Statistics 36-201
Final Exam
May 4, 1998

INSTRUCTIONS

1. There are 40 Multiple Choice questions. Each is worth 2.5 points.
2. The Normal Table from Chapter 8 is on the back of this sheet. TEAR OFF THIS PAGE NOW.
3. The last page is for your answers. TEAR OFF THIS PAGE NOW.

   Put your NAME and SECTION on the answer sheet now.
4. For the multiple choice questions. Mark an X through ONE answer for each question ON THE ANSWER SHEET, not on the sheet with the test questions. Choose the best answer to each question.
5. When you are finished, hand in BOTH the answer sheet and the exam questions.

1. We want to test the hypothesis that children of mothers over 40 have IQs that equal, on average, the population average which is 100. We take a random sample of 100 children born of older mothers and find that the mean IQ is 105 and a standard deviation of 15. Based on these data our conclusion is which of the following?

   (a) The standardized score equals .33, reject the null hypothesis. The mean IQ in the population of children born of older mothers is significantly greater than 100.

   (b) The standardized score equals .33, do not reject the null hypothesis. The mean IQ in the population of children born of older mothers is not significantly different from 100.

   (c) The standardized score equals 3.33, do not reject the null hypothesis. The mean IQ in the population of children born of older mothers is not significantly different from 100.

   (d) The standardized score equals 3.33, reject the null hypothesis. The mean IQ in the population of children born of older mothers is significantly greater than 100.

   (e) The standardized score only provides weak support of the alternative hypothesis.

For problems 2-3 use the following information.

A student claims he is just guessing on a multiple choice test. We wish to test this hypothesis. Each question has 4 possible solutions, so his chance of getting a question right is 25%, if he is just guessing. Out of 100 questions the student got 35 correct.

2. Which of the following is true?

   (a) The test statistic is less than -2.

   (b) The test statistic is about 8.08.

   (c) The test statistic is about 2.3.

   (d) Instead of computing a standardized score, we should be computing the a chi-square statistic.

   (e) Not enough information was given to compute the test statistic.

3. What is the p-value?

   (a) The p-value is less than .01.

   (b) The p-value is between .01 and .05.

   (c) The p-value is between .10 and .05.

   (d) The p-value is greater than .01.

   (e) Not enough information was given to compute the p-value.

4. A confidence interval was computed for average body temperature of healthy adults. The 95% confidence interval is (98.0,98.5). We are interested in testing the null hypothesis that average body temperature is equal to 98.6. Based on the confidence interval we can conclude which of the following?

   (a) We have strong evidence supporting the null hypothesis.
   (b) We cannot reach a conclusion without knowing the standard deviation of the sample.
   (c) We cannot reach a conclusion without knowing the sample size.
   (d) We have strong evidence against the null hypothesis.
   (e) We cannot reach a conclusion without knowing the chance of committing a Type I error.

Questions 5-6 rely on the following information.

We want to estimate the proportion of faculty at Carnegie Mellon who have unlisted phone numbers. We draw a random sample of size 80 and find that 8 have unlisted numbers. Our plan is to compute a 95% confidence interval.

5. The standard deviation of the sample proportion for this study is:
   (a) .002
   (b) .034
   (c) .001
   (d) bigger than .04
   (e) smaller than .001

6. Which of the following statements is true about the 95% confidence interval for p, the proportion of faculty with unlisted numbers?
   (a) The confidence interval would be wider if the sample size was larger.
   (b) The confidence interval is about (6.6%,13.4%)
   (c) The confidence interval is about (3.2%,16.7%)
   (d) We cannot compute a confidence interval because the sample is not Normally distributed.
   (e) The confidence interval is much bigger than the ones given above.

7. A poll is being conducted to determine who is likely to win an election, candidate A or B. If the contest is likely to be extremely close, how big of a random sample would be required to obtain a margin of error of ± 0.05 for the proportion in favor of candidate A.

   (a) less than 300

   (b) more than 800

   (c) It is impossible to achieve this level of accuracy with a sample survey.

