One way of increasing the power of an experimental methodology mentioned in Section 1.3 is to choose an experimental design that provides for a more precise estimate of treatment effects and a smaller error variance. A randomized block design is more powerful than a completely randomized design if the block effects in the former design account for an appreciable portion of the total variance. It should be noted that the increased power of the randomized block design was made possible through the use of matched subjects. In many research situations, the increased experimental effort required to match subjects may not justify the greater power obtainable with a randomized block design.

LATIN SQUARE DESIGN

A Latin square design utilizes the blocking principle to obtain homogeneity with respect to two nuisance variables. The levels of the two nuisance variables are assigned to the rows and columns of a Latin square. Treatment levels are identified within each cell of the Latin square. In the randomized block design example, subjects were equated on the basis of genetic characteristics. It is reasonable to assume that rats in the same litter are also relatively homogeneous in weight. However, because the dependent variable in the radiation example is food consumption, the experimenter might wish to control the extraneous variable of weight. This can be accomplished by assigning the lightest rat in each litter to category b_1, the rat intermediate in weight to category b_2, and the heaviest rat to category b_3. Blocking with respect to both genetic characteristics a_i and weight b_j is shown in Table 1.4-4.

TABLE 1.4-4 Latin Square Design

	Weight Categories of Rats			
	b_1 Lightest	b_2 Intermediate	b_3 Heaviest	Block means
Block (litter) a_1	c_1 X_{111}	c_2 X_{122}	c_3 X_{133}	$\bar{X}_{1\cdot\cdot}$
Block (litter) a_2	c_2 X_{212}	c_3 X_{223}	c_1 X_{231}	$\bar{X}_{2\cdot\cdot}$
Block (litter) a_3	c_3 X_{313}	c_1 X_{321}	c_2 X_{332}	$\bar{X}_{3\cdot\cdot}$
Weight means =	$\bar{X}_{\cdot 1\cdot}$	$\bar{X}_{\cdot 2\cdot}$	$\bar{X}_{\cdot 3\cdot}$	

Grand mean = $\bar{X}_{\cdot\cdot\cdot}$

Treatment level means: $c_1 = (X_{111} + X_{321} + X_{231})/3 = \bar{X}_{\cdot\cdot 1}$

$c_2 = (X_{212} + X_{122} + X_{332})/3 = \bar{X}_{\cdot\cdot 2}$

$c_3 = (X_{313} + X_{223} + X_{133})/3 = \bar{X}_{\cdot\cdot 3}$