THE FACTORIAL EXPERIMENT

In the experimental designs that we have considered up to this point, we have been interested in the effects of only one variable—the treatments. Frequently, however, we may be interested in studying, simultaneously, the effects of two or more variables. We refer to the variables in which we are interested as factors. The experiment in which two or more factors are investigated simultaneously is called a factorial experiment.

The different designated categories of the factors are called levels. Suppose, for example, that we are studying the effect on reaction time of three dosages of some drug. The drug factor, then, is said to occur at three levels. Suppose the second factor of interest in the study is age, and it is thought that two age groups, under 65 years and 65 years and older, should be included. We then have two levels of the age factor. In general, we say that factor A occurs at a levels and factor B occurs at b levels.

In a factorial experiment we may study not only the effects of individual factors but also, if the experiment is properly conducted, the interaction between factors. To illustrate the concept of interaction let us consider the following example.

EXAMPLE 8.5.1

Suppose, in terms of effect on reaction time, that the true relationship between three dosage levels of some drug and the age of human subjects taking the drug is known. Suppose further that age occurs at two levels—“young” (under 65) and “old” (65 and older). If the true relationship between the two factors is known, we will know, for the three dosage levels, the mean effect on reaction time of subjects in the two age groups. Let us assume that effect is measured in terms of reduction in reaction time to some stimulus. Suppose these means are as shown in Table 8.5.1.

The following important features of the data in Table 8.5.1 should be noted.

1. For both levels of factor A the difference between the means for any two levels of factor B is the same. That is, for both levels of factor A, the difference between means for levels 1 and 2 is 5, for levels 2 and 3 the difference is 10, and for levels 1 and 3 the difference is 15.

2. For all levels of factor B the difference between means for the two levels of factor A is the same. In the present case the difference is 5 at all three levels of factor B.

3. A third characteristic is revealed when the data are plotted as in Figure 8.5.1. We note that the curves corresponding to the different levels of a factor are all parallel.

When population data possess the three characteristics listed above, we say that there is no interaction present.

The presence of interaction between two factors can affect the characteristics of the data in a variety of ways depending on the nature of the interaction. We illustrate

