**AP Statistics** **Name:** _____ **Per:** ____
Review Chapters 23 – 25

**Directions:** Show all your work. Indicate clearly the methods you use, because you will be graded on the correctness of your methods as well as on the accuracy of your results and explanation.

0. Before beginning this review, please note that this test covers concepts from ALL of inference thus far (chapters 19-25). While the exam will focus on inference with means, you may wish to go back through the last group quiz and test review (ch. 20-22) to brush up on the following:

   i. Conditions for every type of test/interval, for means AND proportions. Know what they are, how to check them, and most importantly, WHY we check each of them.
   ii. Type I and Type II errors.
   iii. Power of a hypothesis test – how to interpret it, how to increase it, and (if given $\beta$) how to calculate it.

1. Describe how the shape, center, and spread of t-models change as the number of degrees of freedom increases.

2. Describe how the critical value of t for a 95% confidence interval changes as the number of degrees of freedom increases.

3. Livestock are given a special feed supplement to see if it will promote weight gain. The researchers report that the 77 cows studied gained an average of 56 pounds, and that a 95% confidence interval for the mean weight gain this supplement produces has a margin of error of ±11 pounds. Some students wrote the following conclusions. Did anyone interpret the interval correctly? Explain any misinterpretations.

   a) 95% of the cows studied gained between 45 and 67 pounds.

   b) We're 95% sure that a cow fed this supplement will gain between 45 and 67 pounds.

   c) We're 95% sure that the average weight gain among the cows in this study was between 45 and 67 pounds.

   d) The average weight gain of cows fed this supplement will be between 45 and 67 pounds 95% of the time.

   e) If this supplement is tested on another sample of cows, there is a 95% chance that their average weight gain will be between 45 and 67 pounds.

4. The owners of a local footwear store wishes to know the mean amount of money spent on running shoes by runners at Lady Bird Lake, to see if consumer spending habits have changed since the recent recession. Previous corporate records indicate that the standard deviation for amount of money spent on running shoes is $21. If the store owners wish to estimate the mean amount of money spent with 98% confidence and a margin of error of no more than $10, what is the minimum number of customers that they should survey?

5. **Attitudes** The Survey of Study Habits and Attitudes (SSHA) is a psychological test that measures students' attitudes toward school and study habits. Scores range from 0 to 200. The mean score for U.S. college students is about 115. A teacher suspects that older students have better attitudes towards school. She gives the SSHA to an SRS of 45 of the more than 1000 students at her college who are at least 30 years of age. The sample mean SSHA score was 125.7 and the sample standard deviation was 29.8. A significance test yields a P-value of 0.0101. Interpret the P-value in context.

6. **Anemia** Hemoglobin is a protein in red blood cells that carries oxygen from the lungs to body tissues. People with less than 12 grams of hemoglobin per deciliter of blood (g/dl) are anemic. A public health official in Jordan suspects that Jordanian children are at risk of anemia. He measures a random sample of 50 children. Their sample mean hemoglobin level was 11.3 g/dl and the sample standard deviation was 1.6 g/dl. A significance test yields a P-value of 0.0016. Interpret this P-value in context.

7. **Shut-ins** are adults who are too ill to leave their homes on a normal basis. Researchers asked 10 randomly selected shut-ins in the Dallas area about the number of hours of television they watched per week. The results are

79 96 90 84 75 88 80 94 66 91

a) Determine the 90% confidence interval estimate for the mean number of hours of television watched per week by Dallas area shut-ins. Show all statistical reasoning.

b) Explain the meaning of 90% confidence level in the context of the shut-in data.

8. **STEREOTYPE THREAT** Back in the old days, one common stereotype was that boys are better at math than girls*. But as a result of this "stereotype", could asking a girl to specify her gender before taking a math test negatively impact her performance on that test? A number of studies in the late 1990's sought to address this question.

