Homework 5 - Math 121 **Name:** _____

Due by 5:00pm Friday, October 23. Send a PDF with your solutions to `blins@hsc.edu`.

1. People who take the SATs twice tend to score higher the second time they take it. A study done by the College Board found that people who paid a coaching company to help them improve their scores gained an average of 40 points on the Math SATs, while students who took the test a second time without paying for coaching only improved 22 points, on average. The table below gives the average results (with standard deviations included in the parentheses):

Group	Try 1	Try 2	Gain
Coached ($n = 427$)	521 (100)	561 (100)	40 (58)
Uncoached ($n = 2733$)	505 (101)	527 (101)	22 (50)

   (a) Who or what are the individuals in this study?

   (b) For each individual what are the variables that were recorded in the study? Hint: there are three.

   (c) Ignoring the coached students, suppose you wanted to find out if the average improvement for the uncoached students is statistically significant. Should you do a 1-sample matched pairs test using just the gain or should you do a 2-sample t-test using the results in try 1 and try 2? Why?

   (d) Make a 95% confidence interval for how much coached students will improve on average if they take the SATs twice.

   (e) Make a 95% confidence interval for how much uncoached students will improve on average if they take the SATs twice.

(f) Now compare the gains of coached students vs. uncoached students. Is the difference statistically significant. Do a complete hypothesis test to find out. Be sure to state the null and alternative hypothesis, find the test statistic, find the p-value, and explain your conclusions.

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2. Some people believe that footballs filled with helium will travel farther than regular footballs when kicked. The *Columbus Dispatch* did an experiment to find out. Two identical footballs were tested, one filled with helium, the other with ordinary air. A novice kicker punted the two balls several times without knowing which ball was which. In total, each ball was kicked 39 times. Also, in each trial the ball that was kicked first was random. The distance travelled by each ball was measured in yards, and the data can be found in this spreadsheet:

   `http://people.hsc.edu/faculty-staff/blins/StatsExamples/football.xlsx`

   Use the spreadsheet to do a 1-sample matched pairs hypthesis test to see if the footballs filled with helium travel significantly farther. Be sure to state your hypotheses, find the p-value, and explain your conclusions.

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3. Air quality measurements were collected in a random sample of 25 country capitals in 2013, and then again in the same cities in 2014. We would like to use these data to compare average air quality between the two years. Should we use a matched pairs test or a two-sample test? Explain your reasoning.
