4/21/2008 MATH 171 Name:___________________
Dr. Lunsford Test 2 100 Points Possible

Please show all work and especially show any calculator input for this test. No work or calculator input will result in no credit given (even if your answer is correct).

I. Short Answer and Multiple Choice. All problems are 3 points each unless indicated otherwise. (40 points total)

1. All other things being equal, which sample size will give the largest standard deviation of $\bar{x}$ (the sample mean)? (circle one)

(a) n=36 (b) n=31 (c) Both will be the same.
(d) Impossible to determine since we don't know σ .

2. When finding a confidence interval for a population mean using a small sample, a z interval will be

narrower the same as wider

than a t interval based on the same sample. (circle the correct response to complete the sentence)

3. I collect a random sample of size n from a population with standard deviation σ and, from the data collected I compute a 95% confidence interval for the mean of the population. Which of the following would produce a new confidence interval with larger width (i.e., larger margin of error) based on these same data? (circle one)

(a) Use a larger sample size. (b) Use a larger confidence level
(c) Use a smaller confidence level. (d) Decrease σ.

4. Fill in the blanks: If we computed a 95% confidence t-interval for the mean lifetime (in hours) of a certain type of battery as (37 hours, 42 hours) then the margin of error is equal to ________________and the sample mean is equal to ______________. (3 points each – 6 total)

5. A random sample of eighty-five students in Chicago city high schools takes a course designed to improve SAT scores. Based on these students, a 90% confidence interval for the mean improvement in SAT scores from this course for *all* Chicago city high school students is computed as (72.3, 91.4) points. Please write "true" or "false" next to each statement below according to which is correct: (10 points total)

________ 90% of the students in the sample had their scores improve by between 72.3 and 91.4 points. (3 points)

________ The average improvement on the SAT for the students in the sample, i.e. $\bar{x}$, is in the interval (72.3, 91.4). (3 points)

Write a complete English sentence giving the meaning of this confidence interval in the context of this problem. (4 points)

I. Short Answer and Multiple Choice, continued.

6. Suppose we are testing the null hypothesis $H_0 : \mu = 50$ with the alternative $H_a : \mu \neq 50$ for a normal population. If we have a significant result at the $\alpha = 0.05$ then which of the following is true: (please circle one):

(a) The corresponding 95% confidence interval for μ will contain the number 50.
(b) The corresponding 95% confidence interval for μ will not contain the number 50.
(c) The P-value for the test could be greater or less than 0.05. It cannot be determined without knowing the sample size.

7. The average GPA from a random sample of 35 students in my classes is 2.64 with a standard deviation of 0.56. What is the standard error of the sample mean? (circle one)

(a) 35 (b) 0.56 (c) 0.446 (d) 0.016 (e) 0.96

8. A researcher wants to know if calcium is an effective treatment for lowering blood pressure. He assigns one randomly chosen group of subjects to take calcium supplements; the other group will get a placebo. At the end of the treatment period, he measures the difference in blood pressure. The 50 members of the calcium group had blood pressure lowered by an average of 25 points with standard deviation 10 points. The 50 members of the placebo group had blood pressure lowered by an average of 15 points with standard deviation 8 points. To analyze this information we will use a (circle one)

(a) matched pairs t procedure.
(b) single sample t procedure.
(c) two-sample t procedure.
(d) single sample z procedure.

9. The P-value for a hypothesis test is P=0.03. At which of the following significance levels would we <u>fail to reject</u> the null hypothesis? (circle one)

(a) $\alpha = 0.10$ (b) $\alpha = 0.05$ (c) $\alpha = 0.01$ (d) all of these (e) (a) and (b) only

10. The 95% confidence interval for the average IQ, μ, of seventh graders in a Midwest school district is 102.2 ± 3.6. Suppose tested the hypothesis $H_0 : \mu = 100$ against the two sided alternative. At the 5% level we would: (circle one)

(a) reject H_0 (b) fail to reject H_0 (c) impossible to say, since P is unknown
(d) none of these

<u>Problem II.</u> If a one-sample t-test of the hypotheses $H_0 : \mu = 10$ against $H_a : \mu \neq 10$ is performed using a sample size of 21 then what is the P-value for the test if the calculated test statistic is $t = 2.45$? <u>Draw a picture clearly illustrating both the test statistic and the P-value</u>. (6 points)

