Final

STA 110E Fall 1997

Name ______________________________

Section______________________________

Notes:

1. This is a closed book exam. A single 8.5×11 sheet of notes is permitted.
2. It is to your advantage to show your work and explain your answers.
3. The exam carries 80 points.
4. The points assigned to each problem are indicated below. Use them to plan your time. You have 120 minutes to finish.
5. The exam has 8 problems. Make sure they're all in your copy.

Problem	1	2	3	4	5	6	7	8	Total
Score	/10	/10	/10	/10	/10	/10	/10	/10	

Honor Code

As a student and citizen of the Duke University Community:

- I will not lie, cheat, or steal in my academic endeavors.
- I will forthrightly oppose each and every instance of academic dishonesty.
- I will communicate directly with any person or persons I believe to have been dishonest. Such communication may be oral or written. Written communication may be signed or anonymous.
- I will give prompt written notification to the appropriate faculty member and to the Dean of Trinity College or the Dean of the School of Engineering when I observe academic dishonesty in any course.
- I will let my conscience guide my decision about whether my written report will name the person or persons I believe to have committed a violation of this Code.

Acknowledgement (sign here): ____

1a. The correlation between the ages of husbands and wives in the United States in 1995 was

a) exactly -1 b) close to -1 c) close to $+1$ d) exactly $+1$ e) none of the above

1b. Hospital A has 218 live births during the month of January. Hospital B has 536. Which hospital is likelier to have 55% or more male births? (There is about a 52% chance for a live-born infant to be male.)

(a) Hospital A (b) Hospital B (c) They're both equally likely.
(d) Can't tell from the information given.

1c. In a test of significance, a p-value of 0.03 means the chance of seeing something as extreme, or more extreme, than what was observed is 3% (assuming the null hypothesis is true).

a) true b) false

1d. A result that is *statistically significan* is always *highly significant.*

a) true b) false

1e. A scale used in analytical chemistry gives weights in repeated weighings of the same object that have a normal distribution with mean equal to the true weight of the object (that is, the scale has no bias). The standard deviation of repeated weighings of the same object is 0.010 grams. A student wants to estimate the true weight within $\pm .01$ grams with 95% confidence. How many weighings should she take to achieve this?

2a. A demographer surveys a simple random sample of American families from each of three different income classes, and records the family sizes. The data are summarized in the adjacent table. A total of 1,000 families were surveyed.

	Family Size					
Family Income	2	3	4	5	6	7
Low	145	81	57	22	9	8
Middle	151	73	71	33	13	10
High	124	60	80	42	13	8

Which of the following statements are true under the null hypothesis for a chisquare test for independence? (Some, none, or all may be true.)

a) Families in the Low income class are likely to be larger than those in the High or Middle income class.

b) A randomly selected Low income family has the same chance of having 5 members as does a randomly selected High income family.

c) The frequencies of each family size are the equal.

2b Refer to the previous problem. Assuming the null hypothesis is true, what is the expected number of Middle income families of size 5.

a) 33 b) 34.05 c) 32.33 e) can't tell.

2c. A large truck delivers potatoes, 10% of which are rotten, to the Frito Lay factory. A simple random sample is taken in order to estimate the proportion of rotten potatoes in the truck. If 400 potatoes are sampled, the probability that at least 30 of them are rotten is closest to

(a) 0.95 (b) 0.75 (c) 0.25

(d) cannot tell without knowing the number of potatoes in the truck.

2d. Use the information from the previous problem. The standard error (SE) of the sample proprotion of rotten potatoes is

(a) 0.050 (b) 0.015 (c) 6.0 (d) 0.235 (e) can't tell

3a. A box contains six tickets, numbered as shown:

$$\boxed{\boxed{1}\ \boxed{2}\ \boxed{3}\ \boxed{4}\ \boxed{5}\ \boxed{6}}$$

Three tickets are drawn at random, without replacement, from the box. Find the chance the three tickets left in the box are $\boxed{4}$, $\boxed{5}$, and $\boxed{6}$.

