Barbat (1973) proposed that a worldwide increase in the use of manufactured energy (electricity) for labor-saving purposes is a prospective means for stopping the world's explosive population growth. A correlation between these two variables (birthrate and per capita consumption of electricity) can be demonstrated. However, the implication of a cause-and-effect relation, which pervaded Barbat's paper, is improper, and the statistical extrapolation of the relation into areas where historical data are lacking is misleading.

The relation between birthrate and per capita consumption of electricity presented by Barbat is reproduced in Figure 1. The wide arrow formed by the hatching is Barbat's interpretation of the "world norm." Extrapolation of this "norm" down to the birthrate level which approximates zero population growth (ZPG) yields an order-of-magnitude estimate that consumption of 10,000-12,000 kilowatt-hours (kwh) per capita of electricity would correspond to world population stability, according to Barbat. Two points either have not been considered by Barbat or have been considered but dismissed without explanation. Both of these points pertain to curve fitting and interpretation such as employed by Barbat for his "world norm."

Because of the frequent uncertainty about basic variables and basic mechanisms, it is usually necessary to assume a priori that a particular type of function is a correct model for a given set of data. Then, regression and correlation methods are employed to compute the "best-fit" equation and test it for significance. If the results of these tests show significance, then the equation can be used to describe exactly the functional relation. It is hoped that the postulated function represents a causal mechanism. The first point which must be stressed, however, is that just because a function has been found to be a good fit to a set of observed data, it is improper to infer that a cause-and-effect relation exists among the variables (Ostle, 1963). Barbat's belief that a cause-and-effect relation exists between birthrate and per capita consumption of electricity was implicit in his paper; he asserted that an increase in one variable (per capita electricity consumption) will result in a decrease in another variable (birthrate). Barbat's "world norm," which only superficially represents a "good" fit, cannot be interpreted as establishing a cause-and-effect relation between the two variables.

The second point also arises because of the necessity to assume a priori, whenever there is uncertainty about the relation between variables, that the particular model is correct for the data. One may determine heuristically that the proper model for a known set of data is a linear function; if unknown and perhaps unobtainable data also are included, however, a nonlinear function might be found more representative. Thus, extrapolation of an assumed function outside the data range is not justifiable on statistical grounds alone. Barbat assumed that a linear function (plotted on semilog paper) describes the relation between known birthrates and known per capita consumption of electricity and extrapolates the function into areas of Figure 1 that are devoid of empirical data points (the lower right part of Figure 1 with low birthrates and high per capita consumption). Barbat has not justified the extrapolation of his curve down to the birthrate level represented by ZPG, which is beyond the range of known data.

To test and analyze Barbat's interpretation of the data set, regression analysis has been employed by using the criterion of least squares to find the equation of a line which in some sense provides the best possible fit to the data set. The standard t test (from the Student-t distribution) determines how well the data follow the assumed functional form.

Regression analysis of the 1958 and the 1967 data presented by Barbat and of 1971 data for 70 countries (United Nations, 1973) was conducted to determine the linear equation of the line (on semilog paper) that represents the least-squares fit for each set of data (Fig. 2). For the number of...