

## STATISTICAL METHODS IN CHEMICAL ANALYSIS

Once we accept that quantitative studies will play a dominant role in any analytical laboratory, we must accept also that the errors that occur in such studies are of supreme importance. Our guiding principle will be that no quantitative results are of any value unless they are accompanied by some estimate of the errors inherent in them. The principle naturally applies not only to analytical chemistry but to any field of study in which numerical experimental results are obtained.

► **Absolute error:** The absolute error of a measurement is the difference between the measured value and the true value. It bears a sign. The absolute error  $E_a$  in the measurement of a quantity  $x_i$  is given by the equation:

$$E_a = x_i - x_t$$

where  $x_t$  is the true, or accepted, value of the quantity. A negative value of  $E_a$  implies that the experimental result is smaller than the true or accepted value while a positive value shows that the experimental result is greater than the true or accepted value.

► **Relative error:** Often, the relative error  $E_r$  is a more useful quantity than the absolute error. The percent relative error is given by the expression:

$$E_r = (x_i - x_t) / x_t \times 100\%$$

► **Accuracy:** Accuracy indicates the closeness of the measurements to its true or accepted value and is expressed by the *error*. Accuracy is expressed in terms of either absolute or relative error.

► **Precision:** When a sample is analyzed several times, the individual results are rarely the same. Instead, the results are randomly scattered. Precision is a measure of the variability. The closer the agreement between the individual analyses, the more precise is the results. Precision describes the reproducibility of measurements- that is, the closeness of results that have been obtained in exactly the same way. Generally, the precision of a measurement is readily determined by simply repeating the measurement.

Three terms are used widely to describe the precision of a set of replicate data: standard deviation, variance and coefficient of variation. All of these terms are a function of the deviation from the mean, which is defined as: deviation from the