1. (17 pts) The game called “rock-paper-scissors” involves players selecting one of those three options (rock or paper or scissors). I recently read that novice players tend to pick “scissors” less often than would be expected if the three choices were equally likely.

   a) (1 pt) Identify (in words) the relevant parameter in this study.

   b) (2 pts) State (in symbols) the null and alternative hypothesis to be tested.

   The articles that I read described a study in which 119 novice players played this game against a computer, and researchers recorded the first option that each player selected. Fourteen (14) of the 119 players selected “scissors” as their first option.

   c) (2 pts) Identify the observational units and variable in this study.

   Observational units:    Variable:

   d) (4 pts) Describe how you could use a fair six-sided die to conduct a simulation analysis of this study and its result. Give sufficient detail that someone else could implement this simulation analysis based on your description. Be sure to indicate how you would decide whether the observed data provide convincing evidence in support of the claim that novice players tend to pick “scissors” less often than would be expected if the three choices were equally likely.

   The exact p-value (to seven decimal places) can be calculated to be .0000001.

   e) (4 pts) Complete this sentence to interpret the p-value in this context:

   This p-value is the probability that …, assuming that …

   f) (2 pts) Summarize the conclusion that you would draw from this study.

   g) (2 pts) Describe what a Type II error would mean in the context of this study and these hypotheses.

2. (13 pts) The same study described in the previous question found that 39 of the 119 players selected “paper” as their first option. Suppose that you want to test whether these data provide evidence that the probability of selecting “paper” among novice players is not one-third.

   a) (2 pts) Would it be appropriate to use a normal approximation to conduct this test? Justify your answer.

   b) (3 pts) Draw a well-labeled sketch, and shade the appropriate area to represent the p-value based on the normal approximation.
c) (4 pts) Fill in the following to indicate how to use the normal approximation to approximate the p-value for this test:

\[ p\text{-value} = \Pr( \quad \text{)(normal distribution)} \),

where \( \quad \) has a normal distribution with mean \( \quad \) and standard deviation \( \quad \).

d) (2 pts) Calculate the relevant \( z \)-score.

e) (2 pts) Without calculating the p-value, will this test provide sufficient evidence to reject the null hypothesis at the \( \alpha = .10 \) level? Justify your answer (without calculating the p-value).

3. (7 pts) On December 10-12, 2010, the Gallup organization interviewed a random sample of 1019 American adults and asked: Do you think the U.S. has a unique character that makes it the greatest country in the world, or don’t you think so? Eighty (80) percent of those surveyed responded “yes.”

a) (3 pts) Determine a 90% confidence interval for the value of the relevant population parameter.

b) (2 pts) Interpret this interval, being sure to make clear what the parameter is in this study.

c) (2 pts) If a confidence interval were constructed from the responses of only the men in this sample, how would its width compare to the interval in part a)? Circle your answer, and explain briefly.

Wider Narrower Same width

Explain:

4. (6 pts) On January 29, 2011, visitors to the CNN.com website were invited to answer a poll question. The results are shown below:

A 99.9% confidence interval for the population proportion (of “yes” responses) turns out to be: (.484, .495).
a) (2 pts) Explain (using no more than 10 words, preferably no more than 5 words) why this confidence interval is so narrow.

b) (3 pts) The z-statistic for testing the null hypothesis that 50% of American adults claim to be exercising more in 2011 turns out to be -6.51, for a p-value of $2.5 \times 10^{-10}$. Explain what this indicates about the difference between statistical and practical significance.

c) (1 pt) Explain why you think CNN.com adds the disclaimer that “this is not a scientific poll.”

5. (4 pts, .5 pts each) Circle your answers to the following, which do not pertain to any particular study: Do not bother to explain.

a) If you decide to reject a null hypothesis at the $\alpha = .05$ significance level, would you also reject the null hypothesis at the $\alpha = .01$ significance level?
   Yes  No  Cannot be determined

b) Can a p-value ever be negative?  Yes  No

c) Can a p-value ever be greater than 0.5? Yes  No

d) Can a z-score ever be negative?  Yes  No

e) Can a z-score ever be greater than 1? Yes  No

f) Does doubling a sample size cut the margin-of-error in half?  Yes  No

g) Does the value of the sample proportion always fall within a 90% confidence interval for a population proportion $\pi$? Yes  No

h) What effect does increasing the significance level have on the power of a test?  Increase  Decrease  No change

6. (3 pts, 1 pt each) Suppose that you want to re-conduct the kissing study at Cal Poly with a sample of 100 kissing couples. You want to test the null hypothesis $H_0: \pi = .667$ against a one-sided alternative $H_a: \pi < .667$ using a significance level of $\alpha = .05$, and you are concerned about the power of your test when $\pi = .5$.

Consider the following graph:
Circle your answers, but do not bother to explain:

a) Which region represents the probability of making a Type I error?
   
   I    II    III    IV

b) Which region represents the probability of making a Type II error?

   I    II    III    IV

c) Which region represents the power of the test?

   I    II    III    IV