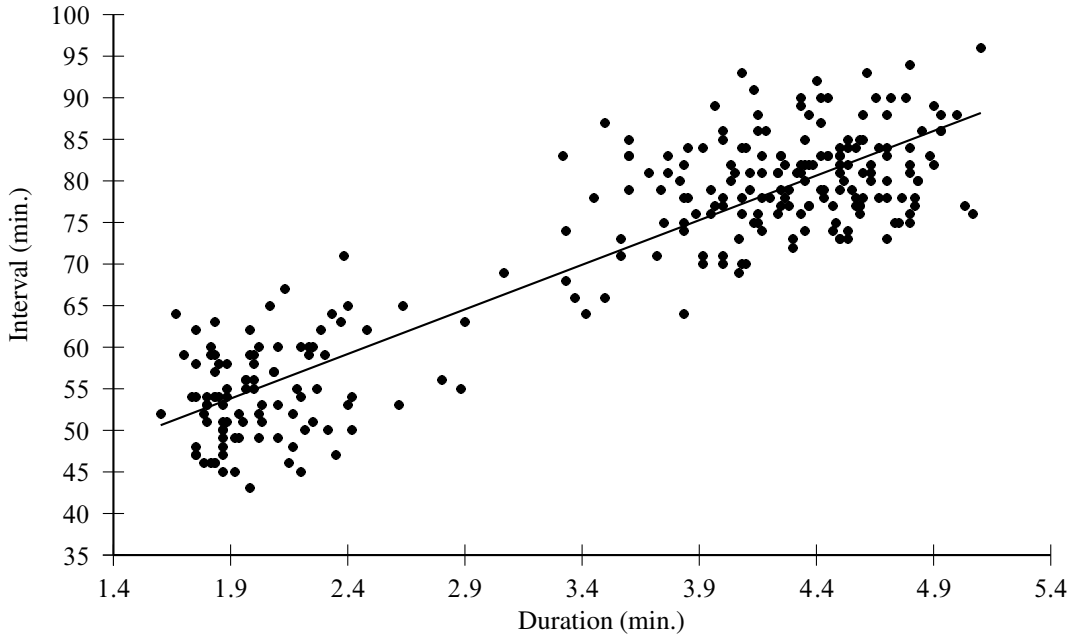
(A) a matched pair design. (C) double blinding.

(B) a factorial design. (D) random placebos.

(E) double replication.

Use the following for the next 3 questions. Can we predict the next eruption of the Old Faithful geyser by knowing the duration of the previous eruption? The observations and least-squares regression line appear in the scatterplot. The correlation between the two variables is $r = 0.901$ and the least-squares regression line for predicting the *Interval* (min.) between eruptions and the *Duration* (min.) of the previous eruption is

$$\texttt{Interval} = 33.47 + 10.73 \times \texttt{Duration}$$



23. Describe the association between *Duration* and *Interval* of the Old Faithful geyser.

(A) There appears to be a fairly strong positive linear relationship with two distinct clusters of data.

(B) There appears to be a fairly strong negative linear relationship with two distinct clusters of data.

(C) There appears to be weak relationship since $r = 0.901$ is smaller than 1.

(D) There appears to a weak relationship because of the two clusters of data.

(E) The relationship would be stronger if r^2 were less than 81%.

24. Explain what the slope of the line means in this context.

(A) If duration goes up by one minute, the interval between eruptions goes up 10.73 minutes on the average.

(B) Since the correlation is .901, time between eruptions increases by about 90%.

(C) The time between eruptions increases by about 33.47 minutes on the average.

(D) The duration of a previous eruption lasts on the average of about 10.73 minutes.

(E) We can predict the time between eruptions will be 10.73 minutes and this can be stated with 0.901 probability.

25. If you just witnessed an eruption that lasted 2 minutes, how long do you predict that you will have to wait until the next eruption?

(A) about 44 mins. (B) about 62 mins. (C) about 55 mins. (D) about 78 mins. (E) about 88 mins.

