THE SIMULTANEOUS COMPUTATION OF GROUPS OF REGRESSION EQUATIONS AND ASSOCIATED MULTIPLE CORRELATION COEFFICIENTS

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1. **Introduction.** The need sometimes arises for the prediction of a number of different variables from a given group of so-called fundamental variables. In the work of college prediction, for example, one might desire regression equations predicting certain measures of college achievement (e.g., first semester average, first semester English grade, first semester mathematics grade, number of hours of A received during first semester, etc.) on the basis of a number of other factors (e.g., high school record, score on American Council on Education Psychological Examination, score on some standard English achievement test, score on some standard mathematics achievement test, etc.). It is the purpose of this paper to show how the regression coefficients and the associated multiple correlation coefficients can be obtained simultaneously. The essence of the method is a simple device by which one solution of general normal equations may be made to serve for all cases.

2. **The normal equations.** Let $x_1, x_2, x_3, \cdots x_n$, be the so-called fundamental variables and let x_k be the predicted variable. The normal equations are computed by standard methods which result in one of the three types.

Type I. Normal equations for determining $b_0, b_1, b_2, b_3, \cdots, b_n$.

$$b_0 n + b_1\Sigma x_1 + b_2\Sigma x_2 + b_3\Sigma x_3 + \cdots\cdots + b_n\Sigma x_n - \Sigma x_k = 0$$

$$b_0\Sigma x_1 + b_1\Sigma x_1^2 + b_2\Sigma x_1x_2 + b_3\Sigma x_1x_3 + \cdots\cdots + b_n\Sigma x_1x_n - \Sigma x_1x_k = 0$$

$$b_0\Sigma x_2 + b_1\Sigma x_1x_2 + b_2\Sigma x_2^2 + b_3\Sigma x_2x_3 + \cdots\cdots + b_n\Sigma x_2x_n - \Sigma x_2x_k = 0$$

$$\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots$$

$$b_0\Sigma x_n + b_1\Sigma x_nx_1 + b_2\Sigma x_nx_2 + b_3\Sigma x_nx_3 + \cdots\cdots + b_n\Sigma x_n^2 - \Sigma x_nx_k = 0$$

Type II. Normal equations for determining $b_1, b_2, b_3, \cdots, b_n$.

$$\bar{x}_i = x_i - M_{x_i}$$

$$b_1\Sigma\bar{x}_1^2 + b_2\Sigma\bar{x}_1\bar{x}_2 + b_3\Sigma\bar{x}_1\bar{x}_3 + \cdots\cdots + b_n\Sigma\bar{x}_1\bar{x}_n - \Sigma\bar{x}_1\bar{x}_k = 0$$

$$b_1\Sigma\bar{x}_2\bar{x}_1 + b_2\Sigma\bar{x}_2^2 + b_3\Sigma\bar{x}_2\bar{x}_3 + \cdots\cdots + b_n\Sigma\bar{x}_2\bar{x}_n - \Sigma\bar{x}_2\bar{x}_k = 0$$

$$\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots\cdots$$

$$b_1\Sigma\bar{x}_n\bar{x}_1 + b_2\Sigma\bar{x}_n\bar{x}_2 + b_3\Sigma\bar{x}_n\bar{x}_3 + \cdots\cdots + b_n\Sigma\bar{x}_n^2 - \Sigma\bar{x}_n\bar{x}_k = 0$$