

AP STATISTICS FRQ

1.

A company manufactures and markets a traditional type of disposable coffee cup that is used in many fast food restaurants. The company has created a new cup that it believes insulates better than the traditional cup. To investigate whether the new cup insulates better, the company plans to conduct a study. In the study, a random sample of cups for each of the two types will be selected. In each sample, each cup will be filled with the same amount of coffee that has been heated to 150 degrees Fahrenheit ($^{\circ}\text{F}$). The amount of time (in minutes) it takes for the coffee to cool to 100 $^{\circ}\text{F}$ will be measured for each cup.

The hypotheses that the company will test are shown below, where μ_N is the true mean time it takes coffee to cool from 150 $^{\circ}\text{F}$ to 100 $^{\circ}\text{F}$ in the new cup and μ_T is the true mean time it takes coffee to cool from 150 $^{\circ}\text{F}$ to 100 $^{\circ}\text{F}$ in the traditional cup.

$$H_0: \mu_N = \mu_T$$

$$H_a: \mu_N > \mu_T$$

- (a) Describe a Type II error in the context of the study.
- (b) The company is concerned about the probability of a Type II error. Which test procedure, one that uses a significance level of $\alpha = 0.10$ or one that uses a significance level of $\alpha = 0.01$, would result in a smaller probability of a Type II error? Explain.
- (c) The marketing department in the company has suggested that a 2-minute increase in the time it takes the coffee to cool from 150 $^{\circ}\text{F}$ to 100 $^{\circ}\text{F}$ would be a noticeable improvement to customers. Suppose the company statistician estimates that the power of the appropriate significance test is 0.88 when the true mean cooling time for the new cups is 2 minutes greater than the true mean cooling time for the traditional cups. Interpret the value of 0.88 in the context of the study.

In a report to the department of transportation of a western state, a large trucking firm stated that the distribution of weights of its fully loaded tractor trailer trucks is approximately normal with a mean of 19,016 pounds and a standard deviation of 2,324 pounds. The state police decided to check a sample of 40 of the company's trucks to test the company's claim concerning the mean weight and standard deviation of the weights of its trucks.

- (a) Assume that the company's claim is true. Describe the distribution of the sample mean weight for random samples, each consisting of 40 trucks.
- (b) At the company's large terminal, a state police crew selects a random sample of 40 fully loaded trucks and finds that the mean weight of those trucks is 19,168 pounds. What is the probability that a random sample of 40 of the company's fully loaded trucks would have a mean weight of 19,168 pounds or more if the company's claim is true?
- (c) A second state police crew is assigned to check trucks at the same terminal as in part (b) but on a different day. However, the second crew believes that the instructions to carry out a random sample are too complicated and too time-consuming. Instead, the crew weighs the first 40 fully loaded trucks as they leave the terminal and finds that the mean weight of the selected trucks is 18,894 pounds. Why is the lack of random selection in using the first 40 trucks a potential problem?