   (d) 400

   (e) 800

8. People magazine reported that 4000 people mailed in a questionnaire answering the following question: "Do you think your coworkers should bathe more often?" Of those responding, 55% said yes. Can we conclude that a majority of readers of People magazine work with individuals who don't bathe often enough?

   (a) Yes, because the 95% confidence interval does not include .50.

   (b) No, because the 95% confidence interval does include .50.

   (c) No because this is not a random sample.

   (d) Yes, because the respondents to this questionnaire represent a stratified random sample.

   (e) Yes, because the respondents to this questionnaire represent a cluster sample.

Use this information to answer questions 9-12.

To compare the age of death for left and right-handed athletes, a random sample was taken of professional athletes. The mean age of death for right-handed professional athletes was 64.5 years ($s = 15.2, n = 1000$) and mean age of death for left-handed professional athletes was 64 years ($s = 15.1, n = 250$). Both distributions were approximately bell-shaped.

9. Which of the following statements is true about a 95% confidence interval for the mean age at death for left-handed professional athletes.

   (a) The confidence interval is about (62.1,65.9)

   (b) The confidence interval is about (63.05,64.96)

   (c) Not enough information given to compute a confidence interval

   (d) 95% of all left-handed professional athletes will die at ages within the 95% confidence interval

   (e) None of the above

10. A 95% confidence interval for the mean age at death for right-handed professional athletes would be considerably narrower than the one computed for lefties for which of the following reasons?

    (a) The distribution of ages is not likely to be normally distributed.
    (b) The mean for lefties is smaller than the mean for righties.
    (c) The sample standard deviation for lefties is smaller than for righties.
    (d) There are more righties than lefties in the population of athletes.
    (e) We have a much bigger sample of righties than lefties.

11. Compute a 95% confidence interval for the mean age of death for lefties minus righties.

    (a) The confidence interval is about (63.05,64.96)
    (b) The confidence interval is about (.05,1.05)
    (c) The confidence interval is about (-1.64,2.65)
    (d) The confidence interval is about (-2.38,3.38)

12. Suppose your neighbor was left-handed professional athlete who died at age 75. Which of the following is true?

    (a) Your neighbor lived an unusually long life for a left-handed athlete.
    (b) Your neighbor lived an unusually short life for a left-handed athlete.
    (c) Your neighbor's age at death was not unusual for a left-handed athlete.
    (d) Your neighbor must have been right-handed, otherwise he wouldn't have lived this long.
    (e) Not enough information given to determine whether your neighbor's life was long or not.

13. Suppose we are testing whether or not a coin is fair ($H_o : p = .5$ vs. $H_a : p \neq .5$). A coin is tossed a number of times and then a test of the hypothesis is conducted. The chance of a type II error is smallest when

    (a) the coin is very biased (p far from .5) and the sample size is small.
    (b) the coin is very biased (p far from .5) and the sample size is large.
    (c) the coin is almost fair (p is close to .5) and the sample size is small.
    (d) the coin is almost fair (p is close to .5) and the sample size is large.
    (e) not enough information is given

14. As in the previous question, suppose we are testing whether or not a coin is fair ($H_o : p = .5$ vs. $H_a : p \neq .5$). If we reject the null hypothesis only if the absolute value of the standardized score is at least 2, then the chance of a type I error

    (a) is always smaller than the p-value.

    (b) is definitely bigger than the chance of a type II error

    (c) decreases as the sample size increases

    (d) increases as the sample size increases

    (e) is at most .05.

15. Suppose we are analyzing the relationship between two variables: $A =$ car phone (yes or no), and $B =$ accident (yes or no). A third variable, $C =$ job pressure (high or low), was also measured. Ignoring C, we find that the relative risk of an accident is greater than 1 for those that own a car phone. However, if we compute a separate relative risk for each level of C, the relative risk is less than 1 for both levels of job pressure.

    (a) This can't happen. The calculations must be in error.

    (b) This is an example of Simpson's Paradox.

    (c) From these analyses we can conclude that owning a car phone causes accidents.

