Analytics Primer

Quiz 2

Honor Pledge:

I certify that I have not received or given unauthorized aid in taking this exam.

Signed: _____

Printed Name: KEY

Date: _____

There are 16 questions. The first 10 are worth 2 points each. The last 6 are worth 5 points each. There will be some True/False, Multiple Choice, and Short Answer questions.

1. Confidence intervals are not random values because they are the same values for every sample from a population.
   a. True.
   b. False.

2. Why do we use the t-distribution in the analysis of means instead of the normal distribution?
   a. Means usually have a skewed distribution and so does the t-distribution.
   b. We do not know the population standard deviation.
   c. Only have small sample sizes when considering problems with means.
   d. Both b. and c.

3. We used the t-distribution to calculate a confidence interval for the population mean. If we changed the sample size from 15 to 30, which of the following would change?
   a. The degrees of freedom.
   b. The standard error.
   c. Both a. and b.
   d. None of the above.

4. An Irish analyst conducted a study on the proportion of residents in her home town in Dublin, Ireland (approximately 500,000 residents) that have visited the United States on vacation over the past 5 years. She randomly selected 100 people from her home town and found 26% of them vacationed in the United States over the past 5 years. A 95% confidence interval for the true proportion of people in Dublin that vacationed in the United States over the past 5 years was 26% ± 8.6%. Which of the following would decrease the margin of error?
   a. If they had sampled 200 people rather than 100 people.
   b. If there had been 1,000,000 people in Dublin instead of 500,000.
   c. If they had used 99% confidence rather than 95% confidence.
   d. Both b and c, but not a.

5. In your own words, describe what the alternative hypothesis in a hypothesis test represents.

   It represents the opposite of the status quo (H_0). We are trying to collect evidence to help test this claim.

6. I calculate a proportion hypothesis test with a sample of 147 people collected from a colleague. After I calculate my results, my colleague tells me he actually sampled 1047 people. Assuming everything else stayed the same except for the sample size, what will change about the results?
   a. My test statistic will get smaller.
   b. I will have a lower chance of rejecting the null hypothesis.
   (c.) I will have a higher chance of rejecting the null hypothesis.
   d. Not enough information.

7. The p-value is calculated assuming that the alternative hypothesis is true.
   a. True.
   (b.) False.

8. In your own words, describe what a p-value is.

   The probability we got as rare a sample as we did, or even more rare, given H_0 is true.

9. You can compare a one-sided hypothesis test and a confidence interval when $C = 1 - \alpha$.
   a. True.
   (b.) False.

10. I conduct a hypothesis test for means with a sample size of 150. If I hold everything else the same and just recalculate everything like I had a sample size of 1500, then which of the following is true?
    (a.) I have a higher chance of making a type I error.
    b. I have a lower chance of making a type I error.
    c. Chances of making a type I error would remain the same.
    d. Need more information.

An employee for a company recently gave a presentation where he stated that over 50% of the smoke detectors in the company's office buildings were non-functional. The safety inspector of the building complex was at the presentation and took offense to this statement. The safety inspector sampled 80 smoke detectors in the company's office buildings and found 28 of them were non-functional. Use this information to answer questions 11-14.

11. (5 points) Are the needed assumptions for confidence intervals met in this situation?

    Large sample $\Rightarrow$ $n\hat{p} = 28 \geq 5$
    $n(1-\hat{p}) = 52 \geq 5$ } YES

12. (5 points) Regardless of your answer to question 11, calculate a 90% confidence interval for the true population proportion of smoke detectors that are non-functional.

$$\hat{p} = \frac{28}{80} = 0.35$$

$$\hat{p} \pm z^* \cdot \sqrt{\frac{\hat{p}(1-\hat{p})}{n}}$$

$$0.35 \pm 1.645\sqrt{\frac{0.35(1-0.35)}{80}}$$

0.35 ± 0.088 OR $(0.262, 0.438)$

13. (5 points) The safety inspector was not happy with the margin of error calculated from the sample. Assuming that the company employee's estimate of over 50% non-functional smoke detectors is true, calculate the sample size the safety inspector needs to get a margin of error of 0.05.

$$n = \frac{z^2 \tilde{\pi}(1-\tilde{\pi})}{e^2} = \frac{1.645^2(0.5)(1-0.5)}{0.05^2}$$

$$= 270.6\cancel{8}3 \approx 271$$

A paper company produces reams of 500 sheets of paper to sell to its customers. If the reams of paper contain more than 500 sheets, the company loses money. If the reams of paper contain less than 500 sheets, the company potentially makes their customers angry. Either situation is not desired. The manager in charge of the packaging department randomly selected 20 reams off the production line to calculate the average number of sheets per ream. The sample average of sheets per ream was 503 with a sample standard deviation of 4.7. Use this information to answer questions 14 and 15.

14. (5 points) The assumptions for hypothesis tests are the same as the assumptions for confidence intervals. What additional assumption is need in this problem to be able to conduct a hypothesis test / confidence interval?

Average sheets per ream follow an approximate Normal distribution.

15. (10 points) Conduct an appropriate test of hypothesis (assuming the needed assumption from 15) to see if there is evidence that the machine is malfunctioning with a significance level of 0.05. Be sure to specify all of the steps in the hypothesis test.

$H_0 : \mu = 500$

$H_a : \mu \neq 500$

$t = \frac{\bar{x} - \mu_0}{s/\sqrt{n}} = \frac{503 - 500}{4.7/\sqrt{20}} = 2.85$

$P(|t_{19}| > 2.85) = (0.01, 0.02)$

P-value $< \alpha \Rightarrow$ REJECT H_0

The machine may not be producing reams of the needed size and should be checked.