Exam III

Test A

STAT 201 - 502

December 1, 2005

Do not open test until instructed to do so.

You should only have a calculator, one page of written notes, and something with which to write.

Read all questions very carefully and make sure you have answered all questions fully before turning in your test.

On Multiple Choice, CLEARLY write the corresponding letter for your answer to the left of the question.

On Written Section, ALWAYS SHOW YOUR WORK!! You will be graded for how you arrived at an answer not just for the answer. If you don't have room in the space provided use scratch paper.

GOOD LUCK!!!

Name: UIN:

Part 1: Multiple Choice (4 points each)

1. The time needed for college students to complete a certain paper-and-pencil maze follows a normal distribution with a mean of 30 seconds and a standdard deviation of 3 seconds. You wish to see if the mean time μ is changed by vigorous exercise, so you have a group of nine college students exercise vigorously for 30 minutes and then complete the maze. Assume that σ remains unchanged at 3 seconds. the hypotheses you decided to test are $H_o : \mu = 30$ *vs.* $H_a : \mu \neq 30$. Suppose it takes the nine students an average of $\bar{X}$=32.05 seconds to complete the maze. At the 1% significance level, what can you conclude?

   (A) H_o should be rejected because the p-value is less than 0.01.

   (B) H_o should not be rejected because the p-value is greater than 0.01.

   (C) H_a should be accepted because the p-value is greater than 0.01.

   (D) H_a should be rejected because the p-value is less than 0.01.

   (E) H_a should not be rejected because the p-value is greater than 0.01.

2. A simple random sample of 120 vet clinics in the Midwest reveals that the vast majority of them only treat small pets (dogs, cats, rabbits, etc) and no large animals (cows, horses, etc). Of the 120 clinics sampled, 88 responded that they do not treat large animals at their clinic. What is the value of the standard error of $\hat{p}$?

   (A) 0.01

   (B) 0.02

   (C) 0.03

   (D) 0.04

   (E) 0.05

3. Is the mean height for all adult American males between the ages of 18 and 21 now over 6 feet? Let μ represent the population mean height of all adult American males between the ages of 18 and 21. What are the appropriate null and alternative hypotheses to answer this question?

   (A) $H_o : \mu = 6$ *vs.* $H_a : \mu < 6$

   (B) $H_o : \mu = 6$ *vs.* $H_a : \mu \neq 6$

   (C) $H_o : \mu = 6$ *vs.* $H_a : \mu > 6$

4. A medical researcher is working on a new treatment for a certain type of cancer. The average survival time after diagnosis on the standard treatment is two years. In an early trial, she tries the new treatment on three subjects who have an average survival time after diagnosis of four years. Although the survival time has doubled, the results are not statistically significant, even at the 0.10 significance level. Suppose, in fact, that the new treatment does increase the mean survival time in the population of all patients with the particular type of cancer. Which of the following statements is true?

   (A) A Type I Error has been committed.

   (B) A Type II Error has been committed.

   (C) No error has been committed

5. Ten years ago, at a small high school in Alabama, the mean Math SAT score of all high school students who took the exam was 490 with a standard deviation of 80. This year, the Math SAT scores of a random sample of 25 students who took the exam are obtained. The mean score of these 25 students is $\bar{X}$=525. To determine if there is evidence that the scores in the district have improved, the hypotheses $H_o : \mu = 490 \quad vs. \quad H_a : \mu > 490$ are tested at the 5% significance level. The p-value is found to be 0.014. Suppose that the average Math SAT score of all high school students at this high school is in fact equal to 505. Which of the following statements is true?

   (A) A Type I Error has been committed.

   (B) A Type II Error has been committed.

   (C) No error has been committed

Determine whether each of the next 4 statements is true or false

6. The margin of error for a 95% confidence interval for the mean μ increases as the sample size increases.

   (A) True

   (B) False

7. The margin of error for a confidence interval for the mean μ, based on a specified sample size n, increases as the confidence level decreases.

   (A) True

   (B) False

8. The margin of error for a 95% confidence interval for the mean μ decreases as the population standard deviation decreases.