3b. Investigators are studying the relationship between income and education, for women age 25–54 who are working. Investigator A computes the correlation between income and education for all these women. Investigator B computes the correlation only for women who have provessional, technical, or managerial jobs. Who gets the higher correlation? Or should the correlations be about the same?

3c. Investigators are studying the relationship between income and education, for women age 25–54 who are working. Investigator C computes the correlation between income and education for all the women. Investigator D looks at each state separately, computes the average income and average education for that state – and then computes the correlation coefficient for the 50 pairs of state averages. Which investigator gets the higher correlation? Or should the correlations be about the same?

4a. A box contains 1,500 marbles, of which 500 are red and 1,000 are blue. The following procedure is repeated many times.

> One hundred draws are made at random with replacement from the box, and the number of red marbles in the 100 draws is counted.

The first time the procedure is done, there are 28 red marbles in the 100 draws; the next time there are 25; the third time there are 27. The results for the first 10 repetitions are shown below:

28 25 27 31 26 29 26 23 30 24

Is there any reason to be suspicious of these results? Answer yes or no. Back up your answer with reasons and/or calculations.

4b. A 95% confidence interval for the average reading achievement score for all of third grade students in a particular school district is (48.3,52.3). If the interval were obtained from a simple random sample of 100 students, a good guess for the standard deviation of reading achievement scores for all third graders in the school district is

(a) 1 (b) 2 (c) 10
(d) You can't say unless you know that the histogram of all reading score from this population follow a normal curve.

4c. A laboratory makes 25 repeated measurements on the molecular weight of a protein (in "kilo-Daltons"). The average is 119, and the SD is 15. The lab now wants to estimate the likely size of certain chance errors. Fill in the blanks, using the options below; some options will be left over. You may assume the Gauss model, with no bias.

i) The chance error in one measurement is about __________.

ii) The chance error in the average of the measurements is about __________.

Options: $15/25$ $15/\sqrt{25}$ 15 $15 \times \sqrt{25}$ 15×25

5. On the average, hotel guests weigh about 150 pounds with a SD of 25 pounds. An engineer is designing a large elevator for a convention hotel, to lift 100 people. If he designs it to lift 15,500 pounds, what is the chance it will be overloaded by a random group of 100 people?

6. Is Wheaties a power breakfast? To find out, a study is done in a large elementary statistics class; 499 students agree to participate; after the midterm, 250 are randomized to the treatment group, and 249 to the control group. The treatment group is fed Wheaties for breakfast 7 days a week. The control group gets Sugar Pops.

   a. Final scores averaged 66 for the treatment group; the SD was 21. For the control group, the figures were 59 and 20. Perform a hypothesis test to determine whether Wheaties improves exam scores in statistics. Be sure to state the null and alternative hypotheses; the test statistic you use; the p-value; and your conclusions.

   b. Could the subjects in this experiment have been "blinded" as to whether or not they were in the treatment or control group. Would this have helped the study?

7. A long series of measurements on a checkweight averages out to 253 micrograms above ten grams, and the SD is 7 micrograms. The Gauss model is believed to apply, with negligible bias. At this point, the balance has to be rebuilt; this may intoduce bias, as well as changing the SD of the error box. Ten measurements on the checkweight, using the rebuilt scale, show an average of 245 micrograms above ten grams, and a SD^+ of 9 micrograms. Has bias been introduced, or is this explainable by chance error? Compute a formal hypothesis test to address this question.

8. The International Rice Research Institute in the Philippines develops new line of rice which combine high yields with resistance to disease and insects. The technique crossing different lines to get a new line which has the most advantageous combination of genes; detailed genetic modeling is required. One project involved breeding new lines for resistance to an insect called "brown plant hopper"; 374 lines were raised, with the results shown below.

	Number of lines
All plants resistant	97
Mixed; some plants resistant, some susceptible	184
All plants susceptible	93

According to the IRRI model, the lines are independent; each line has a 25% chance to be resistant, a 50% chance to be mixed, and a 25% chance to be susceptible. Are the facts consistant with this model? Perform an appropriate hypothesis test to answer the question.