26. A light bulb manufacturer sells a light bulb that has a mean life of 1450 hours with a standard deviation of 33.7 hours. A new manufacturing process is being tested and there is interest in knowing the mean life μ of the new bulbs. How large a sample is required in order to get a margin of error no larger than ± 5 hours with 95% confidence? You may assume that the standard deviation is 33.7 hours.

(A) 14 (B) 123 (C) 12 (D) 4 (E) 175

27. In an USA criminal trial, the null hypothesis is that the defendant is innocent and the alternative hypothesis is that the defendant is guilty. Which of the following describes a Type I error?

(A) A not guilty verdict for a person who is guilty.
(B) A not guilty verdict for a person who is innocent.
(C) A guilty verdict for a person who is not innocent.
(D) Not enough information is provided to describe a Type I error.
(E) A guilty verdict for a person who is innocent.

Use the following for the next 2 questions. The Physicians Health Study followed 22,000 male physicians for a period of several years. About 11,000 took an aspirin every second day while the rest took a placebo. The subjects had been randomly placed in one of the two groups. At the completion of the study, it was noted whether a subject had experienced a heart attack during the period of the study. It was found that the aspirin group had significantly fewer heart attacks than the placebo group.

28. The factor in the experiment is

(A) the severity of the heart attack.
(B) use of a placebo.
(C) the length of the study.
(D) the 22,000 subjects.
(E) medication used (aspirin or placebo).

29. The response variable in this experiment is

(A) whether a heart attack occurred.
(B) the placebo effect.
(C) whether the symptoms lessened.
(D) aspirin or placebo.
(E) the length of the study.

Use the following for the next 7 questions. Researchers at Eastern University conducted a study on their university students to see if there was a link between gender and how often they have cheated on an exam. They selected simple random samples of 100 female students and 100 male students. Two questions were asked of each student:

- What is your gender? Female _____ Male _____
- How many times have you cheated on an exam while in college? Never_____ 1 or 2 times_____ 3 or more times _____

Tabulated statistics: Gender, Cheated on Exam

Rows: Gender Columns: Cheated on Exam

	Never	One or Two	Three or more	All
Female	65	30	5	100
Male	60	24	16	100
All	125	54	21	200

Cell Contents: Count

30. What proportion of male students have cheated 3 or more times?

(A) 8% (B) 16% (C) 76% (D) 40% (E) 33%

31. What proportion of the students in the study are females who cheated 1or 2 times?

(A) 30% (B) 56% (C) 17% (D) 15% (E) 86%

32. If one of the 200 students is selected at random, what is the probability that the student is female given that the student has cheated 3 or more times?

(A) 5% (B) 24% (C) 2.5% (D) 21% (E) 7%

33. If one of the 200 students is selected at random, what is the probability that the student is female and cheated?

(A) 35% (B) 37.5% (C) 17.5% (D) 75% (E) 50%

34. Considering the researchers' objectives, what would be the appropriate null hypothesis to test using a chi-square procedure?

(A) There is a difference in the distributions of cheating on exams reported by male and female students at Eastern University.

(B) There is no difference in the distributions of cheating on exams reported by male and female students at Eastern University.

(C) p = 0.50 where p = probability of answering "Never" to question (2) on survey.

(D) There is a relationship between the two variables.

(E) Males cheat more than Females.

35. From the analysis shown below, what can we conclude if $\alpha = 0.01$?

(A) There is a difference in the distributions of cheating on exams reported by males and females at Eastern University.

(B) Males cheat more than females.

(C) Females cheat more than males.

(D) There is no difference in the distributions of cheating on exams reported by male and female students at Eastern University.

(E) More students don't cheat than do cheat.

