THE RANDOMIZED COMPLETE BLOCK DESIGN

The randomized complete block design was developed about 1925 by R. A. Fisher, who was seeking methods of improving agricultural ﬁeld experiments. The randomized complete block design is a design in which the units (called experimental units) to which the treatments are applied are subdivided into homogeneous groups called blocks, so that the number of experimental units in a block is equal to the number (or some multiple of the number) of treatments being studied. The treatments are then assigned at random to the experimental units within each block. It should be emphasized that each treatment appears in every block, and each block receives every treatment.

**Objective**

The objective in using the randomized complete block design is to isolate and remove from the error term the variation attributable to the blocks, while assuring that treatment means will be free of block effects. The effectiveness of the design depends on the ability to achieve homogeneous blocks of experimental units. The ability to form homogeneous blocks depends on the researcher’s knowledge of the experimental material. When blocking is used effectively, the error mean square in the ANOVA table will be reduced, the V.R. will be increased, and the chance of rejecting the null hypothesis will be improved.

In animal experiments, the breed of animal may be used as a blocking factor. Litters may also be used as blocks, in which case an animal from each litter receives a treatment. In experiments involving human beings, if it is desired that differences resulting from age be eliminated, then subjects may be grouped according to age so that one person of each age receives each treatment. The randomized complete block design also may be employed effectively when an experiment must be carried out in more than one laboratory (block) or when several days (blocks) are required for completion.

The random allocation of treatments to subjects is restricted in the randomized complete block design. That is, each treatment must be represented an equal number of times (one or more times) within each blocking unit. In practice this is generally accomplished by assigning a random permutation of the order of treatments to subjects within each block. For example, if there are four treatments representing three drugs and a placebo (drug A, drug B, drug C, and placebo [p]), then there are 4! " 24 possible permutations of the four treatments: (A, B, C, P) or (A, C, B, P) or (C, A, P, B), and so on. One permutation is then randomly assigned to each block.

**Advantages**

One of the advantages of the randomized complete block design is that it is easily understood. Furthermore, certain complications that may arise in the course of an experiment are easily handled when this design is employed.

It is instructive here to point out that the paired comparisons analysis presented in Chapter 7 is a special case of the randomized complete block design. Example 7.4.1, for example, may be treated as a randomized complete block design in which the two points in time (Pre-op and Post-op) are the treatments and the individuals on whom the measurements were taken are the blocks.

**Data Display**

In general, the data from an experiment utilizing the randomized complete block design may be displayed in a table such as Table 8.3.1. The following new notation in this table should be observed: