

Practical Significance It is possible that some treatment or finding is effective, but common sense might suggest that the treatment or finding does not make enough of a difference to justify its use or to be practical, as illustrated in Example 3.

Example 3 Statistical Significance versus Practical Significance

In a test of the Atkins weight loss program, 40 subjects using that program had a mean weight loss of 2.1 kg (or 4.6 pounds) after one year (based on data from “Comparison of the Atkins, Ornish, Weight Watchers, and Zone Diets for Weight Loss and Heart Disease Risk Reduction,” by Dansinger et al., *Journal of the American Medical Association*, Vol. 293, No. 1). Using formal methods of statistical analysis, we can conclude that the mean weight loss of 2.1 kg is statistically significant. That is, based on statistical criteria, the diet appears to be effective. However, using common sense, it does not seem very worthwhile to pursue a weight loss program resulting in such relatively insignificant results. Someone starting a weight loss program would probably want to lose considerably more than 2.1 kg. Although the mean weight loss of 2.1 kg is statistically significant, it does not have practical significance. The statistical analysis suggests that the weight loss program is effective, but *practical* considerations suggest that the program is basically ineffective.

Analyzing Data: Potential Pitfalls

Here are a few more items that could cause problems when analyzing data.

Misleading Conclusions When forming a conclusion based on a statistical analysis, we should make statements that are clear even to those who have no understanding of statistics and its terminology. We should carefully avoid making statements not justified by the statistical analysis. For example, Section 10-2 introduces the concept of a *correlation*, or association between two variables, such as smoking and pulse rate. A statistical analysis might justify the statement that there is a correlation between the number of cigarettes smoked and pulse rate, but it would not justify a statement that the number of cigarettes smoked *causes* a person’s pulse rate to change. Such a statement about causality can be justified by physical evidence, not by statistical analysis.

Correlation does not imply causation.

Reported Results When collecting data from people, it is better to take measurements yourself instead of asking subjects to report results. Ask people what they weigh and you are likely to get their *desired* weights, not their actual weights. Accurate weights are collected by using a scale to measure weights, not by asking people to report their weights.

Small Samples Conclusions should not be based on samples that are far too small. The Children’s Defense Fund published *Children Out of School in America*, in which it was reported that among secondary school students suspended in one region, 67% were suspended at least three times. But that figure is based on a sample of only *three* students! Media reports failed to mention that this sample size was so small.

Loaded Questions If survey questions are not worded carefully, the results of a study can be misleading. Survey questions can be “loaded” or intentionally worded to

Detecting Phony Data

A class is given the homework assignment of recording the results when a coin is tossed 500 times. One dishonest student decides to save time by just making up the results instead of actually flipping a coin. Because people generally cannot make up results that are really random, we can often identify such phony data. With 500 tosses of an actual coin, it is extremely likely that at some point, you will get a run of six heads or six tails, but people almost never include such a run when they make up results.

Another way to detect fabricated data is to establish that the results violate Benford’s law: For many collections of data, the leading digits are not uniformly distributed. Instead, the leading digits of 1, 2, . . . , 9 occur with rates of 30%, 18%, 12%, 10%, 8%, 7%, 6%, 5%, and 5%, respectively. (See “The Difficulty of Faking Data,” by Theodore Hill, *Chance*, Vol. 12, No. 3.)