Tabulated statistics: Gender, Cheated on Exam

Rows: Gender Columns: Cheated on Exam

	Never	One or Two	Three or more	All
Female	65	30	5	100
	62.50	27.00	10.50	100.00
Male	60	24	16	100
	62.50	27.00	10.50	100.00
All	125	54	21	200
	125.00	54.00	21.00	200.00

Cell Contents: Count
Expected count

Chi-Square = 6.629, DF = 2, P-Value = 0.036

36. Would the conclusion change if $\alpha = 0.05$?

(A) No. (C) Yes.

(B) Maybe. (D) Only if more than 200 students were selected.

(E) Only if less than 200 students were selected.

37. A recent national study showed that approximately 45% of college students binge drink. Let X equal the number of students in a random sample of size $n = 5$ who binge drink. The probability distribution is

Number of binge drinkers X	0	1	2	3	4	5
Probability	0.0503	0.2059	0.3369	0.2757	0.1128	0.0184

What is the probability that there will be at least four binge drinkers in the sample?

(A) 0.1128 (B) 0.0184 (C) 0.8688 (D) 0.1312 (E) $.45^4 = 0.0410$

38. Joe is writing a report on the backgrounds of American presidents. He looks up the ages of all 43 presidents when they entered office. He finds that the mean age of the presidents is 54.8 years with the standard deviation of 6.19 years. Because Joe took a statistics course, he calculates a 95% confidence interval for the mean age of all men who have been president to be 54.8 ± 1.89. Comment on this result.

    (A) The confidence interval makes no sense since Joe has the entire population of ages.

    (B) Joe can be 95% confident that the mean age of all presidents is 54.8 years.

    (C) 95% of all the ages of the presidents lie between 54.8 ± 1.89.

    (D) Joe is 95% confident that the mean age of all presidents lies between 52.91 and 56.69 years.

    (E) Joe should have taken a larger sample to reduce the margin of error.

39. Studies have shown that walnuts can reduce blood cholesterol. Rich in polyunsaturated fatty acids, walnuts also help keep blood vessels healthy and elastic. Almonds appear to have a similar effect, resulting in a marked improvement within just four weeks. A statistical test is more likely to find a significant decrease in blood cholesterol if

    (A) it is based on a very small random sample.

    (B) it is based on a very large random sample.

    (C) the p-value is large.

    (D) the test of hypotheses is not rejected.

    (E) the size of the sample doesn't have any effect on the significance of the test.

40. An anthropologist suspects that color blindness is less common in societies that live by hunting and gathering than in settled agricultural societies. He tests a number of adults in two populations in Africa, one of each type. The proportion of color-blind people is significantly lower ($P - value < 0.05$) in the hunter-gatherer population. What additional information would you want to help decide whether you accept the claim about color blindness?

    (A) What was the proportion of color-blind people in the hunter-gatherer population?

    (B) Were these random samples? How big were the samples?

    (C) Was this a double-blind study?

    (D) What is the **Who, What, Where**?

    (E) What does the side-by-side boxplots look like? Were the samples normally distributed?

41. A Tennessee state senator wants to know what the voters of Tennessee think of proposed legislation regarding an increase in state sales tax. He mails a questionnaire to a simple random sample of 3000 voters in Tennessee. His staff reports that 789 questionnaires have been returned, of which 678 are against the legislation. This is an example of

    (A) a survey with little bias because a large SRS was used.

    (B) a survey containing nonresponse.

    (C) a survey with little bias because it was the voters that elected the senator.

    (D) a survey that is representative of the voters thinking.

    (E) All of the above.

42. The results of an experiment are said to be statistically significant if

    (A) the observed effect is too large to attribute plausibly to chance.

    (B) the results are important to statisticians, regardless of their importance to the researchers.

    (C) both researchers and statisticians agree that the results are meaningful and important.

    (D) they support the findings of previous, similar studies.

    (E) a null hypothesis has to be accepted.

