ESTIMATION OF OPTIMUM PLOT SIZE USING SMITH'S PROCEDURE

Smith found the empirical law that $V_x = V_1/X^b$, where $V_x$ is the variance among plots that are of $X$ basic units in size, on a per basic unit basis, $V_1$ is the variance among plots of one basic unit, and $b$ is the index of soil heterogeneity. He also showed that if the cost per plot without guard rows is $K = K_1 + K_2 X$, then the cost per unit of information would be minimum if

$$X = bK_1/(1 - b)K_2$$

where $X$ is the size of the plot, $K_1$ is the part of the cost that is associated with the number of plots only, and $K_2$ is the cost per unit area. Smith, in his numerical example, defined $K_1$ in man-hours per plot and $K_2$ in man-hours per square foot.

This method was used by many authors to estimate the optimum plot size for different crops. In some of these papers, apparently, Smith's formulae were not used correctly. The same error was repeated in several papers and might possibly be made again. It therefore seems appropriate to point it out. Some examples of possible misinterpretation follow.

Robinson et al. assumed that 30% of the total cost was proportional to the total area used. They inserted 70/30 for the ratio $K_1/K_2$ in equation [1] and calculated the optimum plot size $X$, from this equation in terms of the basic units used in the uniformity trial. Similar procedures were used by Elliott et al. and Pointer and Koch.

According to the original definition, both $K_1$ and $K_2$ are constant for different plot sizes, but $K_1$ is given on a per-plot basis and $K_2$ on a per-unit-area basis. The percentages of the two types of costs from the total cost, however, are proportional to $K_1$ and $K_2 X$, respectively. Thus, the ratio calculated by the above-mentioned authors and used in equation [1] was actually $K_1/K_2 X$ and not $K_1/K_2$. This ratio is dependent on the size of the plot ($X$) from which it was estimated, and it would not be correct to use it in the equation.

Smith's coefficient $b$ is the linear regression coefficient of the logarithms of $V_x$ and of $X$. It is not dependent on the size of the basic units used for its estimation. It would therefore be incorrect to calculate $X$ from equation [1] in terms of the basic units used to estimate $b$. The only term in the equation that is expressed on a per unit of area basis is $K_2$.

The correct procedure would therefore be to calculate $X$ on a per unit of area basis and calculate $K_1$ and $K_2$ on the same unit of area. — A. Marani, Instructor, Agricultural, Hebrew University of Jerusalem.

TRANSFORMATION OF PLOT EAR CORN TO DRY SHELLED GRAIN YIELD TABLES

Tables of factors have been available to workers for many years to convert weights of ear corn harvested from specific plot sizes at specific grain moistures to bushels of dry shelled corn, usually at 15%.

As the moisture content of grain and cob of ear corn is different except at approximately 10 and 66% the ship of dry matter of the entire ear to dry shelled grain alone is curvilinear. The use of such laborious and time consuming. In particular they are not ideally suited to data reduction by modern electronic digital computation equipment.

Bryan's Iowa Uniform Yield Tables as modified by G. H. Stringfield and D. R. Butler have been developed for Pennslyvania Station for some seasons. They are suitable for use with ear corn whose grain moisture between 10.0 and 39.9%. In the course of modern processing procedures to the IBM 7074 system it was desirable to derive equations describing the factors in these tables to grain moisture. FORTRAN polynomial derivation with least squares error program was used.

Table 1 gives a summary of the error data for each coefficient polynomial equations of various degrees from one to twelve. As expected from data of Menga and Kiesselbach, the linear equation gave an unsatisfactory fit as reflected in the sum of squares of error and the sum of absolute errors. The sum of squares of error is derived as the sum of the squares of the differences between actual values of the dependent variable and the predicted values based on the derived equation, and the sum of absolute errors is the sum of the absolute values of the differences regarding sign.

In examining Table 1 it is obvious that the degree of fit increases with increasing equation degree until a maximum degree is reached, after which no appreciable differences are apparent. This indicates that the fourth degree provides a fit to the data equal to or better than a polynomial.

However, the second degree equation gives a very good fit when the predicted dependent variable

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5 Published September, 1963

6 Stroehl, W., and Yoder, N. Least squares polynomial extension of FORTRAN IBM 7074 Program. The Pennsylvania Station, Pennsylvania Agriculture, Hebrew University of Jerusalem.