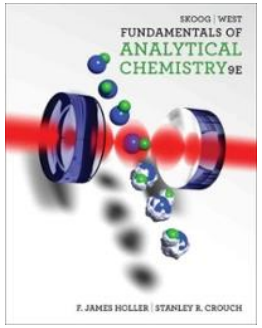
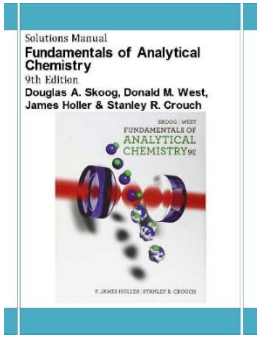
STATISTICS IN CHEMISTRY

1.



2.



1. Skoog DA, West DM, Holler FJ, Crouch SR. Fundamentals of Analytical Chemistry. Nelson Education; 2013.
2. Skoog DA, West DM, Holler FJ, Crouch SR. Solutions Manual of Fundamentals of Analytical Chemistry. Nelson Education; 2013.

Standard deviation of calculated results

Reliability of sample standard deviation

The reliability of the sample standard deviation depends on the number of data (N) in the sample. As the N number increases, the reliability of the s increases. When the N value increases to 20-25, the s value approaches the population standard deviation (σ).

Data consolidation to improve the reliability of s

As the number of N increases, its reliability increases. However, it is not always possible to increase the number of data in the sample to 20-25. While this can sometimes not be practically possible, sometimes it takes a lot of time to work with a large number of samples and can also be quite costly.

In cases where the number of data in the sample cannot be increased, the total number of data can be increased by combining the data obtained from different samples with the same analytical method. Therefore, the reliability of s. The following equation is used to merge data:

$$s_b = \sqrt{\frac{\sum_{i=1}^{N_1}(x_i - \acute{x}_1)^2 + \sum_{j=1}^{N_2}\left(x_j - \acute{x}_2\right)^2 + \sum_{k=1}^{N_3}(x_k - \acute{x}_3)^2 + \cdots \ldots .}{N_1 + N_2 + N_3 + \cdots \ldots . - N_I}}$$

or

$$s_b = \sqrt{\frac{(N_1 - 1) \cdot s_1^2 + (N_2 - 1) \cdot s_2^2 + (N_3 - 1) \cdot s_3^2 + \cdots \ldots .}{N_1 + N_2 + N_3 + \cdots \ldots . - N_I}}$$

Other precision measures

Variance (s^2)

The variance is the square of the standard deviation and can be calculated with the following equation:

$$s^2 = \frac{\sum_{i=1}^{N}(x_i - \acute{x})^2}{N - 1}$$

Relative standard deviation (RSD)

$$RSD = s_r = \frac{s}{\acute{x}}$$

Coefficient of variation (CV)

$$CV = \frac{s}{\acute{x}} \times 100$$

Spread or Range (w)

The **spread**, or **range**, *w*, is another term that is sometimes used to describe the precision of a set of replicate results.

Standard deviation of calculated results

Mostly experimental data is obtained with standard deviations, and if we obtain a result by a mathematical process using two or more of these experimental data, we must calculate the standard deviation of this result. The following is how to calculate the standard deviation for the result from the standard deviation of each data when performing arithmetic operations.

Addition and Subtraction

$$y = a + b - c \qquad s_y = \sqrt{s_a^2 + s_b^2 + s_c^2}$$

Multiplication and Division

$$y = a \cdot b/c \qquad \frac{s_y}{y} = \sqrt{\left(\frac{s_a}{a}\right)^2 + \left(\frac{s_b}{b}\right)^2 + \left(\frac{s_c}{c}\right)^2}$$

Exponentiation

$$y = a^x \qquad \frac{s_y}{y} = x\left(\frac{s^a}{a}\right)$$

Logarithm

$$y = log_{10}a \qquad s_y = 0{,}434\,\frac{s_a}{a}$$

Antilogarithm

$$y = antilog_{10}a \qquad \frac{s_y}{y} = 2{,}303 s_a$$