Use the following for the next 2 questions. What is normal body temperature? A paper published in the *Journal of the American Medical Association* presented evidence that normal body temperature may be less than 98.6 degrees Fahrenheit, the long-held standard. We are interested in testing the hypotheses

$$H_0 : \mu = 98.6 \; vs. \; H_a : \mu < 98.6$$

Suppose that a random sample of $n = 20$ normal body temperatures is

98.6	97.6	99.0	98.4	97.8	96.8	98.6	98.7	97.4	98.8
98.4	98.2	97.3	97.7	98.4	99.2	98.1	98.0	97.5	97.8

Minitab output:

Stem-and-leaf of temp $N = 20$
Leaf Unit = 0.10

1	96	8
3	97	34
8	97	56788
(6)	98	012444
6	98	6678
2	99	02

One-Sample T: temp

Test of mu = 98.6 vs < 98.6

Variable	N	Mean	StDev	SE Mean	95% upper Bound	T	P
temp	20	98.115	0.625	0.140	98.357	-3.47	0.001

43. Is there good evidence the mean normal body temperature is less than 98.6 degrees Fahrenheit? Use $\alpha = .05$.

(A) No, there is insufficient evidence to suggest that the mean normal body temperature is less than 98.6 degrees Fahrenheit.

(B) Yes, since there is only a .1% chance that the null hypothesis ($\mu = 98.6$) is correct.

(C) The results are inconclusive at $\alpha = .05$ and a larger sample size should be taken.

(D) No, since $P = 0.001$ we fail to reject the null hypothesis.

(E) Yes, there is strong evidence that the mean normal body temperature is less than 98.6 degrees Fahrenheit.

44. Any reason(s) why we should question the use of the t-procedure?

(A) No, the use of the t-procedure is appropriate when σ is unknown.

(B) Yes, the z-test should have been used instead of the t-test.

(C) No, the above analysis is appropriate to answer the research question since the data are based on a sample of normal body temperatures.

(D) No, the stemplot illustrates that there are no outliers and the shape does not appear to be notably skewed.

(E) Yes, the sample size needs to be at least 30 in order to use the t-procedure.

45. A radio talk show host in Chicago is interested in the proportion p of adults in his listening area who think the drinking age should be lowered to eighteen. To find this out he poses the following question to his listeners. "Do you think that the drinking age should be reduced to eighteen in light of the fact that eighteen-year-olds are eligible for military service?" He asks listeners to phone in and vote "yes" if they agree the drinking age should be lowered and "no" if not. Of the 1000 people who phoned in 700 answered "yes." Which of the following assumptions for inference about a proportion using a confidence interval are violated?

(A) The population is at least ten times as large as the sample.

(B) The data are an SRS from the population of interest.

(C) n is so large that both the count of successes $n\hat{p}$ and the count of failures $n(1 - \hat{p})$ are ten or more.

(D) Each observation falls into one of just two categories.

(E) There appear to be no violations.

Use the following for the next 4 questions. *Time* Magazine wants to know the opinion of adult Americans to the question "If you or your spouse were pregnant, would you want the unborn child tested for genetic defects?" Specifically, they wanted to known what proportion of all adult Americans who would say yes to this question. They conducted a survey and selected a simple random sample of 1600 adult Americans. In the sample, 928 people answered "yes."

46. What is the population of interest in this survey?

(A) The 1600 adults interviewed

(B) The 928 adults who answered yes to the question.

(C) The people who conducted the survey.

(D) The proportion of adults that answered yes in the survey.

(E) All adult Americans

47. What is the parameter to be estimated?

(A) 1600

(B) 0.58

(C) The proportion of adult Americans who would want their unborn child tested for genetic defects.

(D) All adult Americans

(E) 928

48. Based on the sample collected, what is the estimated value of the parameter?

(A) 928 (B) 1600 (C) 1.72 (D) 0.58 (E) Unknown, we need to take a census.

49. With 95% confidence, estimate the proportion of the adult Americans who would want their unborn child tested for genetic defects.

(A) 1600 ± 0.9674 (B) 1.72 ± 0.0242 (C) 0.58 ± 0.0242 (D) 0.58 ± 2.42 (E) 928 ± 0.0242

50. It is believed that 20% of Americans do not have any health insurance. Suppose this is true and let X equal the number with no health insurance in a random sample of $n = 7$ Americans. Find $P(X \leq 3)$.

