If treatment effects are designated by τ_{ij}, the error effect can be written

$$\hat{\varepsilon}_{ijm} = X_{ijm} - \hat{\tau}_{ij} - \hat{\pi}_m - \hat{\mu}.$$

It is interesting to note the similarity between this error effect and the error effect for a randomized block design, which is the building block for this factorial design. The error effect for the randomized block design was given earlier as

$$\hat{\varepsilon}_{ij} = X_{ij} - \hat{\beta}_j - \hat{\pi}_i - \hat{\mu}.$$

QUESTIONS TO CONSIDER IN SELECTING AN APPROPRIATE DESIGN

Statisticians have provided an experimenter with a vast array of experimental designs. On what basis should an experimenter decide which design to use? Selection of the *best* experimental design for a particular research problem requires (1) a knowledge of the research area and (2) a knowledge of different experimental designs. To arrive at the best experimental design, an experimenter must consider the following questions:

1. What kinds of data are required to test the statistical hypotheses?
   (a) How many treatment levels should be used?
   (b) Should the treatment levels used in the experiment be selected on an *a priori* basis or by random sampling from a population of treatment levels?
   (c) Should a factorial experiment be used so that interaction effects may be evaluated?
   (d) Are all treatments and treatment levels of equal interest to the experimenter? Experimental designs may be used that sacrifice power in evaluating some treatments in order to gain power in evaluating other treatments.
2. Is the proposed sample of subjects large enough to provide adequate precision in testing the statistical hypotheses?
   (a) Do the available subjects represent a random sample from the population of interest to the experimenter?
   (b) Can the subjects be stratified into homogeneous blocks?
   (c) Does the nature of the experiment permit each subject to be observed under more than one treatment level?
   (d) Will the treatment(s) produce physical or psychological injury to the subjects? The use of potentially injurious treatments precludes the employment of human subjects.
3. Is the power of the proposed experimental design adequate to test the statistical hypotheses?
   (a) What is the size of treatment effects that the experimenter considers to be of practical interest?
   (b) What are the consequences of committing type I and type II errors?
4. Does the proposed experimental design provide maximum efficiency in testing the statistical hypotheses?
   (a) Would efficiency be improved more by using a design employing blocks of homogeneous subjects or by using random assignment of a large number of subjects to the treatment levels?