AP Statistics Practice Test
Unit Eight – Introduction to Inference

Name_____Period_____Date_____

Vocabulary:

1. Define a confidence interval.

2. List four ways to increase the power of a test.

3. What is a Type II error and how can this error be decreased?

4. What does “no statistically significant difference” mean in plain language?

5. Explain in your own words the meaning of the P-value.

Multiple Choice:

6. A safety group claims that the mean speed of drivers on a highway exceeds the posted speed limit of 65 miles per hour (mph). To investigate the safety group's claim, which of the following statements is appropriate?
   (A) The null hypothesis is that the mean speed of drivers on this highway is less than 65 mph.
   (B) The null hypothesis is that the mean speed of drivers on this highway is greater than 65 mph.
   (C) The alternative hypothesis is that the mean speed of drivers on this highway is greater than 65 mph.
   (D) The alternative hypothesis is that the mean speed of drivers on this highway is less than 65 mph.
   (E) The alternative hypothesis is that the mean speed of drivers on this highway is greater than or equal to 65 mph.

7. A researcher has conducted a survey using a simple random sample of 50 registered voters to create a confidence interval to estimate the proportion of registered voters favoring the election of a certain candidate for mayor. Assume that a sample proportion does not change. Which of the following best describes the anticipated effect on the width of the confidence interval if the researcher were to survey a random sample of 200, rather than 50, registered voters?
   (A) The width of the new interval would be about one-fourth the width of the original interval.
   (B) The width of the new interval would be about one-half the width of the original interval.
   (C) The width of the new interval would be about the same width as the original interval.
   (D) The width of the new interval would be about twice the width of the original interval.
   (E) The width of the new interval would be about four times the width of the original interval.

8. The government claims that students earn an average of $4500 during their summer break from studies. A random sample of students gave a sample average of $3975 and a 95% confidence interval was found to be $3525 < μ < $4425. This interval is interpreted to mean that:
   (A) If the study were to be repeated many times, there is a 95% probability that the true average summer earnings is not $4500 as the government claims.
   (B) Because our specific confidence interval does not contain the value $4500 there is a 95% probability that the true average summer earnings is not $4500.
   (C) If we were to repeat our survey many times, then about 95% of our confidence intervals will contain the true value of the average earnings of students.
   (D) If we were to repeat our survey many times, then about 95% of all the confidence intervals will be between $3525 and $4425.
   (E) There is a 95% probability that the true average earnings are between $3525 and $4425 for all students.

9. A random sample has been taken from a population. A statistician, using this sample, needs to decide whether to construct a 90 percent confidence interval for the population mean or a 95 percent confidence interval for the population mean. How will these intervals differ?
   (A) The 90 percent confidence interval will not be as wide as the 95 percent confidence interval.
   (B) The 90 percent confidence interval will be wider than the 95 percent confidence interval.
   (C) Which interval is wider will depend on how large the sample is.
   (D) Which interval is wider will depend on whether the sample is unbiased.
   (E) Which interval is wider will depend on whether a *z*-statistic or a *t*-statistic is used.

10. A consulting statistician reported the results from a learning experiment to a psychologist. The report stated that on one particular phase of the experiment a statistical test result yielded a p-value of 0.24. Based on this p-value, which of the following conclusions should the psychologist make?
   (A) The test was statistically significant because a p-value of 0.24 is greater than a significance level of 0.05.
   (B) The test was statistically significant because p = 1 – 0.24 = 0.76 and this is greater than a significance level of 0.05.
   (C) The test was not statistically significant because 2 times 0.24 = 0.48 and that is less than 0.5.
   (D) The test was not statistically significant because, if the null hypothesis is true, one could expect to get a test statistic at least as extreme as that observed 24% of the time.
   (E) The test was not statistically significant because, if the null hypothesis is true, one could expect to get a test statistic at least as extreme as that observed 76% of the time.

11. A 95% confidence interval for μ is calculated to be (1.7, 3.5). It is now decided to test the hypothesis H_0: μ = 2 vs. H_a: μ ≠ 2 at the α = 0.05 level, using the same data as was used to construct the confidence interval.
   (A) We cannot test the hypothesis without the original data.
   (B) We cannot test the hypothesis at the α = 0.05 level since the α = 0.05 test is connected to the 97.5% confidence interval.
   (C) We can only make the connection between hypothesis tests and confidence intervals if the sample sizes are large.
   (D) We would reject H_0 at level α = 0.05.
   (E) We would fail to reject H_0 at level α = 0.05.

Short Answer:

12. The diameter of a spindle in a small motor is supposed to be 5mm. If the spindle is either too small or too large, the motor will not work properly. The manufacturer measures the diameter in a sample of motors to determine whether the mean diameter has moved away from the target. State the null and alternative hypotheses to be tested in this case.