(A) 0.9667 (B) 0.0333 (C) $0.2^3 = .008$ (D) $3/7 = 0.4286$ (E) 0.8520

51. According to a $CNN/USA\,Today$ poll, approximately 70% of Americans believe the IRS abuses its power. Let X equal the number of people who believe the IRS abuses its power in a random sample of $n = 1000$ Americans. What is the mean number of Americans in the sample who think the IRS abuses its power?

(A) 0.70 (B) 70/1000 (C) 700 (D) 1/1000 (E) 300

52. A pack of a certain brand of cigarettes displays the statement "1.5 mg nicotine average per cigarette." Let μ denote the mean nicotine content per cigarette for all cigarettes of this brand. People who smoke this brand would probably be disturbed if it turned out that the true average nicotine content exceeded the claimed value. We carry out a test of the hypotheses: $H_0 : \mu = 1.5$ and $H_a : \mu > 1.5$. Which is a correct description of the Type II error?

(A) We believe the advertisement but the true average content is above 1.5 mg.

(B) The true average nicotine content is 1.5 mg but we decide that it is higher.

(C) The true average nicotine content is 1.5 mg but we decide that it is lower.

(D) The true average nicotine content is 1.5 mg but we decide that it is different.

(E) The p-value of the test must be smaller than α.

53. The national mean IQ test score for seventh grade girls is 100. An educator wonders if seventh grade girls who attend charter schools have a mean IQ different from the national mean IQ score. She selects a simple random sample of 50 seventh grade girls from charter schools and finds that the mean IQ of those 50 girls is 102 and the standard deviation is 13. She calculates a 95% confidence interval for the mean IQ of all seventh grade girls in charter schools and finds it to be $(98.305, 105.695)$. Which of these statements IS TRUE?

    (A) The study definitely concludes that charter school seventh grade girls have a mean IQ score higher than the national mean of 100 at the 0.05 level.

    (B) We are 95% confident that all charter school girls have their IQ scores between 98.305 and 105.695.

    (C) The sample mean is equal to the population mean and this can be stated with 95% confidence.

    (D) The study does not provide enough evidence to claim that charter school seventh grade girls have a mean IQ different from the national mean of 100 at the 0.05 level.

    (E) 95% of girls in charter schools have their IQ scores between 98.305 and 105.695.

54. Does using premium gas increase your miles per gallon? A study was conducted with three vehicles that can run on regular gas to see if using premium gas will get better gas mileage. Each car in our sample was randomly filled first with either regular or premium gasoline, and the mileage for that tankful recorded. The mileage was recorded again for the same cars for a tankful of the other kind of gasoline.

	N	Mean	StDev
Premium	3	30.33	3.51
Regular	3	27.33	3.79
Difference Premium-Regular	3	3.00	2.65

The research question is *'Does using premium gas increase your miles per gallon?'*. Below you see four outputs from Minitab.

```
-------------------------------------------------------------------------
output 1) Paired T for Premium - Regular
          T-Test of mean difference = 0 (vs not = 0): T-Value = 1.96  P-Value = 0.188
-------------------------------------------------------------------------------------
output 2) Paired T for Premium - Regular
      T-Test of mean difference = 0 (vs > 0): T-Value = 1.96  P-Value = 0.094
-------------------------------------------------------------------------------------------
output 3) Test of mu = 0 vs > 0
                                    95% Lower
Variable  N   Mean  StDev  SE Mean      Bound      T      P
Premium   3  30.33   3.51     2.03      24.41  14.96  0.002
-----------------------------------------------------------
output 4) Test of mu = 27.33 vs > 27.33
                                    95% Lower
Variable  N   Mean  StDev  SE Mean      Bound      T      P
Premium   3  30.33   3.51     2.03      24.41   1.48  0.139
-----------------------------------------------------------
```

Which of the outputs would you select and what would your answer be to the research question? Use significance level $\alpha = .05$.

