**Test3D** Math 140 Exam #3

Name: ___________________________ Date: _____________

You are to mark your answers on the blue side of the scantron answer sheet. Be sure to put your name on the scantron. You should mark the answer sheet with a number 2 pencil (make dark marks), and completely erase any changes. Make no stray marks.

For your convenience, I have attached a Normal table and t-table at the end of the exam.

Use the following to answer questions 1-3:

An SRS of 20 recent birth records at the local hospital were selected. In the sample, the average birth weight was 121.4 ounces and the standard deviation was 7.5 ounces. Assume that in the population of all babies born in this hospital, the birth weights follow a Normal distribution, with some mean $\mu$.

1. A 90% confidence interval for the population mean birth weight based on these data is
   A) $121.4 \pm 5.63$ ounces.
   B) $121.4 \pm 4.80$ ounces.
   C) $121.4 \pm 3.29$ ounces.
   **D) $121.4 \pm 2.89$ ounces.**

2. We are interested in a 99% confidence interval for the population mean birth weight. The margin of error associated with the confidence interval is
   A) 21.46 ounces.
   **B) 4.80 ounces.**
   C) 1.07 ounce.
   D) 0.84 ounces.

3. The standard error of the mean is
   A) 27.1.
   B) 6.1.
   **C) 1.7.**
   D) 0.4.

Use the following to answer questions 4-8:

DDT is a pesticide banned in the United States for its danger to humans and animals. In an experiment on the impact of DDT, 6 rats were exposed to DDT poisoning and 6 rats were not. For each rat in the experiment, a measurement of nerve sensitivity was recorded. The researchers suspected that the mean nerve sensitivity for rats exposed to DDT is greater than that for rats not poisoned. The data follow:

| | | | | | | |
|---|---|---|---|---|---|---|
| Poisoned Rats: | 12.207 | 16.869 | 25.050 | 22.429 | 8.456 | 20.589 |
| Unpoisoned Rats: | 11.074 | 9.686 | 12.064 | 9.351 | 8.182 | 6.642 |

Let $\mu_1$ be the mean nerve sensitivity for rats poisoned with DDT. Let $\mu_2$ be the mean nerve sensitivity for rats not poisoned with DDT.

4. The numerical value of the standard error of the difference in sample means is
   A) 1.30.
   **B) 2.71.**
   C) 4.05.
   D) 9.02.

5. Which of the following is the alternative hypothesis for the relevant significance testing problem?
   **A) $H_a : \mu_1 > \mu_2$**
   B) $H_a : \mu_1 < \mu_2$
   C) $H_a : \mu_1 \neq \mu_2$
   D) $H_a : x_1 > x_2$

6. Using Table C and the conservative version for degrees of freedom (Option 2), the *P*-value is
   A) larger than 0.10.
   B) between 0.10 and 0.05.
   **C) between 0.05 and 0.01.**
   D) below 0.01.

7. The numerical value of the *t* statistic is
   A) 0.57.
   B) 1.93.
   C) 6.00.
   **D) 2.99.**

8. Which of the following is a reasonable conclusion?
   A) There isn't much evidence to support a conclusion that the mean nerve sensitivity is greater in rats exposed to DDT than in rats not exposed to DDT.
   **B) There is fairly strong evidence to support a conclusion that the mean nerve sensitivity is greater in rats exposed to DDT than in rats not exposed to DDT.**
   C) There are outliers in these data, so we can't rely on the two-sample *t* test.
   D) This test is unreliable because the populations we're sampling from are heavily skewed.

Use the following to answer questions 9-10:

The water diet requires one to drink two cups of water every half hour from when one gets up until one goes to bed, but otherwise allows one to eat whatever one likes. Four adult volunteers agree to test the diet. They are weighed prior to beginning the diet and after six weeks on the diet. The weights (in pounds) are

| Person | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| Weight before the diet | 180 | 125 | 240 | 150 |
| Weight after six weeks | 170 | 130 | 215 | 152 |

For the population of all adults, assume that the weight loss after six weeks on the diet (weight before beginning the diet minus weight after six weeks on the diet) is Normally distributed with mean $\mu$.

9. To determine if the diet leads to weight loss, we test the hypotheses
   $H_0$: $\mu = 0$, $H_a$: $\mu > 0$.
   Based on these data, we conclude
   **A) we would not reject $H_0$ at significance level 0.10.**
   B) we would reject $H_0$ at significance level 0.10 but not at 0.05.
   C) we would reject $H_0$ at significance level 0.05 but not at 0.01.
   D) we would reject $H_0$ at significance level 0.01.

10. A 95% confidence interval for $\mu$ based on these data is
   **A) $7 \pm 21.70$.**
   B) $7 \pm 13.64$.
   C) $7 \pm 6.82$.
   D) $7 \pm 4.00$.

