Linear fitter and uncertainties of parameters.

If N measurements result in N pairs of numbers x_i and y_i, and we expect that according to the physical process, y is the linear function of x given by $y = mx + b$, the unknown parameters m and b can be found as:

$$\Delta = N\sum x_i^2 - \left(\sum x_i\right)^2; \quad m = \frac{N\sum_{i=1}^{N} x_i y_i - \sum_{i=1}^{N} x_i \sum_{i=1}^{N} y_i}{\Delta}; \quad b = \bar{y} - m\bar{x} = \frac{\sum_{i=1}^{N} y_i - m\sum_{i=1}^{N} x_i}{N}. \quad (1)$$

If $s_{y,x}^2 = \frac{1}{N-2}\sum\left[y_i - \left(b + mx_i\right)\right]^2$ is the variance of $y(x)$, then the standard deviation s_m of the estimated slope is a square root of $s_m^2 = N\frac{s_{y,x}^2}{\Delta}$; (2a) and the standard deviation s_b of a y-intercept is the square root of $s_b^2 = \frac{s_{y,x}^2 \sum x_i^2}{\Delta}$ (2b).

We recommend creating a code in any programming language to simplify calculations for any number of measurements in your future experiments.

Finally, your linear fit is the function $y = mx + b$,
with *slope* $= m \pm s_m$, and *y-intercept* $= b \pm s_b$, given by equations (1) and (2).

The coefficient of determination R^2 is calculated by Excel as follows:

$$R^2 = 1 - \frac{(N-2)s_{y,x}^2}{\sum\left(y_i - \bar{y}\right)^2} = 1 - \frac{(N-2)s_{y,x}^2}{\sum\left(y_i - \frac{\sum y_i}{N}\right)^2}$$