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Predicting Market Prices of Maize and Guinea Corn using Markov Chain Processes

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ABSTRACT

The extent of uncertainty caused by price instability in agriculture has made the industry risky. This study predicts the market price of maize and guinea corn in Michika Local Government Area of Adamawa State. Data was collected from primary sources using structured questionnaires from a random sample of eighty eight and ninety two of maize and guinea corn farmers, respectively. The results were subjected to analysis using Markov Chain model. Based on classification of the prices into three states, results indicate that 16% and 19% of maize and guinea corn farmers, respectively would sell at price state S_1, which is less than ₦4000, 20% and 16% of maize and guinea corn farmers respectively would sell at price state S_2 which is ₦4000-₦7999, while 64 and 65% of the farmers would sell at price State S_3, which is at least ₦8000 in the long run (equilibrium). The study revealed that farmers would receive high price per 100 kg bag of maize and guinea corn in the long run. It is then recommended that in order to check excessive price, which may have a negative effect on farmers and the economy generally, a price stabilization program is proffered.

Key Word: Price; Farmers; Fluctuation forecasting; Market

INTRODUCTION

A significant fact about agricultural products is that their prices fluctuate very much from one season to another (Livingston & Ord, 1984). Agricultural products prices are volatile for a number of reasons, suppliers of agricultural commodities are dependent on weather and the demand for most products is less price elastic than for manufactured products. This causes price supply variability to lead to greater price variability. Supply is also often very inelastic in the short term especially when the commodity is perishable, the cost of inventory is high, or the production takes considerable time like tree crops, so that shift in demand have large impact on prices (World Bank, 2000).

Price discovery is a major issue and concern for agricultural producers as information on prices is critical for the creation and implementation of production, financial and marketing strategy. Price is a basic regulator of the economic system, because it influences the allocation of factors of production; labour, land and capital. As an allocator of resources, price determines what will be produced (supply) and who gets the goods and services produced (demand). Therefore price is an information signal that summarizes all relevant information on supply and demand.

Very often we are faced with making decision based on phenomena that have un-certainty associated with them. This un-certainty is caused by inherent variation that elude control or due to the un-predictability of natural phenomena. Rather than treat variation qualitatively, we can incorporate it into a mathematical model and thus handle it quantitatively. This treatment generally can be accomplished if the natural phenomena exhibit some degree of regularity so that a probability model can be used to describe variations. Markov chain has the advantage that probability involving how the process will evolve in the future depend on the present state of the process and so are independent of the events in the past (Hillier & Lieberman, 1995).

The massive changes in real income and level of economic activities caused by changes in prices, can increase uncertainty and have a negative impact on performance and poverty. The extent of un-certainty caused by price instability in agriculture has also made the industry a risky one. There is therefore the need to predict the future market prices of maize and guinea corn so that farmers can plan their production activities well. The study seeks will also serve as a reference materials to stakeholders in economics and agriculture.

MATERIALS AND METHODS

Primary data for the study was sourced by employing interview schedule.Michika Local Government Area was stratified based on its relative importance in the production of maize and guinea corn. Then a multi-stage random sampling was involved to draw sample for the study by selection of four districts, four wards, nine villages and 180 maize and guinea corn farmers for the study. The selected villages included Kudzum, Wummu and Watsilla from Tsukumu/Tilijo ward, Futuless and Hemike from Futu ward, Murva and Mbororo from Nkafa ward and Buppa and Zah Nduka from Zah. The farmers were sampled proportionate to the number of maize and guinea corn farmers in the respective villages. Data were collected on quarterly sales of 100 kg bag ₦ of maize and guinea corn in the year 2004 and 2005 when Markov chain was used to analyse.

Markov chains assumes the existence of a physical

system S which has a number of possible systems S_1, S_2, ------,S_n and at each instance of time can be in one of these states. We shall denotes the time after successive trials by t_0, t_1, t_2, -------, tn with t_0 representing the starting point in t, t_1, the time of conclusion of the first trial, etc. For Markov chains, the probability of passing to some state S_1 at a time depends only on the state that the system was at the preceding time and does not change, if we know what its state was at earlier times (Markov, 1971).

With a given set of states (S_1, S_2, ------, Sn), it is assumed possible to estimate the probability P_{ij} of moving from state S_i to state S_j. Let the starting or initial probability be denoted by:

$$P_i(0) = \text{Prob}(S_i \text{ at } t_o) \text{----------(1)}$$
$$I = 1, 2\text{------}$$

The set of the starting probabilities can be arranged as row vector as:

$$[P(0) = P_1(0), P_2(0), \ldots P_n(0)] \ldots\ldots\ldots 2$$

P (0) is probability vector that gives us the probability of the system being in state S_1, S_2,……., S_n respectively at the start. Further, we have:

$$\sum p1\,(0) = \quad (3)$$

As stated earlier, we let P_{ij} denotes the transition from state i to state j. Then, by arranging the transition probabilities in a rectangular array, we obtain a matrix P given by:

$$P = \begin{Bmatrix} P_{11} & P_{12} & P_{13} \ldots\ldots\ldots P_{1n} \\ P_{21} & P_{22} & P_{23} \ldots\ldots\ldots P_{2n} \\ \cdot & \cdot & \cdot \ldots\ldots\ldots \cdot \\ \cdot & \cdot & \cdot \ldots\ldots\ldots \cdot \\ \cdot & \cdot & \cdot \ldots\ldots\ldots \cdot \\ \cdot & \cdot & \cdot \ldots\ldots\ldots \cdot \\ \cdot & \cdot & \cdot \ldots\ldots\ldots \cdot \\ P_{n1} & P_{n2} & P_{n3} \ldots\ldots\ldots P_{nn} \end{Bmatrix} \ldots\ldots\ldots\ldots\ldots\ldots (4)$$

