Name: Answers
Rutgers ID: Exam #2
November 3, 2003

Statistics 401 (01)

**Instructions:** The exam is closed book but you may use one page (both sides) of notes. Calculators are permitted. Please show your work on these pages. Work not shown will not be credited. For calculations please show at least one intermediate step. Please circle your final answer to each question. There are a total of 4 pages.

1. (12 points) Please identify the following as an (O) observational study or (E) experiment. (Please circle O or E)
   (a) O
   E A political pollster reports that his candidate has a 10% lead in the polls with 10% undecided.
   (b) O
   E An educational researcher used school records to determine that, in one school district, 84% of children living in two-parent homes graduated high school while 75% of children living in single-parent homes graduated high school.
   (c) O
   E 780 participants suffering from high blood pressure were randomly assigned to one of three groups. Over a one-month period, the first group received the experimental drug, the second group received a placebo, and the third group received no treatment. The diastolic blood pressure of each participant was measured at the beginning and at the end of the period and the change in blood pressure was recorded. The average change in blood pressure was calculated for each of the three groups and the three averages were compared.

2. (5 points) At a college there are 120 freshmen, 90 sophomores, 110 juniors, and 80 seniors. A school administrator selects a random sample of 12 of the freshmen, a random sample of 9 of the sophomores, a random sample of 11 of the juniors, and a random sample of 8 of the seniors. She then interviews all the students selected. Please identify the type of sampling used in this example: A) Simple random sample B) Cluster sampling C) Voluntary response [D) Stratified sampling]

3. (5 points) I would like to simulate a random variable X giving the number of “Heads” in 5 coin tosses. I assign odd numbers to “Tails” and even numbers to “Heads.” If the random numbers I will use begin 76928 30880 93908, what will be the first value of X?

   The first five tosses would be THTHH, giving X = 3.
4. (8 points) Please determine whether the events are disjoint, independent, both, or neither.

(a) You roll a fair die two times. Event E is a 1 on the 1st die, and event F is a 1 on the 2nd die.
A) Disjoint  B) Independent  C) Both  D) Neither

(b) One ball is removed from a bag containing 1 blue ball, 1 red ball, 1 yellow ball, and 1 green ball. Without returning the first ball to the bag a second ball is removed. Event G is the yellow ball on the first draw, and event H is the yellow ball on the second draw.
A) Disjoint  B) Independent  C) Both  D) Neither

5. (8 points) A recent study found that 20% of suburban New Jersey high school students drink alcohol. Suppose you pick 5 NJ suburban high school students at random. What is the probability that at least 1 of them drink alcohol? (Please give the probability to 2 decimal places.)

Write $A_1$ for the event that the 1st student drinks alcohol, and so on. Then

\[
\text{Prob}(A_1 \text{or } A_2 \text{or } A_3 \text{or } A_4 \text{or } A_5) = 1 - \text{Prob}(A_1^c \text{and } A_2^c \text{and } A_3^c \text{and } A_4^c \text{and } A_5^c)
\]

\[
= 1 - \text{Prob}(A_1^c) \times \text{Prob}(A_2^c) \times \text{Prob}(A_3^c) \times \text{Prob}(A_4^c) \times \text{Prob}(A_5^c)
\]

\[
= 1 - .8^5
\]

\[
= 1 - .33
\]

\[
=.67
\]

6. (4 points) Suppose you perform an experiment and calculate that the 95% confidence interval for the proportion is (.71, .83). Which of the following statements is true? (Just one statement is true.)

a. There is 0.95 probability that the true proportion is in the interval (.71, .83).

b. About 95% of the time the sample proportion will be in the interval (.71, .83).

c. About 95% of the time the confidence interval will include (.71, .83).

d. The interval (.71, .83) was calculated by a method such that the true proportion is included in the resulting interval about 95% of the time.

e. The interval (.71, .83) was calculated by a method such that the sample proportion is included in the resulting interval about 95% of the time.

f. About 95% of the proportions are in the interval (.71, .83).