Use the following to answer questions 11-13:

Is there a difference in the amount of airborne bacteria between carpeted and uncarpeted rooms? In an experiment, 5 rooms were carpeted and 5 were left uncarpeted. The rooms are similar in size and function. After a suitable period of time, the concentration of bacteria in the air was measured (in units of bacteria per cubic foot) in all of these rooms. The data and summaries are provided:

| | $\bar{x}$ | $s$ |
|---|---|---|
| Carpeted Rooms: | 184 | 27.0 |
| Uncarpeted Rooms: | 172 | 17.9 |

11. The *P*-value for the test described in problem 12 is (use Option 2 for the degrees of freedom)
    **A) between 0.40 and 0.50.**
    B) between 0.20 and 0.25.
    C) between 0.05 and 0.20.
    D) below 0.05.

12. The researcher wants to investigate whether carpet makes a difference (either increases or decreases) in the mean bacterial concentration in air. The numerical value of the two-sample *t* statistic for this test is
    A) 0.414
    **B) 0.828.**
    C) 1.312
    D) 2.116

13. A 95% confidence interval for the difference in mean bacterial concentration in the air of carpeted rooms versus uncarpeted rooms is (use the conservative value for the degrees of freedom)
    A) –7.468 to 31.468.
    B) –8.772 to 32.772.
    C) –12.366 to 36.336.
    **D) –28.218 to 52.218.**

Use the following to answer questions 14-15:

Bags of a certain brand of tortilla chips claim to have a net weight of 14 ounces. Net weights actually vary slightly from bag to bag and are Normally distributed with mean $\mu$. A representative of a consumer advocate group wishes to see if there is any evidence that the mean net weight is less than advertised and so intends to test the hypotheses
$H_0$: $\mu = 14$, $H_a$: $\mu < 14$.
To do this, he selects 16 bags of this brand at random and determines the net weight of each. He finds the sample mean to be $\bar{x} = 13.88$ and the sample standard deviation to be $s = 0.24$.

14. Suppose we were not sure if the distribution of net weights was Normal. In which of the following circumstances would we not be safe using a *t* procedure in this problem?
    A) The mean and median of the data are nearly equal.
    B) A histogram of the data shows moderate skewness.
    **C) A stemplot of the data has a large outlier.**
    D) The sample standard deviation is large.

15. Based on these data,
    A) we would reject $H_0$ at significance level 0.10 but not at 0.05.
    **B) we would reject $H_0$ at significance level 0.05 but not at 0.025.**
    C) we would reject $H_0$ at significance level 0.025 but not at 0.01.
    D) we would reject $H_0$ at significance level 0.01.

16. You are thinking of employing a *t*-procedure to test hypotheses about the mean of a population using a significance level of 0.05. You suspect the distribution of the population is not Normal and may be moderately skewed. Which of the following statements is correct?
    A) You should not use the *t*-procedure, because the population does not have a normal distribution.
    **B) You may use the *t*-procedure, provided your sample size is large, say, at least 50.**
    C) You may use the *t*-procedure, but you should probably claim the significance level is only 0.10.
    D) You may not use the *t*-procedure, because *t*-procedures are robust to non-Normality for confidence intervals but not for tests of hypotheses.

17. A medical researcher wishes to investigate the effectiveness of exercise versus diet in losing weight. Two groups of 25 overweight adult subjects are used, with a subject in each group matched to a similar subject in the other group on the basis of a number of physiological variables. One group is placed on a regular program of vigorous exercise, but with no restriction on diet, and the other group on a strict diet, but with no requirement to exercise. The weight losses after 20 weeks are determined for each subject, and the difference between matched pairs of subjects (weight loss of subject in exercise group – weight loss of matched subject in diet group) is computed. The mean of these differences in weight loss is found to be –2 lbs. with standard deviation $s = 6$ lbs. Is this evidence of a difference in mean weight loss for the two methods? To test this, consider the population of differences (weight loss overweight adult would experience after 20 weeks on the exercise program) – (weight loss the same adult would experience after 20 weeks on the strict diet). Let $\mu$ be the mean of this population of differences and assume their distribution is approximately Normal. We test the hypotheses $H_0$: $\mu = 0$ versus $H_a$: $\mu \neq 0$, using the matched pairs *t* test. The *P*-value for this test is
    **A) larger than .10.**
    B) between .10 and .05.
    C) between .05 and .01.
    D) below .01.

18. Which of the following is an example of a matched pairs design?
    **A) A teacher compares the pretest and posttest scores of students.**
    B) A teacher compares the scores of students using a computer-based method of instruction, with the scores of other students using a traditional method of instruction.
    C) A teacher compares the scores of students in her class on a standardized test with the national average score.
    D) A teacher calculates the average of scores of students on a pair of tests and wishes to see if this average is larger than 80%.

19. To estimate μ, the mean salary of full professors at American colleges and universities, you obtain the salaries of a random sample of 400 full professors. The sample mean is $\bar{x}$ = \$73,220, and the sample standard deviation is $s$ = \$4400. A 99% confidence interval for μ is
    A) 73,220 ± 11,440.
    **B) 73,220 ± 577.**
    C) 73,220 ± 431.
    D) 73,220 ± 28.6.

