where $\mu_j - \mu$ = the minimum treatment effect an experimenter is interested in detecting, k = number of treatment levels, σ_ε = square root of population error variance, and n = size of sample. If estimates of $\mu_j - \mu$ and σ_ε can be made, the size of a sample necessary to achieve a designated power can be determined from Table D.14 by a process of trial-and-error. The probability of type I and type II errors, α and β respectively, that the experimenter is willing to accept must also be specified.

Assume that a treatment has three levels and that the smallest treatment effects of interest to the experimenter are -4, -1, and $+5$. That is,

$$\sum_{1}^{k}(\mu_j - \mu)^2 = (-4)^2 + (-1)^2 + (5)^2 = 42.$$

Assume, also, that on the basis of previous research σ_ε is estimated to be six and that the investigator wishes the power of his test $(1 - \beta)$ to equal at least .80 and the probability of a type I error to equal .05. If nine subjects are assigned to each of the three treatment levels, Table D.14 in the appendix can be used to determine if the specified power is achieved. For example,

$$\phi = \frac{\sqrt{\dfrac{(-4)^2 + (-1)^2 + (5)^2}{3}}}{6/\sqrt{9}} = \frac{\sqrt{42/3}}{6/3} = 1.87,$$

with $k - 1 = 2$ and $N - k = 24$ degrees of freedom. The value of $\phi = 1.87$ and $\alpha = .05$ are entered in the table for $k - 1$ degrees of freedom. The curve corresponding to $N - k$ degrees of freedom indicates that the power is equal to .79, which is less than that desired by the experimenter. If the sample size is increased to 30, with ten subjects assigned to each treatment level, the power can be estimated from

$$\phi = \frac{\sqrt{\dfrac{(-4)^2 + (-1)^2 + (5)^2}{3}}}{6/\sqrt{10}} = 1.97,$$

with $k - 1 = 2$ and $N - k = 27$ degrees of freedom. The probability of detecting the specified treatment effects is approximately .83. Thus the required sample size is found to be 30.

If reasonable estimates of the parameters can be made, the required sample size should always be computed before the experiment is begun. If these preliminary calculations indicate that the power of the experimental design is inadequate, the experimenter may choose not to conduct the experiment or may modify it so as to increase its power. The two most common procedures for increasing power are (1) to increase the size of the sample and (2) to employ an experimental design that provides a more precise estimate of treatment effects and a smaller error term. The first procedure was illustrated in this section. The second is described in