(Please circle the letter of the correct answer.)

7. (5 points) Suppose event A has probability 0.3, event B has probability 0.6, and the probability of events A and B is 0.1. What is the probability of events A or B?

\[
\text{Prob}(A \text{or } B) = \text{Prob}(A) + \text{Prob}(B) - \text{Prob}(A \text{and } B) = .3 + .6 - .1 = .8.
\]
8. (8 points) Suppose the number of hours that high school students spend using computers has a mean of 4 hours and a standard deviation of 2 hours. 400 high school students will be selected at random. Let \( \bar{X} \) represent the mean number of hours on the computer for this sample.

(a) What is the mean of the distribution of \( \bar{X} \)?

4

(b) What is the standard deviation of the distribution of \( \bar{X} \)?

\[
\frac{2}{\sqrt{400}} = \frac{2}{20} = 0.1
\]

9. (8 points) Please circle True or False:

TRUE  FALSE  In a dataset ranging from 10 to 100 that is right-skewed, a log re-expression will generally reduce the skewness.

TRUE  FALSE  If a fair coin shows “Heads” 4 times in a row, the Law of Large Numbers implies that “Tails” will be more likely than “Heads” on the next toss.

10. (16 points) I opened a special bag of M&M’s. It had 25 red M&M’s out of 100 total.

(a) Based on this sample, please calculate the 95% confidence interval for the proportion of red M&M’s in the M&M population. Please write the confidence interval in the form \( (a, b) \), where \( a \) is the lower confidence limit and \( b \) is the upper limit, and give your answer to the third decimal place.

\[
\hat{p} = .35, \ Z^* = 1.96, \text{ and } se(\hat{p}) = \sqrt{.35 \times .65/100} = .0433.
\]

The 95% CI is \( \hat{p} \pm z^*se(\hat{p}) = .25 \pm 1.96 \times .0433 = .25 \pm .085 = (.165, .335) \).

(b) Below are lines representing the 90%, 95%, and 99% confidence intervals for the proportion of red M&M’s (the axis is not shown). Please circle the 99% confidence interval.

[Diagram of confidence intervals]
11. (6 points) Please choose the null and alternative hypotheses you would use to test the following situations.
(a) 4% of trucks of a certain model have needed new engines after being driven between 0 and 100 miles. The manufacturer hopes that the redesign of one of the engine’s components will reduce this percentage.
A) $H_0: p < 0.04$ $H_a: p > 0.04$
B) $H_0: p = 0.04$ $H_a: p < 0.04$
C) $H_0: p > 0.04$ $H_a: p = 0.04$
D) $H_0: p < 0.04$ $H_a: p = 0.04$
E) $H_0: p = 0.04$ $H_a: p > 0.04$

95) At a local university, only 62% of the original freshman class graduated in four years. Has this percentage changed?
A) $H_0: p \neq 0.62$ $H_a: p = 0.62$
B) $H_0: p = 0.62$ $H_a: p < 0.62$
C) $H_0: p = 0.62$ $H_a: p \neq 0.62$
D) $H_0: p < 0.62$ $H_a: p > 0.62$
E) $H_0: p < 0.62$ $H_a: p = 0.62$

12. (15 points) About 10% of the population is left-handed. A study looked at the proportion of left-handers among artists, and found 18 of 150 artists sampled were left-handed. Please find the $p$-value (give 4 digits after the decimal point; no reject/accept decision is necessary) for the test of

$H_0 : p = 0.10$

$H_a : p > 0.10$

$\hat{p} = 0.12$, while $sd(p) = \sqrt{\frac{1}{150} \times 0.10 \times 0.9} = 0.02449$, so the $z$-score is

$z = \frac{0.12 - 0.10}{0.02449} = 0.82$.

The area to the right of $z = 0.82$ is $1 - 0.7939 = 0.2061$. 

4