Estimation of sample size and statistical power rely on several components related to researcher's research objectives, the experimental design, the topic being studied, as well as the sampling methods used and the data being collected. Some of the statistical terms used in the process of estimation are described below.

1) **n**   **Sample Size.** This value is either fixed/specified by the researcher, as in the case of power estimation, or it can be an unknown quantity to be estimated. It may be represented as either the size per treatment group, or the total sample size, depending on the estimation procedure used.

2) σ^2 **Data Variance.** This is a fixed value of variability for the data. The value used here may come from existing data, literature review, or simply the researcher's best approximation. It is often expressed as a data standard deviation, σ, or the square root of the mean squared error (root MSE) in the case of analysis of variance procedures.

3) δ **Estimate of Precision.** This is also a fixed value, set by the researcher, representing the degree of precision to be expected from the experimental estimates. It can take the form of the half width of a confidence interval, the expected or observed difference between treatment estimates, or a relative value such as a percentage of the estimate.

4) α **Significance Level.** The fixed level of significance for hypothesis testing, or conversely, $(1-\alpha)$, the level of confidence coefficient desired. As defined by R. A. Fisher, α is the probability of falsely rejecting the null hypothesis of no treatment effects (Type I error or false positive).

5) β **Type II Error Rate.** Introduced into the statistical testing paradigm by statisticians Neyman and Pearson, β represents the probability of a false negative result. The converse probability, $(1-\beta)$, is the statistical <u>power</u> or the probability of correctly identifying a true rejection of the null hypothesis. Unlike the other components above, β is entirely dependent on the alternative hypothesis being proposed. That is, the statistical power of any experiment will change depending on the hypothesis being tested. In sample size estimation, β is specified by the researcher, while in power analysis, it is estimated from the other components and a fixed sample size.

In summary, α, δ, and σ are quantities predetermined by the researcher through known data, subject matter expertise, and expected outcomes. The sample size, **n**, and statistical power, β, are quantities to be estimated with the following restrictions: **n** can be estimated when β is specified, or conversely, β can be estimated if **n** is given.