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1. Write the null and alternative hypotheses in words and then symbols for each of the following situations
   a. New York is shown as "the city that never sleeps". A random sample of 25 New Yorkers were asked how much they sleep per night. Does this data provide convincing evidence that New Yorkers, on average, sleep less than 8 hours a night?
   The Null Hypothesis is that New Yorkers sleep 8 hours or more per night, on average
   The Alternative Hypothesis is that New Yorkers sleep less than 8 hours per night, on average
   Ho: $S \geq 8$ Hours of sleep
   Ha: $S < 8$ Hours of sleep
   b. Employers at a firm are worried about the effect of March Madness, a basketball championship held each spring in the US, on employee productivity. They estimate that, on a regular business day, employees spend an average of 15 minutes of company time checking personal email, making personal phone calls, etc. They also collect data on how much company time employees spend on such non-business activities during March Madness. They want to determine if these data provide convincing evidence that employee productivity decreases during March Madness.
   The Null hypothesis is that employees don't spend 15 minutes, daily, on non-business activity during March Madness
   The Alternative hypothesis is that employees spend 15 minutes, daily, on non-business activity during March Madness
   NBA = Non-Business Activity (lol)
   H_0: $NBA_{\text{during march madness}} \neq 15$
   H_1: $NBA_{\text{during march madness}} = 15$
   c. Since 2008, chain restaurants in California have been required to display calorie counts of each menu item. Prior to menus displaying calorie counts, the average calorie intake of diners at a restaurant was 1100 calories. After calorie counts started to be displayed on menus, a nutritionist collected data on the number of calories consumed at this restaurant from a random sample of diners. Does this data provide convincing evidence of a difference in the average calorie intake of a diner at this restaurant?
   The null hypothesis is that calorie intake after displaying calorie count does not differ from an average of 1100 calories per meal
   The Alternative Hypothesis is that calorie intake after displaying calorie count does differ from an average of 1100 calories per meal
   H_0: $\mu_{\text{post calorie display}} = 1100$
   H_1: μ
   d. Based on the performance of those who took the GRE exam between July 1, 2004 and June 30, 2007, the average verbal reasoning score was calculated to be 462. In 2011, the average verbal score was slightly higher. Do these data provide convincing evidence that the average GRE Verbal Reasoning score has changed since 2004?
   The Null Hypothesis is that the average GRE Verbal Reasoning score has not changed from 462
   The Alternative Hypothesis is that the average GRE Verbal Reasoning score has changed from 462
   H_0: $\mu = 462$
   H_1: $\mu \neq 462$

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2. You are given the following hypotheses:
   H_0: μ = 30
   H_1: μ ≠ 30
   We know that the population standard deviation is 10 and the sample size is 70. For what sample mean would the p-value be equal to 0.05? (Hint: you will have two answers)
   H_0: μ = 30
   H_1: μ ≠ 30
   σ = 10
   n = 70
   α = 0.05
   df = 69
   t = 1.96
   $t = (\bar{x}-\mu)/(\sigma/\sqrt{n})$
   $\pm 1.96 = (\bar{x}-30)/(10/\sqrt{70})$
   $1.96 = (\bar{x}-30)/(1.195)$
   $1.1952 * 1.96 = \bar{x}-30$
   $30 + (1.1952 * 1.96) = \bar{x}$
   $\pm 32.343= \bar{x}$
3. You are given the following hypotheses:
   H_0: μ = 30
   H_1: μ > 30
   We know that the population standard deviation is 10 and the sample size is 70. For what sample mean would the p-value be equal to 0.05? (Hint: you will have two answers)
   H_0: μ = 30
   H_1: μ > 30
   σ = 10
   n = 70
   α = 0.05
   df = 69
   t = 1.65
   $t = (\bar{x}-\mu)/(\sigma/\sqrt{n})$
   $\pm 1.65 = (\bar{x}-30)/(10/\sqrt{70})$
   $1.65 = (\bar{x}-30)/(1.195)$
   $1.1952 * 1.65 = \bar{x}-30$
   $30 + (1.1952 * 1.65) = \bar{x}$
   $\pm 31.972= \bar{x}$
4. The nutrition label on a bag of potato chips says that a one ounce (28 grams) serving of potato chips has 130 calories and contains 10 grams of fat, with three grams of saturated fat. A random sample of 35 bags yielded a sample mean of 134 calories with a standard deviation of 17 calories. Is there evidence that the nutrition label does not provide an accurate measure of calories in the bags of potato chips?
   μ = 134
   σ = 17
   $2*(\sigma/\sqrt{n})$ = (12.36, 139.632)
   Because the average number of calories per bag (134) falls within the confidence interval, we can conclude that there is enough evidence to provide an accurate measure of calories in the bags of potato chips

