Preceding paragraphs described a quantitative independent variable. If the treatment levels consisted of unmodulated radiation, amplitude-modulated radiation, and pulse-modulated radiation, the treatment is designated as a *qualitative* independent variable. The different treatment levels represent different *kinds* rather than different *amounts* of the independent variable. The distinction between quantitative and qualitative treatments is important in connection with trend analysis. The specific levels of a qualitative independent variable employed in an experiment are generally of direct interest to an experimenter. The levels chosen are usually dictated by the nature of the research hypothesis.

CONTROL OF NUISANCE VARIABLES

In addition to independent and dependent variables, all experiments include one or more *nuisance* variables. Nuisance variables are undesired sources of variation in an experiment that may affect the dependent variable. As the name implies, the effects of nuisance variables are of no interest per se. In the radiation example, potential nuisance variables include sex of the rats, variation in weight of the rats prior to the experiment, presence of infectious diseases in one or more cages where the rats are housed, temperature variation among the cages, and differences in previous feeding experiences of the rats. Unless controlled, nuisance variables can bias the outcome of an experiment. For example, if rats in the radiated groups suffer from some undetected disease, differences among the groups would reflect the effects of the disease in addition to radiation effects—if the latter effects exist.

Four approaches can be followed in controlling nuisance variables. One approach is to hold the nuisance variable constant for all subjects. For example, use only male rats of the same weight. Although an experimenter may attempt to hold all nuisance variables constant, the probability is high that some variable will escape his attention. A second approach, one that is used in conjunction with the first, is to assign subjects randomly to the experimental conditions. Then known as well as unsuspected sources of variation or bias are distributed over the entire experiment and thus do not affect just one or a limited number of treatment levels. In this case an experimenter increases the magnitude of random variation among observations in order to minimize systematic effects, that is, the effects of nuisance variables that bias all observations in one or more treatment levels in the same manner. Random variation can be taken into account in evaluating the outcome of an experiment, whereas it is difficult or impossible to account for systematic nuisance effects. A third approach to controlling nuisance variables is to include the variable as one of the *treatments* in the experimental design. This approach is illustrated in Section 1.4 in connection with a Latin square design.

The above three approaches for controlling nuisance variables illustrate the application of *experimental control* as opposed to the fourth