    (d) The results should be ignored because they are not practically significant.

    (e) From these analyses we can conclude that owning a car phone is not associated with having a high pressure job.

16. In 1960 all of the eight year old boys attending public school in Auckland were enrolled in a study to relate criminal behavior with verbal IQ. The IQ of each boy was measured at the beginning of the study. The boys were followed for 15 years. Criminal behavior was defined as the number of times an individual was charged with a criminal offense over the 15 years of the study. This is an example of a

    (a) retrospective study

    (b) prospective study

    (c) case-control study

    (d) randomized experiment

    (e) stratified random sample

17. From a study of 20 children it was discovered that the correlation between the vocabulary size at age 2 and the IQ at age 5 is .90. From this we can conclude which of the following.

    (a) There is a negative association between the two measured variables.
    (b) There is a weak positive association between the two measured variables.
    (c) The relationship between the two variables must be caused by a confounding variable.
    (d) The data must be Normally distributed.
    (e) There is a strong positive association between the two measured variables.

18. After examining data from a large number of towns, an investigator noticed a strong positive association between the number of ministers and the number of liquor stores per town. From these data we can conclude which of the following.

    (a) People who drink more feel a need to go to church more.
    (b) People who go to church feel a need to drink more.
    (c) The relationship between the two variables can be explained by the Hawthorne effect.
    (d) This is an example of a practically significant result.
    (e) There could be a confounding variable inducing a spurious relationship between the two measured variables.

Questions 19-22 are based on this study:

A researcher investigated the relationship between performance on an exam and amount of sleep the student had the night before. The researcher explained the purpose of the study to the instructor of the class and the students before beginning the study. She then asked the students to report how much sleep they had the night before the exam on their exam papers. The results showed that students who sleep more tend to obtain better scores on exams.

19. What was the research method used in this study?

    (a) randomized experiment
    (b) observational study
    (c) case control study
    (d) double blind study
    (e) single blind study

20. The explanatory variable was
    (a) gender of the student
    (b) exam scores
    (c) amount of sleep
    (d) class size
    (e) length of test

21. The response variable was
    (a) gender of the student
    (b) amount of sleep
    (c) class size
    (d) exam scores
    (e) length of test

22. What type of relationship between sleep and exam scores was found?
    (a) positive
    (b) negative
    (c) although it was a good study, no relationship was found
    (d) no relationship was found because of confounding variables
    (e) because of Simpson's paradox the relationship must be causal

Questions 23-24 are based on the following information:

After giving an exam the instructor reported that the 5 number summary was ($min = 0, Q1 = 60, Median = 71, Q3 = 82, max = 99$). He also noted that mean was 69.

23. Based only on the first and third quartiles we can draw which of the following conclusions?
    (a) The data are skewed left.
    (b) 50% of the exam scores fell between 60 and 82.
    (c) 100% of the exam scores fell between 0 and 99.
    (d) The data are skewed right.
    (e) The exam was too hard; more than a third of the students got scores below 60%.

24. Using all of the information given, the distribution can be described by which of the following statements?

    (a) Normally distributed with no outliers.
    (b) Skewed right.
    (c) Skewed left with more than half of the scores below 60%.
    (d) Basically symmetric, but with some very low scores which cause the mean to be less than the median.
    (e) Not enough information given to answer the question.

25. In a study of sleep deprivation during finals week a random sample of 65 Carnegie Mellon students were interviewed. It was discovered that 70% of the students sleep less than 5 hours per night during finals week. Which statement is correct?

    (a) 70% of all students at Carnegie Mellon sleep more than 5 hours per night
    (b) 70% of all students at Carnegie Mellon sleep less than 5 hours per night
    (c) 70% is a parameter
    (d) 70% is a statistic
    (e) The results are meaningless because we were not given the average amount of sleep students get.

26. Suppose, based on the study described in question 25, 95% and 99% confidence intervals were computed for the mean amount of sleep obtained. Which of the following statements is correct?