    (A) Output 1; The probability that the null hypothesis is true is 0.188.

    (B) Output 4; Fail to reject H_0 and conclude that mean miles per gallon using premium is 27.33.

    (C) Output 4; There is strong evidence to suggest that using premium gas will increase your miles per gallon.

    (D) Output 3; There is strong evidence to suggest that the average miles per gallon using premium gas is greater than 0.

    (E) Output 2; There is insufficient evidence to suggest that cars that can run on regular gas will increase their miles per gallon using premium gas. A larger sample size should be taken to better evaluate the use of premium gas.

Binomial Probability Table

		p											
n	*x*	.01	.05	.10	.15	.20	.25	.30	1/3	.35	.40	.45	.50
1	0	0.9900	0.9500	0.9000	0.8500	0.8000	0.7500	0.7000	0.6667	0.6500	0.6000	0.5500	0.5000
	1	0.0100	0.0500	0.1000	0.1500	0.2000	0.2500	0.3000	0.3333	0.3500	0.4000	0.4500	0.5000
2	0	0.9801	0.9025	0.8100	0.7225	0.6400	0.5625	0.4900	0.4444	0.4225	0.3600	0.3025	0.2500
	1	0.0198	0.0950	0.1800	0.2550	0.3200	0.3750	0.4200	0.4444	0.4550	0.4800	0.4950	0.5000
	2	0.0001	0.0025	0.0100	0.0225	0.0400	0.0625	0.0900	0.1111	0.1225	0.1600	0.2025	0.2500
3	0	0.9703	0.8574	0.7290	0.6141	0.5120	0.4219	0.3430	0.2963	0.2746	0.2160	0.1664	0.1250
	1	0.0294	0.1354	0.2430	0.3251	0.3840	0.4219	0.4410	0.4444	0.4436	0.4320	0.4084	0.3750
	2	0.0003	0.0071	0.0270	0.0574	0.0960	0.1406	0.1890	0.2222	0.2389	0.2880	0.3341	0.3750
	3	0.0000	0.0001	0.0010	0.0034	0.0080	0.0156	0.0270	0.0370	0.0429	0.0640	0.0911	0.1250
4	0	0.9606	0.8145	0.6561	0.5220	0.4096	0.3164	0.2401	0.1975	0.1785	0.1296	0.0915	0.0625
	1	0.0388	0.1715	0.2916	0.3685	0.4096	0.4219	0.4116	0.3951	0.3845	0.3456	0.2995	0.2500
	2	0.0006	0.0135	0.0486	0.0975	0.1536	0.2109	0.2646	0.2963	0.3105	0.3456	0.3675	0.3750
	3	0.0000	0.0005	0.0036	0.0115	0.0256	0.0469	0.0756	0.0988	0.1115	0.1536	0.2005	0.2500
	4	0.0000	0.0000	0.0001	0.0005	0.0016	0.0039	0.0081	0.0123	0.0150	0.0256	0.0410	0.0625
5	0	0.9510	0.7738	0.5905	0.4437	0.3277	0.2373	0.1681	0.1317	0.1160	0.0778	0.0503	0.0313
	1	0.0480	0.2036	0.3280	0.3915	0.4096	0.3955	0.3601	0.3292	0.3124	0.2592	0.2059	0.1562
	2	0.0010	0.0214	0.0729	0.1382	0.2048	0.2637	0.3087	0.3292	0.3364	0.3456	0.3369	0.3125
	3	0.0000	0.0011	0.0081	0.0244	0.0512	0.0879	0.1323	0.1646	0.1811	0.2304	0.2757	0.3125
	4	0.0000	0.0000	0.0005	0.0022	0.0064	0.0146	0.0283	0.0412	0.0488	0.0768	0.1128	0.1562
