

## Math 222 - Project 3

Due Friday, March 8

1. A teacher doubted whether his students could tell the difference between Coke and Pepsi, so he arranged an experiment. Each of his 21 students got three cups. Two cups contained one brand of cola, and the third cup contained the other brand. Which cup contained which brand was randomly determined for each student. Each student was asked to identify which cup contained the cola that was different from the other two. It turned out that 12 of the students successfully identified the “odd” cola.
  - (a) Is this strong evidence that students really do better than just guessing? Back up your answer with an explanation of the results of the appropriate statistical test. Include a clear statement of hypotheses and the p-value calculation. Explain the procedure you used to get your p-value.
  - (b) Calculate a 95% confidence interval based on these sample data. Clearly define the parameter that this interval estimates, and interpret the interval.
  - (c) Describe what Type I and Type II errors mean in this situation.
  - (d) Calculate the power of the teacher’s test if the reality is that half of all students in the population can tell the difference.
2. In 1995, the National Highway System Designation Act abolished the federal mandate of 55 miles per hour maximum speed limit and allowed states to establish their own limits. Of the 50 states (plus District of Columbia), 32 increased their speed limits in 1996. The data in this file: TrafficFatalities.txt shows the percentage change in interstate highway traffic fatalities from 1995 to 1996 and whether or not the state increased their speed limit. (Data from the National Highway Traffic Safety Administration as reported in Ramsey and Schafer, 2002.)
  - (a) Identify the individuals and response variable of interest. Is this a randomized experiment or an observational study?
  - (b) Produce numerical and graphical summaries of these data and describe how the two groups compare. Does it look like raising the speed limit caused more people to die?
  - (c) Are the technical conditions for a two-sample t-test met for this study? Explain.
  - (d) Carry out a two-sample t-test to determine whether the average percentage change in interstate highway traffic fatalities is significantly higher in states that increased their speed limit. If you find a significant difference, estimate its magnitude with a confidence interval.
  - (e) Repeat the significance test from part (d) with a permutation test instead. How does the p-value with this method compare with the p-value from the two-sample t-test?