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least-squares technique

A procedure for replacing the discrete set of results obtained from an experiment by a continuous function. It is defined by the following. For the set of variables y, x_0, x_1, ... there are n measured values such as y_i, x_{0i}, x_{1i}, ... and it is decided to write a relation:

$$y = f(a_0, a_1, ..., a_K; x_0, x_1, ...)$$

where a_0, a_1, ..., a_K are undetermined constants. If it is assumed that each measurement y_i of y has associated with it a number w_i^{-1} characteristic of the uncertainty, then numerical estimates of the a_0, a_1, ..., a_K are found by constructing a variable S, defined by

$$S = \sum_i (w_i\,(y_i - f_i))^2,$$

and solving the equations obtained by writing

$$\frac{\partial S}{\partial a_j}\tilde{a}_j = 0$$

$\tilde{a}_j =$ all a except a_j. If the relations between the a and y are linear, this is the familiar least-squares technique of fitting an equation to a number of experimental points. If the relations between the a and y are non-linear, there is an increase in the difficulty of finding a solution, but the problem is essentially unchanged.

Source:
PAC, 1981, *53*, 1805 *(Assignment and presentation of uncertainties of the numerical results of thermodynamic measurements (Provisional))* on page 1822

