

Lesson 30: Inference

Inference

Drawing conclusions based on the data/information.

Two key questions:

1. Were the individuals randomly selected?

If yes, then you can make inferences about the population. (The sample reflects the larger group)

2. Were the treatments randomly assigned?

If yes, then you can make inferences about cause and effect. (The results in the response variable were caused by the explanatory variable)

Vitamin C and Canker Sores

Determining scope of inference

A small-town dentist wants to know if a daily dose of 500 milligrams (mg) of vitamin C will result in fewer canker sores in the mouth than taking no vitamin C.⁵⁰

The dentist is considering the following four study designs.

Design 1: Get all dental patients in town with appointments in the next two weeks to take part in a study. Give each patient a survey with two questions: (1) Do you take at least 500 mg of vitamin C each day? (2) Do you frequently have canker sores? Based on patients' answers to Question 1, divide them into two groups: those who take at least 500 mg of vitamin C daily and those who don't.

Design 2: Get all dental patients in town with appointments in the next two weeks to take part in a study. Randomly assign half of them to take 500 mg of vitamin C each day and the other half to abstain from taking vitamin C for three months.

Design 3: Select a random sample of dental patients in town and get them to take part in a study. Divide the patients into two groups as in Design 1.

Design 4: Select a random sample of dental patients in town and get them to take part in a study. Randomly assign half of them to take 500 mg of vitamin C each day and the other half to abstain from taking vitamin C for three months.

For whichever design the dentist chooses, suppose she compares the proportion of patients in each group who complain of canker sores. Also suppose that she finds a statistically significant difference, with a smaller proportion of those taking vitamin C having canker sores.

PROBLEM: What can the dentist conclude for each design?

Do Center Brake Lights Reduce Rear-End Crashes?

Lack of realism

Do those high center brake lights, required on all cars sold in the United States since 1986, really reduce rear-end collisions? Randomized comparative experiments with fleets of rental and business cars, done before the lights were required, showed that the third brake light reduced rear-end collisions by as much as 50%. But requiring the third light in all cars led to only a 5% drop.

What happened? Most cars did not have the extra brake light when the experiments were carried out, so it caught the eye of following drivers. Now that almost all cars have the third light, they no longer capture attention.

Does Smoking Cause Lung Cancer?

Living with observational studies

Doctors had long observed that most lung cancer patients were smokers. Comparison of smokers and similar nonsmokers showed a very strong association between smoking and death from lung cancer. Could the association be due to a lurking variable? Is there some genetic factor that makes people both more likely to get addicted to nicotine and to develop lung cancer? If so, then smoking and lung cancer would be strongly associated even if smoking had no direct effect on the lungs. Or maybe confounding is to blame. It might be that smokers live unhealthy lives in other ways (diet, alcohol, lack of exercise) and that some other habit confounded with smoking is a cause of lung cancer. How were these objections overcome?