Sociology 592 - Research Statistics I
Exam 1
September 26, 2003

Where appropriate, show your work - partial credit may be given. (On the other hand, don't waste a lot of time on excess verbiage.) Do not spend too much time on any one problem. It is legitimate (and probably essential) to refer to results that have previously been proven in class or homework, without re-proving them - for example, you wouldn't need to prove that $P(-1.96 \leq Z \leq 1.96) = .95$, since we have already shown that in class. Likewise, you are free to refer to anything that was demonstrated in the homework or handouts.

---

1. (4 points each, 20 points total). Indicate whether the following statements are true or false. If you think the statement is false, indicate how the statement could be corrected. For false statements, do not just say that you could substitute not equals for equals. For example, the statement $P(Z \leq 0) = .7$ is false. To make it correct, don't just say $P(Z \leq 0) <> .7$, instead say $P(Z \leq 0) = .5$ or $P(Z \leq .525) = .7$.

A. If X and Y are random variables, $V(XY) = X^2V(Y)$.

B. If N is large and X has a uniform distribution, then $\overline{X}$ will also have a uniform distribution.

C. $P(Z \leq -1.7) = .95543457$

D. A fair die has been rolled two times, each time producing a 6. If the die is rolled again, the probability is 1/216 that you will once again get a 6.

E. Four hopelessly confused graduate students can't decide whether the answer to problem 1D is True or False. If they all flip a fair coin to decide, there is a 1/8 chance that they will all get the same answer.

---

2. (10 points each, 30 points total) Answer <u>three</u> of the following. The answers to most of these are fairly straightforward, so do not spend a great deal of time on any one problem. NOTE: I will give up to 5 points extra credit for each additional problem you do correctly.

A. $\overline{X} = 40$, N = 9. Determine the 95% confidence interval when

a. $\hat{\sigma} = 12$

b. $\sigma = 9$

B. Here are the results from a previous cohort's first exam in statistics. Compute the mean and variance of the scores. There were 9 Sociology Graduate Students in the class. (The exam was obviously much too easy – hopefully this exam will be more of a challenge for you.)

Score
84
100
109
110
106
97
102
82
105

C. A company has developed a questionnaire that measures attitudes toward its product on a scale that ranges from a low of 0 to a high of 200. It now wants to administer this questionnaire to a random sample of consumers to find out how popular its product is. On the one hand, it wants results that are fairly precise, but on the other hand it only has a limited budget for collecting data. If the population standard deviation $\sigma = 45$, how many people will have to be surveyed so that the true standard error is no greater than 3? How many people would have to be surveyed so that the true standard error would be no greater than 1? Comment briefly on how a desire for increased precision would affect the cost of this survey.

D. It is January 2004. After a disappointing 7-7 record in 2002, the Nebraska Cornhuskers have shocked the college football world by going 13-0 in 2003. Today, however, in the National Championship game, they face their greatest challenge of all: the undefeated and #1 ranked Miami Hurricanes. Miami humiliated the Cornhuskers in the title game just two years ago, and Coach of the Year Frank Solich from Nebraska has vowed that it will not happen again.

Nebraska's greatest strength all season long has been its impenetrable defense. The Huskers estimate that they have a 60% chance of holding Miami to 14 points or less, and if they do, there is a 70% chance Nebraska will win. But, if the defense can't contain Miami, then Nebraska's offense, which has struggled all season, will have to come through. The coaches estimate that there is a 15% chance that Miami will score more than 14 points and Nebraska will win the game.

What is the probability that Nebraska will win the game if Miami scores more than 14 points? What is the probability that Nebraska will win the game?

E. You have to take a true-false test on a subject you know absolutely nothing about. You must get 2/3 or more of the answers right in order to pass. Would you rather take a 3 question test, where you had to get at least 2 answers right, or a 36 question test, where you had to get at least 24 answers right? Or would it not make any difference to you how long the test was? Explain your reasoning.

3. (25 points) A recent article on the WebMD web pages (http://content.health.msn.com/content/article/73/88984.htm) states the following:

> Married men are healthier men. But for women, the health benefit of marriage depends on the health of the marriage. Over and over again, studies show that marriage is good for men's health. For women, the picture has been less clear. Some studies suggest that women need marriage like a fish needs a bicycle. That's true, a new study finds -- but only for women who aren't highly satisfied. Women who say their marriages are very satisfying have better heart health, healthier lifestyles, and fewer emotional problems, report Linda C. Gallo, PhD, and colleagues.

Another study decides to investigate the relationship between gender, marital satisfaction, and health. A sample of 1000 men and 1000 women, each of whom has been married for at least 30 years, is drawn. 70% of the men but only 40% of the women report that they are happy in their marriage. Five hundred (500) men and 300 women report that they have happy marriages and are in good health. For those who do not have happy marriages, 30% of the men and 35% of the women report they are in good health.

a. (10 pts) Complete the following table. Remember, there were 1000 men and 1000 women in this study.

	Male			Female		
Health/Marital satisfaction	Happy Marriage	Unhappy marriage	Σ	Happy Marriage	Unhappy Marriage	Σ
Good health						
Poor health						
Σ			1000			1000

b. (5 pts) What percentage of those in unhappy marriages have good health? What percentage of those in happy marriages have good health?

c. (10 pts) As these figures show, women tend to have worse health than men do. However, women are also less likely to be happy in their marriages. Suppose that just as many women had happy marriages as men did. Suppose further that women maintained their marital satisfaction-specific health rates. What percentage of women would then be in good health? Based on these results, do you think that differences in marital satisfaction explain much of the health differences between married men and women, or does it explain relatively little?

4. (25 points) Although he announced his candidacy only days ago, General Wesley Clark is already being touted by many as the frontrunner for the Democratic Presidential nomination. There is universal agreement that on the day he announced, 40% of all Democrats wanted Clark to be the party's nominee. But, his rivals for the Democratic nomination claim that Clark's support has already declined. A random sample of 175 Democratic voters is drawn, 58 of whom state that Clark is their first choice to be the Party's nominee for President. Using the .05 level of significance, test whether Clark's support has declined. Be sure to indicate:

(a) The null and alternative hypotheses - and whether a one-tailed or two-tailed test is called for.

(b) The appropriate test statistic

(c) The critical region

(d) The computed value of the test statistic

(e) Your decision - should the null hypothesis be rejected or not be rejected? Why?

(f) Would your decision change if you used the .01 level of significance instead? Why or why not?