13. Under what conditions would an α value of .01 be preferable to an α value of .05?

14. Suppose we want a 90% confidence interval for the average amount spent on books by freshmen in their first year at a major university. The interval is to have a margin of error of $2, and the amount spent has a normal distribution with a standard deviation σ = $30. What sample size would be needed for these conditions?

Free Response:

15. The EPA sets limits on the maximum allowable concentration of certain chemicals in drinking water. For the substance PCB, the limit has been set at 5 ppm. A random sample of 36 water specimens from the same well results in a sample mean PCB concentration of 5.18 ppm and we believe the population standard deviation is 0.6 ppm.

    (a) Carry out a test using a significance level of .01 to decide whether the water is unsafe. Do all steps!

    (b) Describe the type I and type II errors in the <u>context of this problem</u>. Which error would be more detrimental?

    (c) What is the probability of a Type I error in this problem (#15)? _____

16. You measure the weights of 24 male runners. You choose an SRS from the population of male runners in your town or city. The population is known to have a normal distribution. Here are their weights in kilograms:

67.8	61.9	63.0	53.1	62.3	59.7	55.4	58.9
60.9	69.2	63.7	68.3	64.7	65.6	56.0	57.8
66.0	62.9	53.6	65.0	55.8	60.4	69.3	61.7

    Suppose that the standard deviation of the population is known to be σ = 4.5 kg.

(a) Construct a 95% confidence interval for μ, the mean of the population from which the sample is drawn. Verify conditions are met and interpret your C.I. in the context of the problem.

(b) Explain the meaning of 95% confidence in general terms. Do NOT repeat your conclusion sentence in part a.

(c) Based on this confidence interval, does a test of: H_o = 61.3 kg vs. $H_a \neq$ 61.3 kg reject H_o at the 5% significance level? (Yes or no and why. Do NOT do a test!!)

17. Patients with chronic kidney failure may be treated by dialysis, using a machine that removes toxic wastes from the blood, a function normally performed by the kidneys. Kidney failure and dialysis can cause other changes, such as retention of phosphorous, that must be corrected by changes in diet. A study of the nutrition of dialysis patients measured the level of phosphorous in the blood of several patients on six occasions. Here's the data for one patient:

5.6 5.3 4.6 4.8 5.7 6.4

The measurements are separated in time and can be considered an SRS of the patient's blood phosphorous level. Assume that this level varies normally with σ = 0.9 mg/dl. The normal range of phosphorous in the blood is considered to be 2.6 to 4.8 mg/dl. Let's use a 5% significance level.

(a) Is there strong evidence that the patient has a mean phosphorous level that exceeds 4.8? Do all steps!

(b) Describe a Type I error and a Type II error in this situation. Which is more serious?

(c) Referring to your answer in question (b), if you were able to pick your significance level, would you prefer $\alpha = 0.1$ or $\alpha = 0.01$? Explain.

Review: Circle the best answer.

18. In a recent high school basketball tournament where over 750 games were played, the mean team score was 68 points and the standard deviation was 13 points. The scores were approximately normally distributed. A coach was overheard saying that his team scored 95 points in one game. About what proportion of teams' scores during the tournament were more than 95 points?

    (A) 0.0035
    (B) 0.0190
    (C) 0.05
    (D) 0.9810
    (E) 2.07

19. Which of the following statements are true?

    I. The sampling distribution of $\hat{p}$ has mean equal to the population proportion *p*.

    II. The sampling distribution of $\hat{p}$ has a standard deviation equal to $\sqrt{np(1-p)}$.

    III. The sampling distribution of $\hat{p}$ is considered close to normal provided that $n \geq 30$.

    (A) I only
    (B) I and II only
    (C) I and III only
    (D) II and III only
    (E) I, II, and III

20. In a test of a new allergy medication, some subjects take the actual drug and some take an inactive sugar pill that looks like the actual drug. The subjects do not know which pill they are taking.

    a. What is the term for subjects not knowing which pill they are taking?
    b. What is the term for the inactive sugar pill some subjects are taking?

    (A) *a.* Bias
        b. Blinding

    (B) *a.* Blinding
        b. Bias

    (C) *a.* Blinding
        b. Placebo

    (D) *a.* Placebo
        b. Control

    (E) *a.* Random assignment
        b. Placebo

21. A company has 1000 employees evenly distributed throughout five assembly plants. A sample of 30 employees is to be chosen as follows. Each of the five plant managers will be asked to place the 200 time cards of their respective employees in a bag, mix them up, and draw out six names at random. The six names from each plant will be put together to make up the sample. Will this method result in a simple random sample of the 1000 employees?

    (A) Yes, because every employee has an equal chance of being selected.
    (B) Yes, because each plant is equally represented.
    (C) Yes, because this is an example of stratified sampling, which is a special case of simple random sampling.
    (D) No, because the plants are not chosen randomly.
    (E) No, because not every group of 30 employees has an equal chance of being selected.