Tutorial: Hypotheses Testing

1. State the null and alternative hypotheses for each of the following situations. (That is, identify the correct number μ0 and write $H_0: \mu = \mu_0$ and the appropriate analogous expression for H_a.)

   a. The average July temperature in a region historically has been 74.5°F. Perhaps it is higher now.

   b. The average weight of a female airline passenger with luggage was 145 pounds ten years ago. The FAA believes it to be higher now.

   c. The average stipend for doctoral students in a particular discipline at a state university is $14,756. The department chairman believes that the national average is higher.

   d. The average room rate in hotels in a certain region is $82.53. A travel agent believes that the average in a particular resort area is different.

   e. The average farm size in a predominately rural state was 69.4 acres. The secretary of agriculture of that state asserts that it is less today.

2. The government of an impoverished country reports the mean age at death among those who have survived to adulthood as 66.2 years. A relief agency examines 30 randomly selected deaths and obtains a mean of 62.3 years with standard deviation 8.1 years. Test whether the agency's data support the alternative hypothesis, at the 1% level of significance, that the population mean is less than 66.2.

3. The average household size in a certain region several years ago was 3.14 persons. A sociologist wishes to test, at the 5% level of significance, whether it is different now. Perform the test using the information collected by the sociologist: in a random sample of 75 households, the average size was 2.98 persons, with sample standard deviation 0.82 person.

4. The recommended daily calorie intake for teenage girls is 2,200 calories/day. A nutritionist at a state university believes the average daily caloric intake of girls in that state to be lower. Test that hypothesis, at the 5% level of significance, against the null hypothesis that the population average is 2,200 calories/day using the following sample data: n = 36, x'= 2,150, x-= 2,150, s = 203.

Small Sample Tests for a Population Mean

5. Researchers wish to test the efficacy of a program intended to reduce the length of labor in childbirth. The accepted mean labor time in the birth of a first child is 15.3 hours. The mean length of the labors of 13 first-time mothers in a pilot program was 8.8 hours with standard deviation 3.1 hours. Assuming a normal distribution of times of labor, test at the 10% level of significance test whether the mean labor time for all women following this program is less than 15.3 hours.

6. A dairy farm uses the somatic cell count (SCC) report on the milk it provides to a processor as one way to monitor the health of its herd. The mean SCC from five samples of raw milk was 250,000 cells per milliliter with standard deviation 37,500 cell/ml. Test whether these data provide sufficient evidence, at the 10% level of significance, to conclude that the mean SCC of all milk produced at the dairy exceeds that in the previous report, 210,250 cell/ml. Assume a normal distribution of SCC.

7. Six coins of the same type are discovered at an archaeological site. If their weights on average are significantly different from 5.25 grams then it can be assumed that their provenance is not the site itself. The coins are weighed and have mean 4.73 g with sample standard deviation 0.18 g. Perform the relevant test at the 0.1% (1/10th of 1%) level of significance, assuming a normal distribution of weights of all such coins.

8. An economist wishes to determine whether people are driving less than in the past. In one region of the country the number of miles driven per household per year in the past was 18.59 thousand miles. A sample of 15 households produced a sample mean of 16.23 thousand miles for the last year, with sample standard deviation 4.06 thousand miles. Assuming a normal distribution of household driving distances per year, perform the relevant test at the 5% level of significance.

Large Sample Tests for Population Proportion

9. Five years ago, 3.9% of children in a certain region lived with someone other than a parent. A sociologist wishes to test whether the current proportion is different. Perform the relevant test at the 5% level of significance using the following data: in a random sample of 2,759 children, 119 lived with someone other than a parent.

10. The government of a particular country reports its literacy rate as 52%. A nongovernmental organization believes it to be less. The organization takes a random sample of 600 inhabitants and obtains a literacy rate of 42%. Perform the relevant test at the 0.5% (one-half of 1%) level of significance.

11. Two years ago, 72% of household in a certain county regularly participated in recycling household waste. The county government wishes to investigate whether that proportion has increased after an intensive campaign promoting recycling. In a survey of 900 households, 674 regularly participate in recycling. Perform the relevant test at the 10% level of significance.

12. Prior to a special advertising campaign, 23% of all adults recognized a particular company's logo. At the close of the campaign the marketing department commissioned a survey in which 311 of 1,200 randomly selected adults recognized the logo. Determine, at the 1% level of significance, whether the data provide sufficient evidence to conclude that more than 23% of all adults now recognize the company's logo.