Use the following to answer questions 20-23:

A psychologist has developed a set of activities which she hopes will help children develop better reading skills. In a study of the effectiveness of these activities, one class of second grade children learns with the activities. Another class of second grade children serves as the control, and learned without the activities. After some period of time, the reading skills of all of these children were assessed. A summary of these data is:

| | $n$ | $\bar{x}$ | $s$ |
|---|---|---|---|
| Activities class: | 21 | 51.48 | 11.01 |
| No Activities class: | 23 | 41.52 | 17.15 |

20. A 95% confidence interval for the difference in mean reading skill score between children that learned with activities and children that learned without activities is (use Option 2, the conservative method for degrees of freedom)
    **A) 0.97 to 18.95 points.**
    B) 2.53 to 17.39 points.
    C) 8.83 to 11.09 points.
    D) 6.45 to 13.47 points.

21. The psychologist suspects that children who learn with activities have higher mean reading skill test scores than children that don't learn with activities. Based on these data, the computed two-sample *t* statistic is
    A) 1.84.
    B) 2.02.
    **C) 2.31.**
    D) 4.70.

22. Which of the following would lead us to believe that the *t*-procedures were *not* safe to use here?
    A) The sample medians and means for the two groups were slightly different.
    B) The two population distributions being studied are slightly non-Normal.
    C) Some children learn to read before second grade, and these could be outliers in the data.
    **D) The two population distributions are heavily skewed, and far from Normal.**

23. The *P*-value for the test described in problem 21 (again, using Option 2 for degrees of freedom) is
    A) larger than 0.05
    B) between 0.025 and 0.05.
    C) between 0.02 and 0.025.
    **D) between 0.01 and 0.02.**

Use the following to answer questions 24-27:

A special diet is intended to reduce the cholesterol of patients at risk of heart disease. If the diet is effective, the target is to have the average cholesterol of this group be below 200. After six months on the diet, an SRS of 50 patients at risk for heart disease had an average cholesterol of $\bar{x}$ = 192, with standard deviation $s$ = 21. Is this sufficient evidence that the diet is effective in meeting the target? Assume the distribution of the cholesterol for patients in this group is approximately Normal with mean $\mu$.

24. Based on the data, the value of the one-sample *t* statistic is
    A) 3.42.
    B) 2.89.
    **C) –2.69.**
    D) –2.89.

25. The appropriate degrees of freedom for this test are
    A) 21.
    **B) 49.**
    C) 51.
    D) 200.

26. The *P*-value for the one-sample *t* test is
    A) larger than 0.10.
    B) between 0.10 and 0.05.
    C) between 0.05 and 0.01.
    **D) below 0.01.**

27. The appropriate hypotheses are
   **A) $H_0$: μ = 200, $H_a$: μ < 200.**
   B) $H_0$: μ = 200, $H_a$: μ > 200.
   C) $H_0$: μ = 192, $H_a$: μ ≠ 192.
   D) $H_0$: μ = 200, $H_a$: μ ≠ 200.

Use the following to answer questions 28-29:

We wish to see if, on average, traffic is moving at the posted speed limit of 65 miles per hour along a certain stretch of Interstate 70. On each of four randomly selected days, a randomly selected car is timed and the speed of the car is recorded. The observed speeds are 70, 65, 70, and 75 miles per hour. Assuming that speeds are Normally distributed with mean μ, we test whether, on average, traffic is moving at 65 miles per hour, by testing the hypotheses
$H_0$: μ = 65, $H_a$: μ ≠ 65.

28. Based on the data, the value of the one-sample *t* statistic is
   A) 5.
   B) 4.90.
   **C) 2.45.**
   D) 1.23.

29. Based on these data,
   **A) we would reject $H_0$ at significance level 0.10 but not at 0.05.**
   B) we would reject $H_0$ at significance level 0.05 but not at 0.025.
   C) we would reject $H_0$ at significance level 0.025 but not at 0.01.
   D) we would reject $H_0$ at significance level 0.01.

30. Do students tend to improve their math SAT scores the second time they take the test? A random sample of four students who took the test twice received the following scores.

| Student | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| First score | 450 | 520 | 720 | 600 |
| Second score | 440 | 600 | 720 | 630 |

   Assume that the change in math SAT score (second score – first score) for the population of all students taking the test twice is Normally distributed, with mean μ. A 90% confidence interval for μ is
   A) 25.0 ± 64.29.
   **B) 25.0 ± 47.54.**
   C) 25.0 ± 43.08.
   D) 25.0 ± 33.24.

## Answer Key

1. D
2. B
3. C
4. B
5. A
6. C
7. D
8. B
9. A
10. A
11. A
12. B
13. D
14. C
15. B
16. B
17. A
18. A
19. B
20. A
21. C
22. D
23. D
24. C
25. B
26. D
27. A
28. C
29. A
30. B