    (a) The 95% interval is wider
    (b) The 99% interval is wider
    (c) The intervals have the same width.
    (d) You cannot determine which is wider unless you know the sample size.
    (e) None of the above

27. You wish to display three data sets graphically:

    (I) Two related quantities, both measurement variables
    (II) Two related quantities, one a categorical variable and the other a measurement variable
    (III) One categorical variable

    It would be best to use

    (a) A scatterplot for I, side-by-side boxplots for II, and a pie chart for III
    (b) A scatterplot for both I and II, and a histogram for III.
    (c) A scatterplot for I, histogram for II, and a pie chart for III
    (d) Two histograms for I, pie charts for II and III.

28. Here are the ages of death for United States Presidents displayed in a stem and leaf plot:

```
4 : 69
5 : 36678
6 : 003344567778
7 : 01112347889
8 : 01358
9 : 00
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What is the median?

(a) 90

(b) 68

(c) 46

(d) 67

(e) 69

29. A soft-drink company wants to sell bottles of soda pop containing 12 ounces of fluid. In fact, the amount of soda varies from bottle to bottle. Suppose that the weights are Normally distributed with a mean of 12 ounces and a standard deviation of 0.5 ounces. A bottle is considered defective if it has less than 11 ounces or more than 13 ounces. Approximately what fraction of bottles are defective?

(a) 5%

(b) 95%

(c) 32%

(d) 68%

(e) None of the above

30. Suppose that adult body temperature is Normally distributed with mean 98.5 degrees Fahrenheit and standard deviation 0.5. What fraction of the population has a temperature above 98.75?

(a) 69%

(b) 31%

(c) 60%

(d) 40%

(e) 50%

31. When doing a survey it is important to use a random sample for which one of the following reasons?

    (a) Because the results will be more accurate than if we took a complete census of the population.

    (b) To get a statistically significant result.

    (c) To avoid biases and get a representative sample.

    (d) So that it will be a randomized experiment.

    (e) It will then be a case-control study which is a good experimental design.

32. A new treatment for insomnia is given to a randomly selected group of 30 patients who suffer from chronic sleep disorders. Nineteen of the patients claimed that they experienced marked improvements in their ability to sleep. From this information we can conclude which of the following?

    (a) The treatment is effective.

    (b) The results are promising, but the sample size was not large enough to be statistically significant.

    (c) The margin for error is 7%.

    (d) Nothing, because there is no control group for comparison. The effect could be attributable to the Hawthorne effect.

    (e) The new treatment is better than anything on the market, but only 63% of the patients experienced relief.

33. The median and the mean of a random sample from a population will be about equal when:

    (a) The population is not Normally distributed.

    (b) The standard deviation is small

    (c) The mode is large.

    (d) The data are skewed.

    (e) The histogram of the sample is bell-shaped.

34. The following data are from an observational study to compare the rate of colds in a meditation group versus a non-meditation group. The response is whether the person became infected with a cold in the next four months.

	Cold	No Cold
Meditate?		
Yes	100	900
No	200	800

The relative risk of a cold for those who meditate vs. those who don't is:

(a) 3
(b) .63
(c) .5
(d) -.1
(e) 3.84

35. For the data in the previous question, the chi square value is 38.43. The strongest conclusion we can make is:

(a) There is not strong evidence that meditation and colds are associated.
(b) There is strong evidence that meditation and colds are associated, but it may not be a causal relationship.
(c) There is strong evidence that meditation causes fewer colds.
(d) We cannot assess the evidence that colds and meditation are associated.
(e) There must be a confounding variable causing a spurious relationship between colds and meditation.

