

Sociology 592 - Research Statistics I
Exam 1
September 27, 1996

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. (5 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 A and B are independent events, then $P(A|B) = P(B|A)$.

b. $V(X + 7) = 7^2 + V(X) + 2*COV(X, 7)$

c. The null and alternative hypotheses are

$$H_0: p = .7$$

$$H_A: p > .7$$

In reality, $p = .7$. The researcher rejects the null. A type I error has been committed.

d. $P(Z \geq 1) = .84134474$

2. (10 points each, 30 points total) Answer three 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. It is January, 1997. Bill Clinton's second term is only days old, yet already speculation is rampant about who will succeed him. Naturally, much of the attention has come to be focused on one man: Robert Kerrey, the incredibly popular and talented senior senator from Nebraska. Kerrey's fortunes have always been closely linked to that of his favorite football team, the Nebraska Cornhuskers. This past season, the Huskers suffered an early setback but courageously struggled back and claimed the national championship with a convincing win over Florida State in the Sugar Bowl. But, can their luck continue? Kerrey estimates that, in any given season, Nebraska has an 80% chance of winning the national title. What

is the probability that Nebraska will win at least three of the next four national championships? How likely is it that the unthinkable will happen and they will not win any championships at all in the next four years?

- b. $N = 18$, $\bar{x} = 30$, $s^2 = 36$. Construct the 90% confidence interval. If the null and alternative hypotheses are

$$H_0: \mu = 19$$

$$H_A: \mu < 19$$

should you reject or not reject the null? Explain why.

- c. Here are the results from a previous cohort's first exam in statistics. Compute the mean and variance of the scores. There were 9 Students in the class.

<i>Score</i>	<i>Frequency</i>
68	1
77	1
86	2
90	1
94	1
98	1
101	2

- d. The University has decided that there are too many weak graduate students here. Therefore, students whose Grade Point Average (GPA) falls in the bottom 25% will be terminated from the University. If $GPA \sim N(3.4, .25^2)$, how high does your GPA have to be for you to stay in school?
- e. Following is an edited description of the Powerball Lottery, taken from the "Powerball Main Page" on the World Wide Web. In this Saturday's drawing, the estimated jackpot is \$13 million. If you rush out and buy one ticket after the exam today, what is the probability that you will be the jackpot winner? (And if you do win, just remember who it was that gave you the idea!)

"Game Description. PowerBall is an on-line lottery game which is a combined large annuitized jackpot lotto game and a cash game. Every Wednesday and Saturday night at 10:59 p .m. Eastern Time, we draw five white balls out of a drum with 45 balls and one red

ball out of a drum with 45 red balls. Numbers can be matched in any order. The jackpot (won by matching all five white balls and the red PowerBall) is an annuitized prize paid out over 20 years and will average around \$30 million.”

3. (25 points) Numerous studies have found that blacks are more likely to have their home mortgage loan applications denied than are whites. However, critics of these studies maintain that higher denial rates for blacks are justified because blacks are more likely to default (i.e. fail to repay) on their loans than are whites.

To see whether higher default rates really do justify racial disparities in lending, a researcher gathered data on 900 loans made to whites and 100 loans made to blacks. For each loan, the researcher recorded the income of the home-owner (dichotomized into “low” or “high”) and whether or not the home-owner defaulted on the home. She found that 31% of blacks, but only 25% of whites, defaulted on their loans. She also found that 60% of blacks were low income, compared to 30% of whites. Finally, she found that 4 high income blacks and 90 high income whites defaulted.

- a. Complete the following table. Remember, there are 100 blacks and 900 whites.

	Black			White		
	Low Inc	High Inc	Σ	Low Inc	High Inc	Σ
Defaulted						
Did Not Default						
Σ			100			900

- b. What percentage of those who defaulted were black?
- c. As these figures show, blacks are indeed more likely to default than are whites. However, blacks are also more likely to have low incomes. Suppose that blacks had the same income distribution as did whites, i.e. suppose that only 30% of blacks were low income instead of the current 60%. Suppose further it continued to be the case that blacks maintained their income-specific default rates. What percentage of blacks would then default? If a black and a white of comparable incomes were both to apply for a home mortgage loan, who would be the better “risk” for the bank, i.e. which one would be more likely to pay the loan off?

4. (25 points) Jury selection for Trial of the Century II is under way. O.J. Simpson's lawyers are concerned that the potential jurors in his civil suit are atypical of the general population — that is, they are more likely than most people to believe that Simpson murdered his wife.

National polls show that 70% of the general population thinks Simpson is guilty. One hundred potential jurors in the Simpson trial are surveyed; of those, 79 report they think Simpson is guilty.

Using the .05 level of significance, test whether the lawyers' fears appear to be justified. 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?