1. Does the design permit an experimenter to calculate a valid estimate of the experimental effects and error effects?
2. Does the data-collection procedure produce reliable results?
3. Does the design provide maximum efficiency within the constraints imposed by the experimental situation?
4. Does the design possess sufficient power to permit an adequate test of the statistical hypotheses?
5. Does the experimental procedure conform to accepted practices and procedures used in the research area? Other things being equal, an experimenter should use procedures that offer an opportunity for comparison of his findings with the results of other investigations.

1.5 A REVIEW OF STATISTICAL INFERENCE

In the previous section an overview of experimental designs was presented. This section is written to accomplish the same goal with respect to procedures involved in statistical inference. It is assumed that the reader is already familiar with basic hypothesis-testing concepts. Hays (1963) presents an excellent introduction to this topic.

A distinguishing characteristic of the scientific method is the formulating and testing of hypotheses. The testing of hypotheses requires the *a priori* formulation of decision rules to guide the decision maker. The problem may be stated: Given two mutually exclusive hypotheses about a population, how does one decide on the basis of sample data which hypothesis is supported? It will be apparent that this question lacks a simple answer.

A statistical hypothesis is a statement about one or more parameters of population distributions; and, as such, it refers to a situation that *might* be true. Such a statement is always made with respect to a population and not to a sample. Distinguishing between statistical hypotheses and research or scientific hypotheses is important. Research hypotheses are normally stated in general terms, at least in the initial stages of an inquiry. In this form they are not amenable to evaluation through the use of the procedures and theory of statistical inference. It may be possible, by means of deductive reasoning, to transform a research hypothesis into a statistical hypothesis that can be subjected to test. Statistical hypotheses refer to population parameters, whereas scientific hypotheses refer to the phenomena of nature and man (Clark, 1963).

In logic, the terms *direct statement* and *indirect statement* are analogous in many ways to statistical and scientific hypotheses. A direct statement is made in reference to limited phenomena that are directly observable; for example, "This rat is running." The truth or falsity of such a direct statement can be determined by observing the rat. An indirect statement refers to phenomena that cannot be directly observed or that are so numerous in time that it is impossible to view them all. For example,