

Chapter 1-Introduction

1.1 A good example is the development of tolerance to caffeine. People who do not normally drink caffeinated coffee are often startled by the effect of one or two cups of regular coffee, whereas those who normally drink regular coffee see no such effect. To test for a context effect of caffeine, you would first need to develop a dependent variable measuring the alerting effect of caffeine, which could be a vigilance task. You could test for a context effect by serving a group of users of decaffeinated coffee two cups of regular coffee every morning in their office for a month, but have them drink decaf the rest of the time. The vigilance test would be given shortly after the coffee, and tolerance would be seen by an increase in errors over days as the vigilance-enhancing effects of real coffee become less effective. At the end of the month, they would be tested after drinking caffeinated coffee in the same and in a different setting.

The important points to cover here are:

1. Tolerance is shown by an increase in errors on the vigilance task.
2. To see the effect of context, subjects need to be presented with caffeine in two different contexts.
3. There needs to be a difference between the vigilance performance in the two contexts.

1.2 The sample in the previous exercise would be those subjects we actually used. The population would be those people to whom we wish to generalize our conclusions.

This is really not as trivial as it sounds, because you could involve the students in a discussion of just who would be included in the population. Should children be? Should all U.S. adults? Should all Canadian adults? What about Tibetans? What about generalization to adults much older or younger than our participants?

1.3 Contexts affects people's response to alcohol, to off-color jokes, or to observed aggressive behavior.

1.4 The population of interest would be all heroin addicts (at least those who are reasonably similar to our subjects on important variables).

1.5 The sample would be the addicts that we observe.

1.6 A statistic would be the mean "euphoria" score of our subjects. The corresponding parameter would be that same measure on the population.

1.7 Not all people in the city are listed in the phone book. In particular, women and children are underrepresented. A phone book is particularly out of date as a random selection device with the increase in the use of cell phones. (I no longer have a land line, for example.)

A discussion of this question might involve pointing out that many telephone surveys really miss the general population, and instead focus on a restricted population, dominated by male adults.

1.8 The people who design the census have elaborate ways of breaking a city down into neighborhoods, and randomly drawing housing units (houses, apartments, etc.) from within each of those neighborhoods.

1.9 In the tolerance study discussed in the text, we really do not care what the mean length of paw-lick latency is. No one would be excited to know that a mouse can stand on a surface at 105 degrees for 3.2 seconds without licking its paws. But we do very much care that the population mean of paw-lick latencies for morphine-tolerant mice is longer in one context than in another.

1.10 The less variability in the thing we are measuring, the smaller our sample can be. If we think that different breeds of cows produce different quantities of milk, we would have to either obtain separate measures for each breed, or restrict our population of interest to those breeds we measured. We would be able to take only a few cows in each breed if milk production were relatively homogeneous within breed.

Since variability is such a critical concept in statistics, and since sample size and variability are closely linked in designing experiments, it is important to take time to make sure that students thoroughly understand this concept.

1.11 I would expect that your mother would continue to wander around in a daze, wondering what happened.

1.12 Three examples of categorical data: type of crime committed; criminal sentencing—jail, prison, parole, public service, etc.; preferred radio station .

1.13 Three examples of measurement data: performance on a vigilance task; typing speed, blood alcohol level.

1.14 (a) Categorical, or frequency, data (b) The population might be all M&Ms that Mars ever made (at least of a certain type). A parameter would be the proportion of the population of M&Ms that are red. A sample could be the batch of M&Ms that you just dumped out on your desk to count, and a statistic would be the proportion of red M&Ms in that sample.

1.15 Relationship: The relationship between stress and susceptibility to disease; the relationship between driving speed and accident rate.

1.16 Group differences: Do people who have learned to deal with stress have fewer colds than those who have not had such training. Are there more accidents on Interstates with 75 mph limits than on Interstates with 65 mph limits?

The point of the last two exercises is that the same basic variables can be looked at both from the point of relationships and from the point of group differences. It depends on how you organize the situation. In Exercise 1.16, in particular, it would be useful to bring out the fact that we would somehow have to control for traffic density, driving conditions, and so on. And don't forget that speed limits vary by region of the country, with generally higher limits in the West.

1.17 You could have one group of mice trained and tested in the same condition, one group trained in one condition and tested in the other, and a group given a placebo in the training context but given morphine in the testing condition.

It might be useful to assign the Siegel paper to students and then bring up each important concept in a class discussion. These concepts include things like population and sample, as well as basic elements of experimental design.

1.18 There are links to important and helpful Web sites, a variety of data sets, pages for other instructors' courses which offer a lot of useful information, a number of online calculators and java scripts to run analyses.

1.19 This is an Internet search exercise without a fixed answer.

<http://onlinestatbook.com/2/index.html> is an excellent online statistics text put together primarily by David Lane at Rice. Various departments offer data sets, computing advice, and clarifying examples.

1.20 This is an Internet search exercise without a fixed answer.

Examples, Data Sets, and Suggestions

1.1 The following article is from the July, 1997 issue of *Chance News*, a wonderful source of material for statistics courses, whose Internet address is

http://www.dartmouth.edu/~chance/chance_news/news.html. (Chance News became a Wiki several years ago, but the older archives are still available.)

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Low-control job called heart risk.
The Chicago Tribune, 25 July 1997, p.3
Associated Press

In what the article bills as more bad news for "the Dagwoods and Dilberts of the world", a study in the British medical journal "The Lancet" finds that feelings of lack of control on the job are associated with increased risk of heart disease.

An earlier study of British bureaucrats, started in the 1960s, found those in low status jobs to be at increased risk for heart disease. In general, these workers had poorer health, were more likely to smoke and less likely to exercise, and died younger. The present study followed 7372 men and women in British civil service jobs from 1985 to 1993, looking in detail at the effects of smoking, inactivity, high blood pressure, and feelings of loss of control.

At the highest grades of civil servants, feelings of lack of control were reported by 8.7% of the men and 10.1% of the women. At the lowest grades, the corresponding figures were 77.9% and 75.3%. Overall, those reporting little or no control had 50% higher risk of heart disease as compared to executives. When researchers statistically adjusted to account for feeling out of control, the increased risk for low status workers was only 18%. This makes feeling out of control the largest single risk factor.

Physiologically, lower control was found to be associated with higher concentrations of plasma fibrinogen, a protein that binds blood cells into clots, which could increase heart attack risk.

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Among other things, students can address:

- What makes this a subject worth studying?
- What other variables should the researchers take into account?
- Distinguish between the population and the sample?
- Identify an inference.
- What do you suppose it means to “statistically adjust to account for feeling out of control”?
- What can you conclude from the data as presented?
- What other things might you like to know?

1.2 The above example makes a good place to start a statistics course, because the students already know what is necessary to provide a good answer. It illustrates the fact that statistics is not a foreign land full of awful equations and bizarre terminology. They will certainly have to learn to work with equations, and they will be presented with new terminology, but they are starting the class knowing much more about the material than they probably supposed.

1.3 You could assign your students the task of searching recent issues of the local paper to find similar kinds of studies. By the time they do so, they will have covered the next few chapters, and can discuss the concepts in those chapters as well.

1.4 In a section of the Austin American-Statesman on 9/24/2002 entitled L. M. Boyd Revisited, we find the fascinating statistic that “Seventy-two percent of the people, when they walk, subconsciously try to synchronize their steps with their heartbeats.” Among the questions that spring to mind are:

- How do they know that it is 72%, and not 74%?
- Who is meant by “the people?”
- What do we mean here by “subconscious?”
- How would we design a study to verify this statistic?
- Gee, don’t they have better things to worry about?