36. Which of the following are **NOT** examples of experimental data: (1) Data on height and weight of babies at birth; (2) Data on average rainfall where areas are randomly assigned to either a cloud seeding treatment or a control; (3) Data on maximum temperature per day collected at the Pittsburgh airport;

(a) 1 only
(b) 2 only
(c) 3 only
(d) 1 and 3
(e) 1, 2 and 3

37. A public opinion poll uses a random sample of size 500 from a town with population 25,000. A second public opinion poll uses a random sample of size 500 from a town with population 250,000. The polls are trying to estimate the percentage of voters who favor government sponsored health care. Suppose the true proportion of people who favor government sponsored health care is the same in each population. Which of the following is true?

    (a) The first poll will have a considerably smaller margin of error than the second poll because the town is smaller.

    (b) The second poll will have a considerably smaller margin of error than the first poll because the town is larger.

    (c) The margin of error for the two polls is essentially equal.

    (d) The accuracy of the polls cannot be assessed from the given information.

    (e) The margin of error for both polls is about 9%.

38. A study was conducted to measure the effects of eating a low fat diet for 3 months. 50 people were recruited into the study. The results show that eating low fat diet for 3 months resulted in an average drop in cholesterol of 10 points with a standard deviation of 2 points. The distribution of the drop in cholesterol follows a bell-shaped distribution. Which of the following is true?

    (a) Virtually everyone reduced their cholesterol somewhat.

    (b) Most people reduced their cholesterol by more than 10 points.

    (c) Most people reduced their cholesterol by less than 8 points.

    (d) Without 5-number summary it is difficult to interpret these data. Many people may have experienced no decrease in cholesterol.

39. The relationship between height and shoe size in adult men was studied by the LAPD. From a random sample of 200 men, ranging in shoe size from 5 to 13, they discovered that the relationship was linear with no outliers. The correlation was 0.9 with regression equation:

$$\text{height} = 58 + 1.3 \times \text{ shoe size.}$$

    From this analysis we can conclude which of the following?

    (a) That our best guess at the height of a man with size 11 shoes is 72.3 inches.

    (b) We can not conclude anything about the height of a man from his shoe size because the distribution of shoe sizes may be skewed.

    (c) The correlation is weakly positive.

    (d) We can use this regression equation for women too.

    (e) None of the above

40. An observational study was conducted to examine the relationship between class size in 1st grade (A) and reading ability (B). 200 suburban schools in Pennsylvania were examined. It was found that students in smaller classes tend to perform better on reading tests. In particular, children in classes of size 18 scored an average of 78 points on the reading test. Which of the following is true?

    (a) There is no relationship between A and B.

    (b) Without knowing if A and B are normally distributed we can draw no firm conclusions.

    (c) If all 1st graders were taught in classes of size 18 the reading ability of the nation's 1st graders would be, on average, about 78.

    (d) There could be a confounding variable that is causing a spurious relationship between class size and reading ability.

    (e) None of the above.

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ANSWER SHEET
HAND THIS IN

NAME: _____

Section: _____

1.	a	b	c	d	e	**21.**	a	b	c	d	e
2.	a	b	c	d	e	**22.**	a	b	c	d	e
3.	a	b	c	d	e	**23.**	a	b	c	d	e
4.	a	b	c	d	e	**24.**	a	b	c	d	e
5.	a	b	c	d	e	**25.**	a	b	c	d	e
6.	a	b	c	d	e	**26.**	a	b	c	d	e
7.	a	b	c	d	e	**27.**	a	b	c	d	e
8.	a	b	c	d	e	**28.**	a	b	c	d	e
9.	a	b	c	d	e	**29.**	a	b	c	d	e
10.	a	b	c	d	e	**30.**	a	b	c	d	e
11.	a	b	c	d	e	**31.**	a	b	c	d	e
12.	a	b	c	d	e	**32.**	a	b	c	d	e
13.	a	b	c	d	e	**33.**	a	b	c	d	e
14.	a	b	c	d	e	**34.**	a	b	c	d	e
15.	a	b	c	d	e	**35.**	a	b	c	d	e
16.	a	b	c	d	e	**36.**	a	b	c	d	e
17.	a	b	c	d	e	**37.**	a	b	c	d	e
18.	a	b	c	d	e	**38.**	a	b	c	d	e
19.	a	b	c	d	e	**39.**	a	b	c	d	e
20.	a	b	c	d	e	**40.**	a	b	c	d	e