IEOR 151 – Homework 2
Due Wednesday, September 18, 2013 in class

1. A restaurant chain believes that it can increase revenues by adding healthier food options to its menu. As an experiment, the chain randomly selects twenty restaurants in which to add healthier options. The remaining fifty restaurants in the chain keep the existing menu.

   (a) What is the null hypothesis? (1 point)

   The null hypothesis is that there is no difference in revenues between the two groups of restaurants.

   (b) Suppose the management has decided that if the revenue of the healthier restaurants is higher, then the new menu will be used at all restaurants. What is the alternate hypothesis? Should a one-sided or two-sided hypothesis test be used? (2 points)

   The alternate hypothesis is that revenues in the group of restaurants with healthy menus is higher. A one-sided hypothesis test should be used because the same decision would be made if revenues with the healthier menu are lower or the same.

   (c) Suppose the management has decided that if there is no difference in revenue between the two groups, then the healthier menu will be used at all restaurants. What is the alternate hypothesis? Should a one-sided or two-sided hypothesis test be used? (2 points)

   The alternate hypothesis is that revenues in the group of restaurants with healthy menus is higher or lower. A two-sided hypothesis test should be used because there is a potential harm that would be caused by the decision if revenue decreases with a healthier menu.

   (d) An operations engineer is deciding between using a two-sample t-test or a Mann–Whitney U test for this analysis. Which test would you recommend using for this application, and why would you give this recommendation? (2 points)
   The recommendation would be to use a Mann-Whitney U test because there are a relatively small number of data points and because there is no reason to believe that they distributions would be Gaussian.

2. For each the following scenarios, would you (i) accept the null hypothesis, (ii) reject the null hypothesis, or (iii) gather additional data and information before making a decision? Explain your reasoning. Note: The numbers in the scenarios below are fictional.

(a) The null hypothesis is that doctors who use paper records while working in the hospital make as many medical errors on average as doctors who use electronic records, the difference in average errors per month is 10 more errors per month for doctors using paper records, and $p = 0.051$. (2 points)

Even though the null would be accepted at the $\alpha = 0.05$ significance level, the consequences for falsely concluding that there is no difference can be significant since the errors are medical ones. Furthermore, the difference in average errors is quite large. Additional data should be collected.

(b) The null hypothesis is that restaurant chefs who use Twitter cook slower than chefs who do not tweet, the difference between the average time to cook a dish is 5 seconds, and $p = 0.049$. (2 points)

Even though the null would be rejected at the $\alpha = 0.05$ level, the consequences of a 5 second time difference are not significant in this setting. The null should be accepted in this case.

(c) The null hypothesis is that drugs A and B lead to equal reductions in proteinuria for patients with chronic kidney disease, the difference in average reduction is 1 g/day from an average baseline of 3 g/day, and $p = 0.023$. (2 points)

The null should be rejected because the difference in effect size is quite large, and the test would be significant at the $\alpha = 0.05$ significance level.

(d) The null hypothesis is that the speed of light in a vacuum is the same if the light is traveling north versus traveling south, and $p = 0.009$. (2 points)

The null should be accepted because the constancy of the speed of light in a vacuum is a foundational aspect of modern physics with significant numbers of experiments supporting it. For these reasons, a more stringent significance level should be used beyond the $\alpha = 0.01$ or $\alpha = 0.05$ that are often used with hypothesis testing.

3. Which hypothesis test would you select for each of the following scenarios below?

(a) Data of call center service time for 100 employees at location A and 130 employees at location B. (1 point)

Two-sample t-test (or Normal Approximation)

(b) Continuous (not categorical) measurements of customer satisfaction for 10 customers at restaurant A and 25 customers at restaurant B. (1 point)

Mann-Whitney U test

(c) Cost of medical supplies used per day for 50 hospitals in Region A and 75 hospitals in Region B. (1 point)

Two-sample t-test (or Normal Approximation)