November 2003: Be Eclectic and Ecumenical in Inference (Rule 1.14)

Rules of the month are numbered in accordance with the numbering in the book. Thus, Rule 1.1 refers to the first rule in Chapter 1. And so on. These comments do not repeat the material in the book but highlights and amplifies it. A rule is stated as found in the book and then discussed.

"The practical applied statistician uses methods developed by all three schools as appropriate" (Rule 1.14)

Further Comments on the Rule

The three schools referred to in this rule are three principal approaches to statistical inference: likelihood, the Neyman-Pearson approach, and Bayesian inference. The first two are based on a relative frequency interpretation of probability, the latter on a subjective interpretation.
The topic for this month's discussion is probability.*

There may be sharp disagreement about the *interpretation* of probability, there is little disagreement about the *mathematics* of probability as specified axiomatically by Kolmogorov in 1933—except for one axiom (see any textbook on probability theory for details). The basic structure is a *probability space* consisting of a sample space (or set of outcomes of an experiment), all possible subsets of the outcomes, and a probability assignment to each of the subsets. Based on this formulation, random variables can be defined on this space and properties of random variables deduced.

The challenge to statisticians is to determine the applicability of the mathematical theory to real world problems. An analogy might be the applicability of Euclidean geometry to geographical measurements. In the plane the geometry certainly holds, on a sphere strictly speaking not. However, if the sphere is sufficiently large (say the earth) and the arena of measurement local (say lot size for a house), then the geometry can be applied.

This, of course, is argument by analogy, which breaks down if stretched. Nevertheless, given the agreement about the mathematical foundations of probability theory, applied statisticians need not worry too much about the basis of their field. Instead, they can devote time to thinking about how the sample arose from the population, or whether the random variables make sense clinically.

*** Acknowledgment**

The comments for this month are based on a stimulating conversation in September with Ronald Pyke, Professor Emeritus of Mathematics, University of Washington. Any errors in the exposition above are mine, not professor Pyke's.