STAT 110: Practice Problem 4 - Solutions
Fall 2017

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1. A standard test for extrasensory perception (ESP) asks subjects to identify which of five shapes (e.g., circle, square, diamond, waves, or triangle) is on the front of a card, viewed by the experimenter but not the subject. Your friend claims to have ESP. To test her claim, you administer a test with 25 of these cards (you can assume that the probability of seeing any one of the five shapes on any of the 25 trials is constant). Out of the 25 trials, she gets 10 correct.

   <u>Research Hypothesis</u>: Your friend has ESP.

   a. What percent of the time do you expect her to answer correctly if she doesn't have ESP and is just guessing? **1/5 = 20%**

   b. What percent of the time did she answer correctly in the actual experiment? In other words, find the statistic, $\hat{\pi}$.

      $\hat{\pi}$ = **10/25 = 40%**

   c. You should have noted that she answered correctly more often in the experiment than we expected her to do by chance. Now, your question is whether the result from the experiment provides enough statistical evidence for us to believe that she really has ESP. Start by writing the null and alternative hypotheses in terms of the population parameter of interest, π.

      Let π = **the true, long-run probability that she answers correctly.**
      H_o: π = 20%
      H_a: π > 20%

   d. Use binomial probabilities to find the exact p-value for this test.

      Using n = 25 and π = .20, the p-value is .0173

   e. Write a conclusion in the context of the research hypothesis.

      The study provides statistical evidence that your friend has ESP (or is cheating ☺).

   f. When administering this test, at what point do we have statistical evidence that the subject has ESP? In other words, what is the fewest number correct a subject could get that would still provide statistical evidence for ESP? Explain your reasoning.

      Based on the binomial probabilities, as soon as the subject gets 9 or more correct, the p-value falls below .05, which gives us statistical evidence that the subject has ESP. For example, if the subject had been correct on only 8 trials, the p-value would have been .1091, and we would not have statistical evidence for ESP.

2. The latest Behavior Risk Factor Surveillance System Survey revealed that 18.8% of adults (age 18 or older) in the state of Minnesota are current smokers. A college professor at WSU is interested in testing whether the proportion of WSU students who smoke cigarettes is less than this state-wide smoking rate. A survey of 319 randomly selected WSU students reveals that 30 are current smokers.

   a. Start by writing the research hypothesis in words.

      Research Hypothesis (H_a): The proportion of all WSU students who smoke cigarettes is less than the state-wide smoking rate.

   b. What percent of the WSU students sampled are current smokers? In other words, find the statistic, $\hat{\pi}$.

      $\hat{\pi}$ = **30/319 = 9.4%**

   c. You should have noted that the percent of smokers at WSU is less than the state-wide smoking rate. Now, your question is whether this result provides statistical evidence for the research question (i.e., we need to rule out observing this result simply by chance depending on which students were selected for our sample). Start by writing the null and alternative hypotheses in terms of the population parameter of interest, π.

      Let π = **the proportion of all WSU students who smoke cigarettes**

      H_o: $\pi = 18.8\%$
      H_a: $\pi < 18.8\%$

   d. Use binomial probabilities to find the exact p-value for this test.

      Using n = 319 and π = .188, the p-value is 2.6×10^{-6} = .0000026

   e. Write a conclusion in the context of the research hypothesis.

      The study provides statistical evidence that the proportion of all WSU students who smoke cigarettes is less than the state-wide smoking rate.