Econ 325 Section 003
Assignment 8

The due date is Friday, December 1 before the class starts.

1. True or False. If the null hypothesis is not rejected based on sample evidence, the researcher has proven beyond any doubt that the null hypothesis is true.

2. An exit poll research firm claims that the proportion of Democratic voters in Salt Lake City is at most 40 percent. A random sample of 175 voters was selected and found to consist of 35 percent Democrats. Take the opposite of the research firm's claim as the null hypothesis so that $H_0 : p \geq 0.4$, where p is the population proportion. What is the p-value for this test?

3. Read "Notes on Power of Test" on the course website. Let $\{X_1, X_2, X_3, X_4\}$ be $n = 4$ observations, each of which is randomly drawn from normal distribution with mean μ and variance σ^2. The value of μ is not known while σ^2 is known and equal to 100. We are interested in testing the null hypothesis $H_0 : \mu \geq 10$ against $H_1 : \mu < 10$. Consider the following two different test statistics: (i) $\bar{X} = (1/4)(X_1 + X_2 + X_3 + X_4)$ and (ii) $\hat{X} = 0.1X_1 + 0.1X_2 + 0.1X_3 + 0.7X_4$. Suppose that the realized values of $\bar{X}$ and $\hat{X}$ are given by $\bar{X} = 2.0$ and $\hat{X} = 1.0$, respectively.

   (a) Compute the p-value for testing the null hypothesis $H_0 : \mu \geq 10$ against $H_1 : \mu < 10$ *using the test statistic* $\bar{X}$ and test the null hypothesis at the significance level $\alpha = 0.1$.

   (b) Compute the mean and the variance of a statistic $\hat{X}$ when $\mu = 10$ and $\sigma^2 = 100$.

   (c) Test $H_0 : \mu \geq 10$ against $H_1 : \mu < 10$ *using the test statistic* $\hat{X}$ at the significance level $\alpha = 0.1$.

   (d) Compute (i) the power of test using *using the test statistic* $\bar{X}$ at the significance level $\alpha = 0.1$ when the true value of μ is equal to 5 and (ii) the power of test *using the test statistic* $\hat{X}$ at the significance level $\alpha = 0.1$ when the true value of μ is equal to 5. Based on the power comparison, which test statistics, $\bar{X}$ or $\hat{X}$, do you recommend using for hypothesis testing?

4. A company that receives shipments of batteries tests a random sample of nine of them before agreeing to take a shipment. The company is concerned that the true mean lifetime for all batteries in the shipment should be at least 50 hours. From past experience it is safe to conclude that the population distribution of lifetimes is normal with a standard deviation of 3 hours. For one particular shipment the mean lifetime for a sample of nine batteries was 48.2 hours.

   (a) Test, at the 10% significance level, the null hypothesis that the population mean lifetime is at least 50 hours.

   (b) Find the power of a 10% significance level test when the true mean lifetime of batteries is 49 hours.

5. Table 1 reports the number of smokers among 1357 patients with lung-cancer and the number of smokers among 1357 patients with other diseases, which is computed from Table V of Doll and Hill (1952). Suppose that Doll and Hill randomly sampled 1357 patients with lung-cancer from a population of patients with lung-cancer and 1357 patients with other diseases from a population of patients with other diseases. Denote the proportions of smokers for patients with lung-cancer and for patients with other diseases by p_x and p_y. Our concern is with the population difference $p_x - p_y$.

   (a) Test the null hypothesis that $H_0 : p_x \leq p_y$ at the 5 percent significance level.

   (b) Now suppose that professor Kasahara collected the data similar to Doll and Hill (1952) but with a smaller sample size of 136 as reported in Table 2. Using the data reported in Table 2, compute the 95 confidence interval of of the difference between two population proportions of smokers and test the null hypothesis that $H_0 : p_x \leq p_y$ at the 5 percent significance level.

6. Table 3 reports the two-way table of results of some blood test on 1,000 men with tumors (either benign or malignant). We are interested in evaluating if this test is useful to detect if one has cancer or not. Assume that 156 men with tumors are randomly sampled from a population of men with tumors whose test result is positive and that 844 men with tumors are randomly sampled from a population of men with tumors whose test result is negative. Test the null hypothesis that the population proportion of malignant cancer among the population of men with tumors whose test result is positive is lower than or equal to among the population of men with tumors whose test result is negative. Do one-sided test at the 5 percent significant level.

7. A random sample of 802 supermarket shoppers determined that 378 shoppers preferred generic-brand items. Test at the 10% significance level the null hypothesis that at least one-half of all shoppers preferred genericbrand items against the alternative that the population proportion is less than one-half. Find the power of a 10%-level test if, in fact, 45% of the supermarket shoppers preferred generic brands.

Table 1: Tobacco Smoked Daily Over the 10 years: Men

Disease Group	No. of Non-Smokers	No. of Smokers
Men:		
1357 lung-cancer patients	7	1350
1357 patients with other diseases	61	1296

Notes: Computed from Table V of Doll and Hill (1952).

Table 2: Tobacco Smoked Daily Over the 10 years (Hypothetical Example)

Disease Group	No. of Non-Smokers	No. of Smokers
Men:		
136 lung-cancer patients	2	134
136 patients with other diseases	5	13

Table 3: Two-way table of results of tests on 1000 patients with Tumors

	Malignant (cancer)	Benign (no cancer)	Total
Test Positive	7	149	156
Test Negative	3	841	844
Total	10	990	1000