	5	0.0000	0.0000	0.0000	0.0001	0.0003	0.0010	0.0024	0.0041	0.0053	0.0102	0.0185	0.0313
6	0	0.9415	0.7351	0.5314	0.3771	0.2621	0.1780	0.1176	0.0878	0.0754	0.0467	0.0277	0.0156
	1	0.0571	0.2321	0.3543	0.3993	0.3932	0.3560	0.3025	0.2634	0.2437	0.1866	0.1359	0.0938
	2	0.0014	0.0305	0.0984	0.1762	0.2458	0.2966	0.3241	0.3292	0.3280	0.3110	0.2780	0.2344
	3	0.0000	0.0021	0.0146	0.0415	0.0819	0.1318	0.1852	0.2195	0.2355	0.2765	0.3032	0.3125
	4	0.0000	0.0001	0.0012	0.0055	0.0154	0.0330	0.0595	0.0823	0.0951	0.1382	0.1861	0.2344
	5	0.0000	0.0000	0.0001	0.0004	0.0015	0.0044	0.0102	0.0165	0.0205	0.0369	0.0609	0.0938
	6	0.0000	0.0000	0.0000	0.0000	0.0001	0.0002	0.0007	0.0014	0.0018	0.0041	0.0083	0.0156
7	0	0.9321	0.6983	0.4783	0.3206	0.2097	0.1335	0.0824	0.0585	0.0490	0.0280	0.0152	0.0078
	1	0.0659	0.2573	0.3720	0.3960	0.3670	0.3115	0.2471	0.2048	0.1848	0.1306	0.0872	0.0547
	2	0.0020	0.0406	0.1240	0.2097	0.2753	0.3115	0.3177	0.3073	0.2985	0.2613	0.2140	0.1641
	3	0.0000	0.0036	0.0230	0.0617	0.1147	0.1730	0.2269	0.2561	0.2679	0.2903	0.2918	0.2734
	4	0.0000	0.0002	0.0026	0.0109	0.0287	0.0577	0.0972	0.1280	0.1442	0.1935	0.2388	0.2734
	5	0.0000	0.0000	0.0002	0.0012	0.0043	0.0115	0.0250	0.0384	0.0466	0.0774	0.1172	0.1641
	6	0.0000	0.0000	0.0000	0.0001	0.0004	0.0013	0.0036	0.0064	0.0084	0.0172	0.0320	0.0547
	7	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0002	0.0005	0.0006	0.0016	0.0037	0.0078
8	0	0.9227	0.6634	0.4305	0.2725	0.1678	0.1001	0.0576	0.0390	0.0319	0.0168	0.0084	0.0039
	1	0.0746	0.2793	0.3826	0.3847	0.3355	0.2670	0.1977	0.1561	0.1373	0.0896	0.0548	0.0312
	2	0.0026	0.0515	0.1488	0.2376	0.2936	0.3115	0.2965	0.2731	0.2587	0.2090	0.1569	0.1094
	3	0.0001	0.0054	0.0331	0.0839	0.1468	0.2076	0.2541	0.2731	0.2786	0.2787	0.2568	0.2187
	4	0.0000	0.0004	0.0046	0.0185	0.0459	0.0865	0.1361	0.1707	0.1875	0.2322	0.2627	0.2734
	5	0.0000	0.0000	0.0004	0.0026	0.0092	0.0231	0.0467	0.0683	0.0808	0.1239	0.1719	0.2187
	6	0.0000	0.0000	0.0000	0.0002	0.0011	0.0038	0.0100	0.0171	0.0217	0.0413	0.0703	0.1094
	7	0.0000	0.0000	0.0000	0.0000	0.0001	0.0004	0.0012	0.0024	0.0033	0.0079	0.0164	0.0312
	8	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0001	0.0002	0.0002	0.0007	0.0017	0.0039

CONFIDENCE LEVEL	*TAIL AREA*	z^*
80%	0.1000	1.282
90%	0.0500	1.645
95%	0.0250	1.960
96%	0.0200	2.054
98%	0.0100	2.326
99%	0.0050	2.576
99.5%	0.0025	2.807