Edhesive AP Statistics **Unit 1 – Solutions**

**Multiple Choice:** Choose the best answer choice for the following problems.

1. A SRS of 20 observations is collected from a Normal population to test against . If the t-statistic for this test is , which of the following is true?
   1. 0.0 < P-value < 0.01
   2. 0.01 < P-value < 0.025
   3. 0.025 < P-value < 0.05
   4. 0.05 < P-value < 0.25
   5. 0.25 < P-value

For a sample size of 20 and t=-2.06, the corresponding P-value is 0.0534

1. Under proper conditions, the test of versus results in a P-value of 0.015. Which of the following are true?
   1. A 95% confidence interval for will include the value 5.
   2. A 99% confidence interval will not include the value 5.
   3. A 95% confidence interval will include the value 0.
   4. A 95% confidence interval will not include the value 5.
   5. A 99% confidence interval will include the value 0.

The test meets the 95% significance level but not 99%. Thus we do not know if a 99% confidence interval will contain 5 or 0. At 95% we may reject , meaning that a 95% confidence interval would not include 5. It is unknown if a 95% confidence interval will include 0.

1. A researcher is studying bacterial growth and believes she has a new petri dish formula that will increase the amount of growth in the first week by 2%. Which test design is most likely to reach significance in determining the effectiveness of the new petri dish formula?

* 1. A small random sample and a 5% significance level.
  2. A large random sample and a 5% significance level.
  3. A small random sample and a 1% significance level.
  4. A large random sample and a 1% significance level.
  5. The sample size will not affect the significance of the test.

A large sample will increase the test significance over a small one, and demanding only a 95% level of significance will make it more likely that the test results will meet this requirement.

1. The researcher from question 3 designs her experiment to have a power of 0.95 and plans to conduct the test at a significance level of . What is the probability that she commits a Type II error?
   1. 1%
   2. 5%
   3. 50%
   4. 95%
   5. 99%

The power of a test, P, is the probability of correctly rejecting the null hypothesis when the alternative hypothesis is true. Therefore, the probability of committing a Type II error (ie failing to reject the null hypothesis when the alternative is true) is 1-P=1-0.95=5%.

1. You are designing an experiment for class in which you will gather an SRS of 25 observations from a Normal population to test against . What t statistic would mean you have achieved significance at the level?

For a One tail test of H0 at the 5% level we use df=n-1=24 and look up the corresponding t statistic from the t table, giving t=1.711. Thus for we will have met a significance level of 5%.

**Free Response – Solutions**

1. The scientist discussed in questions 3&4 conducts her experiment to test the effectiveness of her new petri dish formula. She collects 25 samples and calculates an average first week growth of 23.5 with a standard deviation of 4.2. The mean first week growth using the standard formula is 22.0.
   1. Is this convincing evidence at the level that the new petri dish formula effectively increases the first week growth? Justify your answer.

A one sample t-test using this data gives a t value of t=(23.5-22)/(4.2/sqrt(25))=1.79. The t-value that corresponds to an level using df=n-1=24 is t=1.711. Thus these samples present convincing evidence that the new petri dish formula does increase first-week bacterial growth.

* 1. How would the results change if the sample mean were instead 23.4? Comment on what this means about statistical testing.

Using a value of 23.4 instead of 23.5 changes the t-value from 1.79 to 1.67. Thus we do not achieve statistical significance at the level. It should be noted that statistical tests offer a sense of how *likely* a given hypothesis may be. Setting a firm boundary (at say a 5% level) is arbitrary and may lead to surprising situations as described here where small changes in the data lead to apparent striking differences in results. What may be more accurate to say is that both sets of data achieve significance at *around* the 95% level.