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5. A hospital administrator randomly selected 64 patients and measured the time (in minutes) between when they checked in to the ER and the time they were first seen by a doctor. The average time is 137.5 minutes and the standard deviation is 39 minutes. She is getting grief from her supervisor on the basis that the wait times in the ER has increased greatly from last year's average of 127 minutes. However, she claims that the increase is probably just due to chance.
   a. Are conditions for inference met? Note any assumptions you must make to proceed.
      Conditions are met. The sample size is large enough to approximate the distribution of the population to be normally distributed.
   b. Using a significance level of 0.05, the change in wait times statistically significant? Use a two-sided t-test since it seems the supervisor had to inspect the data before she suggested an increase occurred.
      H_0: $\mu = 127$
      H_1: $\mu \neq 127$
      $\sigma = 39$
      $n = 64$
      $\alpha = 0.05$
      $df = 63$
      $SE = \sigma/\sqrt{n}$
      $SE = 39/8$
      $SE = 4.875$
      T-Test Statistic
      $t = (\bar{x}-\mu)/SE$
      $t = (137.5-127)/4.875$
      $t = 2.154$
      P-Value = 0.0351 * 2 = 0.0702
      0.0351 < 0.05 therefore we reject the null hypothesis
   c. Would the conclusion of the hypothesis test change if the significance level was changed to 0.01?
      Yes, 0.0351 > 0.01 and therefore we would fail to reject the null hypothesis
6. A patient named Diana was diagnosed with Fibromyalgia, a long-term syndrome of body pain, and was prescribed anti-depressants. Being the skeptic that she is, Diana didn't initially believe that anti-depressants would help her symptoms. However, after a couple months of being on the medication she decides that the anti-depressants are working, because she feels like her symptoms are in fact getting better.
   a. Write the hypothesis in words for Diana's skeptical position when she started taking the anti-depressants.
      Ho: The anti-depressants make no difference in treating fibromyalgia
      Ha: The anti-depressants make a difference in treating fibromyalgia
   b. What is a type 1 error, in this context?
      We reject the null hypothesis even though it is true and the anti-depressants don't work
   c. What is a type 2 error, in this context?
      We accept the null hypothesis even though it is not true and the anti-depressants do work

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7. A food safety inspector is called upon to investigate a restaurant with a few customer reports of poor sanitation practices. The food safety inspector uses a hypothesis testing framework to evaluate whether regulations are not being met. If he decides the restaurant is in gross violation, its license to serve food will be revoked.
   a. What is the hypothesis in words?
      Ho: The health safety standards are being met
      Ha: The health safety standards are not being met
   b. What is type 1 error, in the context?
      We reject the null hypothesis, even though the health safety standards are being met
   c. What is a type 2 error, in this context?
      We accept the null hypothesis, even though the health safety standards are not being met
   d. Which error is more problematic for the restaurant owner?
      A type 1 error would be more problematic for the owner. It would result in the diner not meeting safety standards when it actually is. He would need to face the repercussions of failing a health inspection when he shouldn't have to.
   e. Which error is more problematic for the diners?
      A type 2 error would be more problematic for the diners. They would assume they're at an acceptable/no risk of getting sick when, in fact, they are at risk of getting sick.
   f. As a diner, would you prefer that the food safety inspector requires strong evidence or very strong evidence of health concerns before revoking a restaurant's license?
      As a diner, I would want the health safety inspector to require strong evidence because this would indicate the health safety of the diner is great, with a strong doubt of any violations.
8. .
9. You are given the following hypotheses:
   H_0: μ = 60
   H_1: μ < 60
   We know that the sample standard deviation is 8 and the sample size is 20. For what sample mean would the p-value be equal to 0.05? Assume that all conditions necessary for interference are satisfied.
      Z-Score = -1.64
      t = $(\bar{x}-\mu)/(\sigma/\sqrt{n})$
      t = $(\bar{x} - 60)/(8/\sqrt{20})$
      $\bar{x} = 57.066$

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10. Georgianna claims that, in a small city renowned for its music school, the average child takes at least five years of piano lessons. We have a random sample of 20 children from the city, with a mean of 4.6 years of piano lessons and a standard deviation of 2.2 years.
    a. Evaluate Georgianna's claim using a hypothesis test.
    The average child does not take at least five years of piano lessons
    H_0: $\mu_{child} \leq$ 5 years of piano lessons
    The average child does take at least five years of piano lessons
    H_1: μ_{child} > 5 years of piano lessons
    According to the data, the average child takes 4.6 years of piano lessons, therefore we fail to reject the null hypothesis that the average child in that city takes at least five years of piano lessons
    b. Construct a 95% confidence interval for the number of years that students in this city take piano lessons, and interpret it in context of the data.
    $\bar{x}$=4.6
    σ=2.2
    n=20
    ***t* = 2.09**
    $t = (\bar{x}-\mu)/(\sigma/\sqrt{n})$
    $\pm 2.09 = (4.6 - \mu)/(2.2/\sqrt{20})$
    $\pm 2.09 = (4.6 - \mu)/(0.4919)$
    $\mu = 4.6 \pm 2.09(0.4919)$
    μ_{upper} = 5.6280
    μ_{lower} = 3.5719
    Therefore, we are confident that 95% of the kids in this sample, practice piano between 3.57 and 5.63 years
    c. Do your results from the hypothesis test and the confidence interval agree? Explain your reasoning.
    Yes, because the sample average of 4.6 falls between our confidence interval