This matrix P is called the transition matrix. Since the $P_{ij's}$ are probabilities, it follows that the probabilities in each row sum to unity. This of course is not true for columns:

$$\sum_j P_{ij}(o) \quad = \quad 1 \ldots\ldots\ldots\ldots (5)$$

To determine the equilibrium vector use the equation ep = e……i. A probability row vector e, satisfying the equation ep = e is called a fixed probabilities vector for the transition matrix P. Equation I tells us that the distribution of states tends towards or approaches the value e, which is independent of the original distribution. Hence, e is sometimes called equilibrium distribution since once this distribution is reached, it will be maintained (Mizrahi & Sullivan, 1979).

RESULTS AND DISCUSSION

In order to estimate the transition matrix and probability vector for the prices of maize and guinea corn in 2004 and 2005, the first step was the classification of the prices into three groups from the 88 and 92 maize and guinea corn farmers respectively. Each of the three groups was designed a state "S" these were; S_1 representing farmers that sold less than ₦4000, S_2 representing those farmers that sold between ₦4000 and ₦7999 and S_3 those farmers who sold at price ₦8000 and more for the maize and guinea corn farmers, respectively.

The flow chart for the information is shown in Table I and II. From the result of the initial probability, in the long run or at equilibrium, it showed that 16 and 19% of maize and guinea corn farmers respectively will sell at price state S_1 (less than ₦4000) 20 and 16% of maize and guinea corn farmers respectively will sell at price state S_2 that is ₦4000 - ₦7999, while 64 and 65% of the maize and guinea corn farmers respectively will sell at price state S_3 which is at least ₦8000. The results indicated that farmers would receive good price for their produce in the long run. Previous studies show that population is a factor that influences demand for a commodity (Stanlake & Grant, 1999; Lipsey & Crystal, 2004). Malthusian theory also states that human population is increasing at a geometric progression, while food production is at arithemetic progression. Therefore, this would invariably lead to increasing price of food items as indicated by the study, ceteris paribus. From Table I divide each row by the row total to obtain P given by:

$$P = \begin{matrix} 1/33 & 22/33 & 10/33 \\ 0/42 & 20/42 & 22/42 \\ 3/13 & 0/13 & 10/13 \end{matrix}$$

$$P = \begin{matrix} 0.0303 & 0.6667 & 0.3030 \\ 0 & 0.4762 & 0.5238 \\ 0.2308 & 0 & 0.7692 \end{matrix}$$

$$\begin{matrix} 0.0303 & 0.6667 & 0.3030 \\ (e_1\ e_2\ e_3) \quad 0 & 0.4762 & 0.5238 = (e_1\ e_2\ e_3) \\ 0.2308 & 0 & 0.7692 \end{matrix}$$

The initial probabilities P_o is given by:

$$P_o = \quad (0.16 \quad 0.20 \quad 0.64)$$

Divide each row by the row total to obtain P given by:

$$P = \begin{matrix} 2/26 & 14/26 & 10/26 \\ 13/33 & 0/33 & 20/33 \\ 0/33 & 22/33 & 11/33 \end{matrix}$$

$$P = \begin{matrix} 0.07 & 0.538 & 0.384 \\ 0 & 0.667 & 0.333 \\ 0.39 & 0 & 0.61 \end{matrix}$$

$$\begin{matrix} 0.07 & 0.538 & 0.384 \\ (e_1\ e_2\ e_3) \quad 0 & 0.63 & 0.333 = (e_1\ e_2\ e_3) \\ 0.39 \quad 0 & & 0.61 \end{matrix}$$

The initial probabilities P_o is given by:

$$P_o = (0.32\ 0.25\ 0.42)$$

Table I. Flow Chart for Maize Price 2004 and 2005 Seasons

	Class size	Year t + 1 2005			
		S_1, > 4000	**S_2, 4000 – 7999**	**S_3, ≤ 8000**	**Total for year t^{-1}**
Year t-1 2004	S_1, <4000	1	22	10	33
	S_2, 4000 – 7999	0	20	22	42
	S_3, ≥ 8000	3	0	10	13
	Total for year t+1	4	42	42	88

Source: Field Survey, 2005

Table II. Flow Chart for Guinea corn Price 2004 and 2005 Seasons

	Class size	Year t + 1 2005			
		S_1, ‹ 4000	**S_2, 4000 – 7999**	**S_3, ≤ 8000**	**Total for year t^{-1}**
Year t-1 2004	S_1, <4000	2	14	10	26
	S_2, 4000 – 7999	0	22	11	33
	S_3, ≥8000	13	0	20	33
	Total for year t+1	15	36	41	92

Source: Field Survey, 2005

CONCLUSION

The study predicted that farmers will receive better price for their produce in the long run *ceteris paribus*. This would no doubt encourage agricultural production and competitiveness of the industry there by raising the sectors contribution to the national GDP. There is need for price stabilization programme to check so that these prices are not too excessive in the future. High price may be bad as very low price, because the former lowers real income, encourage inflation and decreases demand for non-agricultural products.

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