Section 1.4. Overall and Dalal (1965) have described a procedure for maximizing the power of a research methodology relative to cost through the optimum allocation of resources to subjects; it requires *a priori* estimates of a number of design parameters. A procedure is described in Section 4.5 for estimating the number of subjects required for an experiment, one that does not necessitate making an estimate of the population error variance.

1.4 OVERVIEW OF TYPES OF EXPERIMENTAL DESIGNS

One of the procedures suggested above for increasing the power of a research methodology was to employ a more *sensitive* experimental design. In this context, the term experimental design refers to the plan by which subjects are assigned to treatment levels and the data analyzed.

An almost bewildering array of kinds of experimental designs exists. Fortunately, most complex experimental designs represent a combination of a relatively small number of basic *building block* designs. For example, most complex designs can be constructed by combining two or more completely randomized, randomized block, or Latin square designs. A simple classification of the experimental designs described in this book is outlined in Table 1.4-1. A more complete classification system appears in Cox (1943); Doxtator, Tolman, Cormany, Bush, and Jensen (1942); and Federer (1955, 6–12).

The category *systematic designs* in the outline is of historical interest only. According to Leonard and Clark (1939), agricultural field research employing systematic designs on a practical scale dates back to 1834. Prior to the work of Fisher, as well as of Neyman and Pearson on the theory of statistical inference, investigators used systematic schemes rather than randomization procedures for assigning treatment levels to plots of land or other suitable experimental units—hence the designation systematic designs for these early field experiments. Impetus for this early experimental research came from a need to improve agricultural techniques. Today the nomenclature of experimental design is replete with terms from agriculture. Systematic designs in which the randomization principle is not followed do not provide a valid estimate of error variance and hence are not subject to powerful tools of statistical analysis, such as analysis of variance.

Modern principles of experimental design, particularly the principle of random assignment of treatment levels to experimental units, received general acceptance as a result of Fisher's work (1922, 1923, 1935). Experimental designs using the randomization principle are called *randomized designs.* Randomized designs can be subdivided into two distinct categories, complete block designs and incomplete block designs, and two pseudo-