MARKOV PROCESS

This chapter reviews the use of Markov processes for projecting farm number and size distributions, describes the process of adjusting the census data for the effects of price inflation, and presents projections to the year 2000. As a result of an 80-percent increase in prices received by farmers between 1969 and 1974, about 90 percent of the apparent increase in the numbers of farms with sales of $100,000 and more is attributed to the effects of price inflation. Of the projected 1.9 million farms in 2000, small farms (less than $20,000) will constitute 50 percent, a decrease from the 72 percent in 1974. By contrast, large farms (sales of $100,000 and more) will constitute 33 percent, an increase from 5 percent in 1974.

Technical Overview

Markov processes have been used to estimate the number and size distribution of firms for a number of industries, including agriculture. 8/ These applications have often used modifications or variants of a Markov process. Many of the modifications are concerned with the estimation of a transition matrix (that is, a description of how firms move among size categories over time) and are necessitated by limited data describing the movement of firms from one time period to another (for example, see 16, 18, 20).

The Markov chain process assumes that a population can be classified into various groups ($S_1, S_2, \ldots, S_n$) and that movements between states over time can be regarded as a stochastic process that can be quantified by probabilities. The states must be defined so that an individual can only be in one state at any point in time. A transition occurs when an individual shifts from one state to another.

A crucial step in the use of Markov processes is estimation of the transition probability--the probability of movement from one state to another in a specified time period. The transition probabilities, P_{ij}, can be expressed in the form of transition matrix, P:

$$P = \begin{array}{c|cccc} & \underline{S_1} & \underline{S_2} & \cdots & \underline{S_n} \\ \hline S_1 & P_{11} & P_{12} & & P_{1n} \\ S_2 & P_{21} & P_{22} & & P_{2n} \\ \vdots & \vdots & \vdots & & \vdots \\ S_n & P_{n1} & P_{n2} & & P_{nn} \end{array}$$

where: $\sum_j P_{ij} = 1.0$ and $P_{ij} \geq 0$, for all i and j.

The elements of P (the P_{ij}) indicate the probability of moving from state S_i to S_j in the next period. Since the elements of the matrix are nonnegative and the sum of the elements in any row is unity, each row of the matrix is a probability

8/ Illustrative studies include (5, 12, 16, 20).