Assignment 1: *Accuracy and precision of analytical measurements*

Aim: *Evaluate the precision, accuracy, and trueness of the measurements, discuss the effect of random, systematic, and gross error in the data set of analytical measurements.*

Four students (A–D) each perform an analysis in which exactly 10.00 ml of exactly 0.1 M sodium hydroxide is titrated with exactly 0.1 M hydrochloric acid. Each student performs five replicate titrations, with the results shown in Table 1:

Tasks:

a) Make a graphical depiction of the results obtained by each student together with the true value.
b) Evaluate the precision and accuracy of the measurements.
c) Evaluate the effect of random, systematic, and gross errors.

Assignment 2: *Expression of random errors' effect in repeated measurements.*

Aim: *Express the effect of random error on the results of repeated measurements by average and standard deviation (variance).*

In analytical experiments, it is necessary to perform multiple repetitions of the measurements to evaluate the effect of random errors. In this case, the basic statistical parameters are applied – arithmetic mean and standard deviation (variation). Use the data from the previous assignment for calculation.

Tasks:

a) Calculate the arithmetic mean, standard deviation (variance) of the measurements from assignment 1 for each student A - D.
b) With the help of calculated parameters evaluate the precision and accuracy.
c) Calculate the relative standard deviation and evaluate the relative error of the measurements for each student A – D.

Assignment 3: *Evaluation of the statistical distribution of repeated measurements.*

Aim: *Evaluate the shape of the distribution graph of 50 determinations of nitrate ion in the sample of wastewater.*

Although the standard deviation represents distribution around average, it does not indicate the shape of the distribution graph. For an illustration of the distribution, it is necessary to perform a large number of measurements (e.g. measurements in Table 2).

Tasks:

a) Summarize the results – do a frequency distribution table, evaluate the average and standard deviation.
b) Draw a histogram and evaluate the distribution of the results.
c) Discuss the shape of the distribution graph and compare with the ideal distribution graph and evaluate the deviations in the real data set.

Assignment 4: *Regression analysis*

Aim: *Calculate a linear regression for a set of calibration solution used for fluorimetric determination of fluorescein in a sample.*

A set of seven standard aqueous solutions of fluorescein was analyzed by fluorimetry. The results of intensity are provided in Table 3.

Tasks:

a) Calculate the correlation coefficient (r), coefficient of determination (r^2), determine the slope (b) and intercept (a) for the regression analysis, evaluate the shape of the regression line y = a + b.x for the data set
b) Draw the regression line

Assignment 5: *Calculation of 95% confidence interval of regression analysis.*

Aim: *Determine the errors for slope, intercept and calculate the 95% confidence interval for these regression parameters.*

Regression analysis from Assignment 4 will be used for calculation of 95% confidence interval. At first, a statistical $s_{y/x}$, that estimates the spread of random errors in along y-axis, will be calculated. Using the $s_{y/x}$ the random errors for slope and intercept (that are important for setting the confidence intervals) will be calculated. The value *t* for (n - 2) = 5 degrees of freedom and 95% confidence interval is 2.57.

Tasks:

a) Calculate the rate of random errors for y ($s_{y/x}$), slope (s_a), intercept (s_b)
b) Determine the 95% confidence interval for a, b