NEWS AND NOTES

A SIMPLIFIED METHOD FOR DETERMINATION OF CONTENTS OF ARSENIC IN GROUND WATER FROM MAJOR OXIDE ELEMENT OF IRON BY REGRESSSION ANALYSIS

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Introduction

A simple mathematical tool based on regression analysis is proposed as an aid for delineating areas of arsenic contamination in ground water, during mapping of the endemic areas of south and central Bengal districts, West Bengal, that have long been identified as an issue of geogenic origin.

Regression Analysis

Let a set of variable y_i is dependent on a fixed variable x_i. The dependent variable is generally known as regressed variable and the independent variable is known as regressor variable.

The problem is to predict y from values those of x; To do this an approximating equation is fitted to data between x and y such that if estimated y is denoted by y' then $\Sigma(y- y')^2$ tends to be minimum.

The approximating equation between x and y is known as least square regression equation. There are several approximating equations between x and y (Davis, 1973; Mayer, 1975), but for clarity, we shall use here straight line equation of the form,

$y = a + b \cdot x$ – to a given set of 'n' observations (x_1,y_1), (x_2,y_2), ...(x_n ,y_n)

For any x_i, the observed value of Y is y_i, and the expected value $y_i' = a + bx_i$, so that error, $e_i = y_1 - y_i'$

The sum of square of the errors (E) is

$$E = e_1^2 + e_2^2 + e_3^2 + e_4^2 + e_5^2 + ...+ e_n^2$$
$$= [y_1 - (a + bx_1)]^2 + [y_2 -(a + bx_2)]^2 + ...+ [y_n - (a + bx_n)]^2$$

For, E to be minimum

$$\text{i.e.} \quad \delta E / \delta a = 0 \qquad (1)$$
$$\text{and} \quad \delta E / \delta b = 0 \qquad (2)$$

From equations (1) and (2),

$$\Sigma y_i = n \cdot a + b \Sigma x_i \qquad (3)$$

$$\text{and } \Sigma x_i \cdot y_i = a.\Sigma x_i + b. \Sigma x_i^2 \quad (i= 1,2,3,.....n) \qquad (4)$$

Equations (3) and (4) are known as normal equations

Solving the normal equations i.e., (3) and (4), values of a and b are determined.

So that, $y = a + b. x$ can be determined

Results and Discussion

The chemical data were taken from field study carried out during the period 1992-95. Five sets of data from S 24-Paraganas district have been considered. Values above 50 ppb of As are taken, since those below 50 ppb are not specified in the analysed data.

Here the content of Fe are taken as independent variable x_i, and the value of As as dependent variable, y_i. The aim of the problem is to set up a correlation between Fe and As so that a standard linear equation of the form y= a+ b.x can be fitted between them. From this equation, values of y_i i.e. As can be estimated for different values of Fe. The analyses of water samples from five different places are given in Table 1. Correlation between Fe and As has been determined, correlation coefficient being – 0.988 indicating that they are negatively correlated. Calculated Regression equation is given by

$$Y= -21.43.x + 370.6 \qquad (5)$$

From the above equation it is possible to determine the contents of As in samples of ground water by knowing Fe at some other intermediate and adjoining areas. The method discussed here is quite simple and can be implemented theoretically with help of pocket calculator

Table 1

Sample No.	Fe (ppm)	Arsenic contents (ppb)	
		Observed	Estimated from eq. 5
WS84/Govindapur TW	12	125	113.44
WS44/TW/lalmath	7.3	200	214.16
WS54/TW/Kashinnathpur	5	250	263.45
WS41/TW/Bejpur	3.4	300	297.74
WS64/TW/Natungram	1.6	350	336.31

If a correlation can be established between Fe and As from the analysed data, then the above procedure will be applicable in suspected zones.

Given the high cost and requirement of sophisticated analytical instruments involved in determination of As contents (occurring in ground water in ppb levels) both at field and laboratory, the present method may prove to be more acceptable for rapid estimation and quick dissemination of results to users.

References

Geological Survey of India (1995) Report on investigation on arsenic contamination in ground water of West Bengal, GSI, ER.

Mayer, S.L. (1975) Data analysis for scientist and Engineers, John Wiley & Sons.

Davis, J.C. (1973) Statistics and data analysis in geology.