Problem III. In comparing students who have transferred to Longwood (LU) from another college, I want to know if the transfer students do as well as those who enter LU directly from high school. I will compare them by examining their GPAs earned during the last two years of their degree program (which occurred at LU). My hypotheses are $H_a : \mu_{transfer} = \mu_{others}$ against $H_a : \mu_{transfer} < \mu_{others}$ where $\mu_{transfer}$ is the mean GPA of transfer students during their last two years of their degree program, etc. I took a random sample of 100 students of each type and computed a P-value of 0.18. (4 points each – 12 total)

(a) Is this a significant result at the $\alpha = 0.05$ level? Why or why not?

(b) At the $\alpha = 0.05$ level, what can I conclude in terms of the hypotheses?

(c) What would be the conclusion <u>in the context of this problem</u>?

Problem IV. The SAT scores of entering freshman at University X are normally distributed with $\mu_X = 1200$ and $\sigma_X = 90$ and the SAT scores of entering freshman at University Y are normally distributed with $\mu_Y = 1215$ and $\sigma_Y = 110$. A random sample of 100 freshmen is obtained from University Y, and the sample mean (i.e. average) of their 100 SAT scores is computed. What is the percent chance that this *average* is less than 1200, the population mean for University X? Please be sure to show all work and all calculator input. Clearly indicate your answer. (6 points)

Problem V. To assess the accuracy of a kitchen scale, a standard weight that is known to weigh 1 gram is repeatedly weighed a total of *n* times, and the mean, $\bar{x}$, of the weightings is computed. Suppose the scale readings are normally distributed with unknown mean μ and standard deviation $\sigma = 0.1$ g. How large should *n* be so that an 83% confidence interval for μ has a margin of error of no more than 0.01? (6 points)

Problem VI. The times for untrained rats to run a standard maze have a normal distribution with a mean of 65 seconds and a standard deviation of 15 seconds. Researchers believe that given a dose of a new metabolism booster the rats will improve these times, on average. Please state the hypotheses the researchers should use to test their belief. Clearly indicate which hypothesis is the belief and the meaning of the population parameter used in the hypotheses in the context of this problem. (6 points)

Problem VII. Do students tend to improve their SAT mathematics (SAT-M) score the second time they take the test? A random sample of four students who took the test twice received the following scores. Please answer the following questions. (15 points total)

Student	**1**	**2**	**3**	**4**
First Score	450	520	720	600
Second Score	440	600	720	630
Difference	-10	80	0	30

(a) Using a matched pairs procedure find a 95% t-confidence interval for the mean difference in SAT-M scores (second score - first score) for the population of all students taking the test twice. Clearly show all calculator input. (5 points)

(b) What assumptions must you make in order to use the above interval for inference for the mean change in SAT-M scores for the population of all students taking the test twice? Please state these assumptions in the context of this problem. (4 points)

(c) Based on the confidence interval computed in part (a), can you conclude that all students improve, on average, their mean SAT-M score the second time they take the test? Why or why not? (4 points)

(d) Even if all of your assumptions in part (b) are met, why might you be hesitant to use the confidence interval computed in part (a) to infer about the mean change in SAT-M scores (second score - first score) for the population of all students taking the test twice? (2 points)

<u>Problem VIII.</u> Alex follows the same route to work each day. A friend has told Alex that she thinks a new route would be faster. To test this, over a period of 20 days Alex randomly decides which route to drive each day and then records the commuting time (in minutes) to work. For the 9 days he drives his old route he has a mean driving time of 32 minutes with a standard deviation of 6 minutes. For the 11 days he drive the new route he has a mean driving time of 28 minutes with a standard deviation of 7 minutes. Alex wishes to test:

$$H_0 : \mu_{old} = \mu_{new} \text{ against } H_0 : \mu_{old} > \mu_{new}.$$

Please answer the following questions: (9 points total)

(a) Conduct the two sample t-test for these hypotheses. Clearly indicate the value of the test statistic and P-value below. Be sure to show all calculator input. (5 points)

test statistic = __________
P-value = __________

(b) State the results of the test in <u>the context of this problem</u> at the $\alpha = 0.10$ level. I.e. should Alex start taking the new route to work if he wants to have a shorter commute? (4 points)