

## STATISTICS: THE BIGGER PICTURE

Effective use of statistical techniques depends on your ability to understand the material you learned in your statistics class on two rather different levels. The first level deals with the detailed analysis and calculation of specific procedures, and is the subject matter of statistics classes. This information is obviously necessary to provide you with an understanding of what the formulas are actually doing to the data. However, in conducting research you will seldom calculate even the simplest descriptive statistical procedures by hand. Calculators, spreadsheets, and particularly statistical software programs like SPSS (Statistical Package for the Social Sciences) handle this detailed work much more effectively and efficiently than you ever could. The second, and broader level, provides the logic and rationale underlying the use and structure of the specific techniques. That is, it helps you understand (1) why the operations used most commonly in statistical procedures are necessary for accurately describing group data and making valid decisions about them; and (2) why statistical measures are put together the way they are. Let me briefly summarize this logic and rationale.

The basic objectives of statistical techniques and operations are to: (1) describe group data in the most compact and reliable way; and (2) make valid comparisons of these data. The principles most commonly used in accomplishing these goals are condensation, representation, and standardization.

In **descriptive** statistics, this first goal has resulted in frequency distributions (of various kinds) as a basic unit for representing a collection of individual scores. Since frequency distributions may vary in a number of ways (e.g., how many scores are being considered, the numerical range of the scores, how similar are the individual scores to one another), a first problem is to develop some common way to represent them. The most basic ways frequency distributions differ is in the dimensions of central tendency, variability, and shape. In your statistics class you discussed a variety of specific summary measures that allow us to describe these first two dimensions of distributions (as well as ways to graphically display their shape), but the ones used most often are the mean and some version of the idea of standard deviation.

Having identified what general characteristics of distributions may be most useful to compare, we still have the problem of how to use them to make valid comparisons between distributions. You would expect, for example, that a distribution based on a range of possible scores from 1 to 100 will have a larger mean than one based on scores ranging from 1 to 5. This is where standardization becomes essential. In this context, by "standardization," we mean that the amount of total space occupied by the combined scores of any distribution is the same, regardless of the possible range or number of scores considered. This requirement is met in the measure called the standard (or "z") score, by converting the original score into one that takes into account the mean and standard deviation of the particular distribution in question. The resulting score represents a percentage or proportion of the whole distribution, the total area of which naturally has to add up to 100% or 1.0, and half of which will be located on either side of the mean.

So far so good. We are now able to describe the scores making up distributions in a standard way. All together, the original scores translated into z-scores will add up to 100% of the area occupied by the distribution. But how do we standardize the shape of the distribution, so that the physical location of our reference point, the mean, and specified proportions (e.g., lower 25%, upper 75%) is constant? As you know, for example, the mean of two distribution. that are skewed to the right (i.e., more low scores) and left will intersect the base line of the distribution curve at different points.

This obviously presents a problem for standardization. As a concrete example of this problem, take a look at the two distributions shown below. The mean for Distribution #1 would fall almost directly in the physical center of the distribution curve, while the mean in Distribution #2 would fall more to the left. Similarly, in the distribution on the right, you would have to go further to the right of the mean to find the score that separated the lower 75% and upper 25%.



Frequently, comparisons are made between two groups who have been intentionally exposed to different conditions (e.g., medical treatments, teaching techniques, supervisory styles). This is the basic design of experiments.

There is a very practical reason for all these comparisons: implementing a major change in the structure or policies of an organization can be very expensive, and wasteful if it doesn't improve things. On the other hand, it may be well worth the effort and expensive if the change produces significant improvement. Statistical comparisons of group data allow us to draw conclusions that reduce the risks involved in making such decisions. At least they do if we know what specific comparisons are needed to draw these conclusions, what constitutes a valid comparison, and the practical implications of statistically significant differences or similarities for our particular substantive problem.

In terms of overall priorities, this broader understanding of statistical techniques (what they attempt to accomplish, why we use the ones we do, and how they relate to real questions we have) is more important than technical expertise in carrying the mathematical operations required for specific procedures. This is particularly true today, when statistical packages for computers (like SPSS) make it impractical to do manual calculations for anything but very small samples (as I mentioned earlier). However, even if we didn't have these time savers, it would still be true because this more general knowledge affects many of the more specific aspects of your use of statistics, such as your ability to evaluate the appropriateness of particular techniques, your awareness of possible alternative techniques for dealing with a particular problem, and your skill in arriving at more precise interpretations of data.

**Bottom Line:** SPSS is fast, tireless, and totally ignorant of the purpose of your study or what you are trying to discover or decide with your research. It's like a big slobbery puppy who only wants to please. It will create beautiful graphs and tables and precise looking correlations and significance tests using incorrect data and inappropriate comparisons if you ask it to. Don't ask it to.

Get familiar enough with your topic area to identify clearly relevant variables and design questionnaire items that will validly capture those variables. Keep the data analysis portion of your research work in mind from the beginning of the design of your study. Ultimately you are going to have to relate or compare variables that are represented by numbers. Make sure that your questionnaire includes all the items you need to produce the quantitative comparisons you'll need to answer your research questions. It's a stone bummer to get to the data analysis portion of your study and discover that you didn't collect some data that you now realize you need to draw conclusions.

Along similar lines, spend some time with the "help" files in SPSS. They provide a good brief description of what each procedure is designed to do. If you have a clear idea of the comparisons you want to make, I would be very surprised if SPSS didn't have a procedure to make those comparisons.

Finally, and very importantly, be aware that each phase of the research process (study design, instrument construction, data collection, coding and setting up the data, and data analysis) will probably take longer than you plan for it.

So get into the concrete details of your study early. Use all the help you can get from the literature review, Babbie's text, the SPSS help files, and me. That way you, the puppy, and I will all be a lot happier at the end of the semester.