STA 110B Fall 1997

Midterm Exam 2
November 6, 1997

Name:	**Section:**

I understand and agree to abide by the Duke honor code,

Signed:

Instructions

This is a closed-book exam, however, one 8.5 by 11 inch "crib sheet" is permitted. You may use a calculator if you find it useful. Show your work in the space provided, but be concise. Correct but unsubstantiated answers will receive no credit.

Point assignments for each of the 4 problems are given in parentheses in the table below. You have 1 hour and 15 minutes total; plan accordingly. You must hand the exam in at 12:10pm, no extra time will be given. Good luck!

		Page 1	**Page 2**	**Page 3**
1.	(60)			
2.	(10)			
3.	(10)			
4.	(20)			
Total	(100)			

1) An experiment was conducted in the mid 1960's to test whether the practice of discounting newly introduced merchandise affects long term sales of the discounted item. The experiment involved 122 K-Marts. Pairs of stores were identified by matching them according to location, sales volume and other characteristics. A new type of cookie was introduced in all 122 stores. One store in each of the 61 pairs offered the cookies at \$0.69 per package for the duration of the experiment (6 weeks), while the remaining stores offered them for \$0.49 for 2 weeks then increased them to \$0.69 for the remaining 4 weeks. Total sales, in cases, were recorded for each store during the experimental period (all 6 weeks) and, for each pair, the difference in sales between the store that discounted and the one that did not was calculated. A summary of the data follows (data courtesy of the UCLA Department of Statistics `http://www.stat.ucla.edu/practice/case-studies`).

	Pair Number	**Discounted Sales**	**Non-Discounted Sales**	**Difference in Sales**
	1	851	916	-65
	2	903	1004	-101
	⋮	⋮	⋮	⋮
	61	787	699	+88
Sample Mean		854	923	-69
Sample Standard Deviation		58	157	150

a) (**10 points**) Calculate a 95% confidence interval for the mean difference Δ in sales using the matched (paired) sample.

1) Cookie experiment, continued.

	Discounted Sales	**Non-Discounted Sales**	**Difference in Sales**
Sample Mean	854	923	-69
Sample Standard Deviation	58	157	150

b) (**5 points**) What is the point estimate of Δ?

c) (**5 points**) Does the point estimate exceed the allowance for error in magnitude?

d) (**5 points**) Was there enough data to discern a difference?

e) (**5 points**) What is the null hypothesis H_o?

f) (**5 points**) Can the null hypothesis be rejected at the 5% significance level.

1) Cookie experiment, continued.

	Discounted Sales	**Non-Discounted Sales**	**Difference in Sales**
Sample Mean	854	923	-69
Sample Standard Deviation	58	157	150

A prominent psychologist postulated that long term sales may decrease as a result of promotional discounting.

g) (**5 points**) Is this a one- or two-sided alternative hypothesis (H_A)?

h) (**10 points**) Calculate the test statistic t for the test of H_o *versus* H_A.

i) (**10 points**) Calculate the p-value for the test of H_o *versus* H_A.

2) (10 points) It is your job to estimate mean family food expenditure on the basis of a sample of 900 families. The deadline is rapidly approaching and you only have 400 results entered into the computer. The 400 families that you've entered are representative of the population, so you could stop and report the sample mean using this smaller sample. What is the relative efficiency of the sample mean based on 400 observations to the sample mean based on all 900 observations for estimating the population mean?

3) (**10 points**) In the 1980 presidential election, 34.9 million voters voted Democrat (Carter) and 43.2 million voted Republican (Reagan). Ignoring "third parties," what is the probability that a poll of 1600 randomly sampled voters from this population would correctly forecast the election winner?

4) Suppose that, among married couples in a certain population, weights of husbands are normally distributed with mean 176 pounds and standard deviation 20 pounds, weights of their wives are normally distributed with mean 132 pounds and standard deviation 9 pounds and that the correlation between weights of wives and their husbands is 1/3.

a) (**5 points**) What is the covariance between weights of wives and their husbands?

Define a couple's total weight as $T = H + W$ where H represents the husband's weight and W the wife's weight (recall that total weight T is normally distributed since it is a linear combination of normal random variables).

b) (**5 points**) What is the expected value of T?

c) (**5 points**) What is the variance of T?

d) (**5 points**) A very simple random sample of 100 couples is drawn from this population. What is the probability that the sample average total weight is greater than 350 pounds?