NEGATIVE EXPONENTIAL FUNCTIONS

This chapter presents an empirical examination of farm size distribution projections to the year 2000 derived by use of negative exponential functions. The farm size distribution, using this projection method, was found to be stable, that is, no significant shifts occur in the distribution over time. However, the size distribution estimated by negative exponential functions deviates from the actual one in that a relatively large proportion of the number of farms goes to the medium-size and large farms (200 acres and more), and a rather small percentage goes to the small farms (less than 100 acres).

Technical Overview

Negative exponential functions have been used by Dovring (7, 8, 9), Boxley (1), Ching (3), and Dixon and Sonka (6) to estimate farm size distributions. If the farm size distribution has been stable around a moving average over time, this would suggest that, if the distributions could be adequately represented by a functional form, the projections problem would be reduced to that of estimating future average sizes. It would also suggest that the diversity of farm size characteristics of past and present is likely to extend into the future. And finally, it would suggest that causal economic studies could be conducted to explain this underlying stability.

Although farm numbers have been declining rapidly and average size has been increasing substantially, small farms have not disappeared nor been amalgamated into a few large operations. Dovring (8) suggested that processes influencing farm sizes produced distributions that may be characterized by specific functional forms. The relatively constant land base means that changes in farm numbers of a given size require an offsetting change in numbers in other size categories. That is, the land base is a physical constraint on the number of farms of a given size, and the number possible is inversely related to size. Noting the inverse relationship between frequency of occurrence and farm size categories, Dovring suggested the size distribution of farm numbers should resemble the inverse exponential distribution (7, 8, 9).

The general form of exponential function is e^x where e is the irrational number 2.71828... and x is the manifest variable. The inverse exponential function (e^{-x}) may represent a decumulative size distribution written as:

$$y = y_0 e^{-Bx} \tag{1}$$

where y is the percentage of farms remaining above a given size limit, x. The size limits can be and are expressed as fractions or multiples of average size in this study, and when $x = 0$, $e^{-Bx} = 1$. The function monotonically decreases asymptotically to zero as x increases. When $Bx = 10$, $e^{-Bx} = .005$ of 1 percent.

Boxley (1) utilized a logarithmic (base 10) transformation of equation (1) as follows:

$$\log y = \log y_0 - Bx \log e \tag{2}$$