Edhesive AP Statistics **Unit 1 – Solutions**

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

1. The mean wait time at a certain DMV is 15 minutes. A city employee tasked with improving these wait times and thinks that providing commonly used forms for customers to fill out while they wait will help things move along faster. The employee measures the wait time for each of 100 customers with access to these forms. The appropriate hypotheses for the significance test are:
   1. H­0 : µ=15 ; Ha : µ >15
   2. H­0 : µ=15 ; Ha : µ ≠15
   3. H­0 : =15 ; Ha : <15
   4. H­0 : µ=15 ; Ha : µ <15
   5. H­0 : µ<15 ; Ha : µ =15

The null hypothesis is that access to the forms does not reduce wait time thus the wait time is still 15 minutes while the alternative hypothesis is that access to the forms reduces the wait time.

1. If the study in problem 1 results in a Type II error, which of the following is true?
   1. The study concluded that there was sufficient evidence to suggest reduced wait times when in reality the wait times were unaffected.
   2. The study concluded that there was insufficient evidence to suggest reduced wait times when in reality wait times were reduced.
   3. The study concluded that there was insufficient evidence to suggest reduced wait times when in reality wait times were not reduced
   4. The study concluded that there was sufficient evidence to suggest reduced wait times when the evidence was inconclusive.
   5. The study concluded that there was insufficient evidence to suggest reduced wait times when the evidence was inconclusive.

A Type II error is the failure to reject a false null hypothesis. In this case that is to claim insufficient evidence to assert reduced wait times when there really was a reduction in wait times.

1. A student is considering running for class president but wants to know if her classmates would support her idea of increasing school lunch options with a 5% cost increase. To investigate, she conducts a survey of a random sample of 75 of her classmates to test the following hypotheses:

H­0 : p=50 ; Ha : p>50

where p is the proportion of students who support the new lunch plan. What is the result of a Type I error in this context?

* 1. The study finds a majority of students support the measure when in reality no more than 50% do.
  2. The study doesn’t find convincing evidence that a majority of students support the measure when in fact more than 50% do support it.
  3. The study doesn’t find convincing evidence that a majority of students support the measure when in reality at most 50% of students support it.
  4. The study finds a majority of students support the measure when in reality more than 50% do support the new lunch plan.
  5. The study finds a majority of students support the measure when in reality there isn’t convincing evidence that a majority support the new lunch plan.

A Type I error is the rejection of the null hypothesis, in this case finding that a majority support the new lunch plan when in fact that is not the case.

1. The sample of students used in Question 3 resulted in being in favor of the new lunch plan. The resulting P-value is 0.13. Which interpretation of the P-value is correct?
   1. Assuming that 50% of students support the plan there is a 13% chance that the null hypothesis is true on chance alone
   2. Only 13% of the students support the new lunch plan
   3. Assuming that over 50% of students support the plan there is a 13% probability that the sample proportion would be 0.63 or higher on chance alone
   4. There is a 13% chance that the majority of students support the new lunch plan
   5. Assuming that exactly half of the students support the plan there is a 13% probability that the sample proportion would be 0.63 or higher on chance alone

The P-value is defined as the probability under the null hypothesis of obtaining a result as or more extreme than the one obtained. In this example this means that assuming half of the students support the lunch plan, there is only a 13% chance that the sample would return a proportion of 0.63 or higher.

1. The situation described in problems 3,4 resulted in a P-value of 0.13. Which of the following represents the most appropriate conclusion to draw from these results?
   1. Because the P-value is large we are not able to confidently reject the null hypothesis and have evidence that more than 50% of the students support the new lunch plan.
   2. Because the P-value is large we are not able to confidently reject the null hypothesis and do not have sufficient evidence that more than 50% of the students support the new lunch plan.
   3. Because the P-value is large we reject the null hypothesis and have evidence that at most 50% of the students support the new lunch plan.
   4. Because the P-value is large we are not able to confidently reject the null hypothesis and can conclude that more than 50% of the students support the new lunch plan.
   5. Because the P-value is large we are not able to confidently reject the null hypothesis but have convincing evidence that no more than 50% of students support the new lunch plan.

A large P-value signifies a high probability of obtaining the given results by chance alone. Thus the assertion that the alternative hypothesis is true is unfounded and we cannot reject the null hypothesis.

**Free Response – Solutions**

1. A jeweller is suspected of lowering the amount of gold being used in their 18 karat jewelry. You plan to measure the gold content of a random sample of 100 pieces of jewelry. The 18 karat gold is supposed to contain 75% gold, with the other 25% made up of a 3/2 ratio of copper to silver, so you will test the hypotheses H­0 : µ=75 *versus* Ha : µ <75 at the α=0.05 level.
   1. Describe what a Type I error would be in this context.

A Type I error would be the incorrect rejection of the hypothesis that the gold content is 75%

* 1. Determine the probability of making a Type I error while performing this test.

Because we set our confidence level to α=0.05, there is a 5% chance of falsely rejecting the null hypothesis.

* 1. Describe what a Type II error would be in this context.

A Type II error would be the rejection of the hypothesis that the jeweler has reduced the amount of gold in their jewelry when in fact they have.

* 1. Which type of error would you want to minimize to lower the chance of a wrongfully accusing the jeweller of lowering the amount of gold in their jewelry?

Lowering the amount of Type I error would reduce the chance of the test saying the jeweller is reducing the amount of gold when they really are not.