Twenty female students that were taking the AP Calculus AB exam at Podunk High School were randomly selected for this study. All 20 took the same test, but half of the girls were randomly assigned to identify their gender before the exam, while the other half were asked to identify their gender after taking the test. The tables below show the raw AP Calculus Exam scores for these 20 students.
*(Note: Although AP scores are reported on a 1 – 5 scale, the raw score for an AP Calculus AB Exam can range from 0 – 108)*

**Group A (were asked to identify gender before the test)**

| Raw AP Exam Score | 74 | 59 | 101 | 77 | 63 | 85 | 54 | 40 | 83 | 76 |
|---|---|---|---|---|---|---|---|---|---|---|

Mean Score: 71.2 Standard Deviation of Scores: 17.54

**Group B (were asked to identify gender after the test)**

| Raw AP Exam Score | 63 | 101 | 82 | 69 | 56 | 92 | 93 | 100 | 75 | 86 |
|---|---|---|---|---|---|---|---|---|---|---|

Mean Score: 81.7 Standard Deviation of Scores: 15.55

Do the data provide convincing evidence, at the $\alpha = 0.05$ level, that the mean exam score for girls who are asked to identify their gender before the exam are lower than girls who are asked to identify their gender after the exam?

9. **E-Coli** Investigators at the U.S. Department of Agriculture wished to compare methods of determining the level of *E. coli* bacteria contamination in beef. Two different methods (A and B) of determining the level of contamination were used on each of ten randomly selected specimens of a certain type of beef. The data obtained, in millimicrobes/liter of ground beef, for each of the methods are shown in the table below.

| | | Specimen | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 |
| Method | A | 22.7 | 23.6 | 24.0 | 27.1 | 27.4 | 27.8 | 34.4 | 35.2 | 40.4 | 46.8 |
| | B | 23.0 | 23.1 | 23.7 | 26.5 | 26.6 | 27.1 | 33.2 | 35.0 | 40.5 | 47.8 |

Is there a significant difference in the mean amount of *E. coli* bacteria detected by the two methods for this type of beef? Provide a statistical justification at the $\alpha = 0.05$ level to support your answer.

10. A high school guidance counselor wondered if Podunk University might admit people with lower ACT scores if they also were athletes. Among the students who were admitted to Podunk U. last year, 8 were randomly chosen from the athletes and another 8 were randomly chosen from the group of non-athletes. Their composite ACT scores are listed below.

    a) Estimate the mean difference in composite ACT score between the two groups by using a 90% confidence interval.

| **Composite ACT Score** | |
|---|---|
| Non-athletes | Athletes |
| 25 | 22 |
| 22 | 21 |
| 19 | 24 |
| 25 | 27 |
| 28 | 19 |
| 29 | 23 |
| 27 | 17 |
| 23 | 20 |

    b) Interpret the meaning of the 90% confidence level in context.

11. A group of psychologists from Podunk University (our favorite place!) conducted a study to investigate whether there is an association between being happy with your grades in school and eating breakfast on a regular basis for the students who attend the local Podunk High School.

    The Podunkian psychologists used two independent random samples of students from Podunk High School: 34 who reported that they choose to eat breakfast on a daily basis, and 33 who reported that they choose not to eat breakfast regularly (if at all). 19 of the 34 that ate breakfast regularly stated that they were satisfied with their grades, while 10 of the 33 that did not eat breakfast regularly reported satisfaction with their school grades.

    a) Suppose you wish to perform a test to see if these samples provide evidence that the proportion of students who are satisfied with their school grades is greater for those who eat breakfast regularly than for those who do not. **What type of test would be appropriate for this problem? Write the hypotheses for this test, then check the appropriate conditions for inference (but DO NOT perform the hypothesis test).**

    b) Suppose that the power of this hypothesis test was calculated to be 0.62. Explain clearly the meaning of this value in context.

    c) Suppose that the results of the hypothesis test that you performed in part (a) were statistically significant (in other words, that the proportion of all Podunk students that are satisfied with their grades is higher for those who eat breakfast regularly than for those who do not eat breakfast regularly). Based on this study, can we state that eating breakfast **causes** a greater likelihood that a Podunk High student will be satisfied with their grades? Clearly explain why or why not.