   (A) True

   (B) False

9. The sample size required to obtain a confidence interval of specified margin of error m, increases as the confidence level increases.

   (A) True

   (B) False

10. To assess the accuracy of a laboratory scale, a standard weight that is known to weigh exactly 1 gram is repeatedly weighed a total of n times and the mean $\bar{X}$ is computed. Suppose the scale readings are normally distributed with unknown mean μ and standard deviation σ=0.01 g. How large should n be so that a 95% confidence interval for μ has a margin of error no larger than $\pm$ 0.0001?

    (A) n=45

    (B) n=100

    (C) n=196

    (D) n=10000

    (E) n=38416

Use the following to answer the next 4 questions:

Central Middle School has calculated a 95% confidence interval for the mean height μ of 11-year old boys at their school and found it to be 56 ± 2 inches.

Determine whether each of the next 3 statements is true or false.

11. There is a 95% probability that μ is between 54 and 58.

    (A) True

    (B) False

12. There is a 95% probability that the true mean is 56, and there is a 95% chance that the true margin of error is 2.

    (A) True

    (B) False

13. If we took many additional random samples of the same size and from each computed a 95% confidence interval for μ, approximately 95% of the time μ would fall between 54 and 58.

    (A) True

    (B) False

14. Which of the following could be the 90% confidence interval based on the same data?

    (A) 56 ± 1

    (B) 56 ± 2

    (C) 56 ± 3

    (D) 56 ± 4

15. If we reject the null hypothesis when, in fact, it is true, we have

    (A) a probability of being correct which is equal to the p-value

    (B) committed a Type I Error

    (C) a probability of being correct which is equal to 1 - p-value

    (D) committed a Type II Error

    Use the following for the next 2 questions:

    Are parents of girls more inclined to buy them a car when they leave for college than parents of boys? Simple random sample of 40 girls and 45 boys are taken from a large university on the West Coast. When interviewed, 20 girls and 21 boys in the sample responded that their parents bought them a car.

16. What is a 95% confidence interval for the difference in popularion proportions of girls and boys whose parents bought a car for them when they left for college? Use girls as group 1 and boys as group 2.

    (A) $..03 \pm .09$

    (B) $.03 \pm .22$

    (C) $.03 \pm .32$

    (D) $.03 \pm .37$

    (E) $.03 \pm .5$

17. This confidence interval represents the two-sided hypothesis test of H_o : $p_1 = p_2$ $vs.$ $H_a : p_1 \neq p_2$. What would you decide about this test based on your confidence interval in the previous question?

    (A) Fail to reject H_o

    (B) Fail to reject H_a

    (C) Reject H_a

    (D) Reject H_o

Part 2: Written Section

1. Car manufacturers want to know if there is any difference in the proportion of Americans that own cars and the proportion of Canadians that own cars. It is known that 65% of Americans own cars. They take an SRS of 174 Canadians, and 103 of them own at least one car. All conditions hold to perform a confidence interval.

   (A) Calculate a 95% confidence interval for the true proportion of Canadians that own at least one car.(5 points)

   (B) What hypotheses are being tested by the confidence interval?(3 points)

   (C) What is the α level of the above hypotheses?(2 points)

   (D) What do you decide about the hypothesis? Why?(2 points)

   (E) What do you conclude in the context of the situation?(2 points)

2. Sociologists want to know if girls who participated in high school athletics do better in college than girls who have not participated in high school athletics. They take an SRS of 30 girls who were involved in high school sports and 44 girls who were not in high school sports and record their final college GPA's. The data is as follows:

$n_1 = 30 \quad \bar{X}_1 = 3.01 \quad \sigma_1 = 0.41$
$n_2 = 44 \quad \bar{X}_2 = 2.85 \quad \sigma_2 = 0.29$

(A) State the null and alternative hypotheses.(3 points)

(B) Calculate the test statistic.(3 points)

(C) What is the distribution of the test statistic.(3 points)

(D) Find the p-value.(3 points)

(E) State your decision using an $\alpha = 0.05$.(3 points)

(F) What is your conclusion in terms of the context of the problem.(3 points)