Name:_____ Class:_____

WISE Hypothesis Testing Module - Worksheet

For each of the questions below, provide an answer and justify your answer. The online tutorial provides many of the answers and explanations; however, please formulate your own responses to develop and demonstrate your understanding of the concepts.

B. Are ACE Graduates Better Test Takers?

Question B1: Would you be convinced that the average score for ACE graduates is greater than 500 if you were told that one randomly selected ACE graduate had a score of 550? (What is the probability that a randomly sampled score from the normally distributed population is 550 or greater, given that the population mean is 500 and the standard deviation is 100?) Show your work.

Question B2: Would it be more convincing if 25 randomly selected ACE graduates had an average score of 550? Why?

Question B3: What is the numerical value for the standard error of the mean for a sample of N = 25 drawn randomly from a population with a standard deviation of σ = 100? Show your work:

C. Sampling Error and Sample Size

From *least* to *most* likely, rank the following events (assume random sampling from the population of VAST-test takers with μ = 500 and σ = 100):

1. Obtaining an individual score of 550 or greater.
2. Obtaining a sample mean of 550 or greater with a sample size of 25.
3. Obtaining a sample mean of 550 or greater with a sample size of 5.

- 1, 2, 3
- 3, 2, 1
- 2, 3, 1
- Events equally likely.

Explanation:

D. Probabilities of Observed Sample Means

VAST scores are normally distributed with a mean score of 500 and a standard deviation of 100. Calculate the *z*-score and the probability of obtaining a sample mean 550 or greater when *N* = 5 (assume random sampling; you can compute the *z*-score and use the *p*-*z* converter to convert the *z*-scores into a *p*-value).

z-score is:_____ *p*-value is: _____

Show your work:

F. Null (H_0) and Alternative (H_1) Hypotheses

Suppose we are interested in deciding whether graduates of ACE training on average have larger scores on VAST than the population of VAST test takers who have not taken ACE training. A random sample of 30 ACE graduates yields a sample mean of 510 (i.e., $\overline{X}$ = 510) and standard deviation of 90 (S = 90). The population mean for untrained test takers is 500 (μ = 500) with a standard deviation of 100 (σ = 100).

If we were interested in testing whether ACE training program graduates on average score better than 500, what form would our null hypothesis take?

- H_0: $\mu > 500$
- H_0: $\mu < 500$
- H_0: $\mu = 500$
- H_0: $\overline{X} = 510$
- H_0: $\overline{X} \leq 500$
- None of the above

(What is correct?)

Explanation:

G. Alpha (α) as a Criterion for Rejecting H_0

Suppose a random sample of 10 students who completed the ACE training program scored an average of 560 on the VAST test. The sample mean of 560 corresponds to a *z*-score of 1.9. Given the null hypothesis, H_0: $\mu \leq 500$ and an alpha level of α = .05, what do you conclude? (Hint: You can use a *z*-table or the *p*-*z* converter for this problem.)

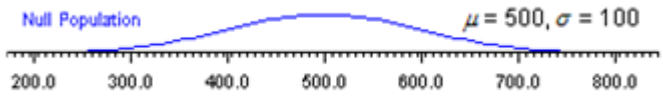
- The population mean for the program may be 500 or less (fail to reject H_0).
- The population mean for the program is not likely to be 500 or less (reject H_0).
- Sample mean is 500.
- Population mean is 560.

Explanation:

Exercise 1: Testing If ACE Graduates Do Better

This exercise reviews several steps in hypothesis testing. You will be asked to calculate a *z*-score corresponding to your data, find an associated *p* value, and draw a conclusion.

The Verbal Ability and Skills Test (VAST) is a standardized test with a range of 0 to 1000. VAST scores are normally distributed within the population of test takers with a mean score of 500 with a standard deviation of 100.



The ACE training program boasts that the population of their graduates scores higher on average than the population of individuals who do not participate in their training course. That is, the training program claims that the average score on the VAST for those complete their training program is higher than 500. As a budding statistician, you have been hired to test this claim.

Question 1: Find the *z*-score

Your data: To test the training program's claim, you recorded the VAST scores of 10 randomly sampled graduates of the program and you found the sample mean to be 530. Use these sample data to address the training program's claim that their graduates on average score better than 500 on VAST.

First, calculate a *z*-score for the sample mean, $\overline{X}$, of 530 given that the population standard deviation, σ, is 100 and population mean, μ, is 500. (Hint: you may view the formula for converting sample means into *z*-scores here). Which of the following *z*-scores is correct?

- $z = 0.00$
- $z = 0.09$
- $z = 0.30$
- $z = 0.95$
- $z = 3.00$

Explanation:

Question 2: Find the *p*-value

Next, you can use your *z*-table or the *p*-*z* converter to find the probability of obtaining a *z*-value this large or larger, assuming that we are sampling from a normal distribution with a mean of 500. This *p*-value corresponds to the probability of obtaining a sample mean of 530 or larger from a sample of 10 people randomly selected from a normally distributed population with a mean of 500.

What is the probability of a *z* score of .95 or more?

- *p* = 0.050
- *p* = 0.171
- *p* = 0.329
- *p* = 0.342
- *p* = 0.829

Explanation:

Question 3: Interpret the *p*-value

Given our result of *p* = .171, what would you conclude about the VAST preparation course? Recall that VAST scores for the population of people who did not take the preparation course is normally distributed with a mean of 500 and standard deviation of 100. Our null hypothesis is that population of people who complete the ACE training course have VAST test scores no larger than those who do not complete the course. We set alpha equal to .05 before we collected data.

- Graduates of ACE training program do not differ from non-graduates on average VAST scores.
- We are confident that the training program graduates on average score higher than 500.
- Graduates of the training program may not differ from non-graduates on average VAST scores.
- We are confident that training program graduates score lower than the VAST.

Explanation:

Question 4: H_0 and H_1

Now, suppose we drew a sample of 100 people from this course and obtained a mean score of 530. Which answer below best reflects the null hypothesis, H_0; alternative hypothesis, H_1; and conclusion based on an alpha of .05? Recall, the average score for people who took the VAST quantitative section with no training is 500 with a standard deviation of 100. Again, you may use a *z*-table or the *p*-*z* converter.

- H_0: $\mu = 530$; H_1: $\mu = 500$; Do not reject null hypothesis.
- H_0: $\mu \leq 500$; H_1: $\mu = 530$; Do not reject null hypothesis.
- H_0: $\mu = 500$; H_1: $\mu \neq 500$; Do not reject the null hypothesis.
- H_0: $\mu \leq 500$; H_1: $\mu > 500$; Reject the null hypothesis.

Explanation: