Probability Analysis of Coffee Sales Using Markov Theory

I M A Anthara$^{1,2}$, E Salim$^2$

$^{1,2}$Departement of Industrial Engineering, Universitas Komputer Indonesia, Jl. Dipati Ukur No. 112-116, Bandung, Indonesia

Email: i.made.aryantha@email.unikom.ac.id

Abstract. The purpose of this research is to find out the opportunity to move from a coffee brand to another coffee brand in a certain period of time and then, make a prediction of the chances of further coffee transfer until the steady state condition is obtained. This research is motivated by the phenomenon of selling three brands of coffee in one of the stalls in the Garut area. The method that used in this research was “Markov Theory” in which the time span used was the number of sales of each brand of coffee within two months. From the results of observations, there are three coffee brands that are most in demand by consumers, namely “ABC” Coffee, “Luwak White” Coffee and “Kapal Api Mix” Coffee. From the results of the analysis, the steady state conditions of the sales of the three coffee brands were obtained at the sixth month with the sales probability value for ABC coffee, Luwak White Coffee coffee, and Kapal Api Mix coffee, each of which was 31.28%, 21.66%, and 47.06%. When viewed from the results of research that has been obtained, it can be concluded that the probability of selling the three coffee brands is quite even and this can be a consideration for sellers to be able to provide the three coffee brands more than the other brands so that the sales of the three coffee brands will increase.

1. Introduction

The country of Indonesia is an agricultural country that can provide food for its people from the agricultural sector. Processed products from the agricultural sector can be in the form of raw materials for food and beverages which are very influential for the survival of the Indonesian people. One type of beverage that is popular in society is coffee. Coffee is the most popular with people, especially men. The demand for coffee products is quite high in the market; the demand for a coffee product is influenced by the taste of consumers of coffee products. Various types of coffee products sold in the market cause competition among coffee producers, so that coffee marketers need to understand consumer behavior and then develop a marketing strategy to compete with consumers, which means that marketing must know what consumers need and examine what causes consumers to choose and buy the product[1]. A deep understanding of consumers will increase the market and can influence consumer decisions so that whatever purchases offered by marketers[2].

Changes that occur in everyday life vary greatly. Some changes are static and dynamic. Because these changes cannot be avoided and cause a loss. So from that, it is better if preparations are made for a change. Every transition to change needs to be examined carefully[3]. Decisions are taken in carrying out an action basically refer to the data obtained. This data can be data from the past or present time. The data is dealt with in such a way as to produce several possibilities or actions to be taken next. In general, the processing of data is carried out using certain methods or methods. Many methods can already be used to assist in data processing, but not all methods are suitable for all problems, in this case the data processing. As for one of the sciences that can be used to find out the process of changing possibilities that occur continuously using Markov analysis. Markov chain is a
calculation technique that is generally used in modeling various conditions [4-5]. This technique is used to assist in predicting changes that might occur in the future. These changes are represented in dynamic variables at a certain time. So that it is necessary to store state variable values at each time. The Markov method is one of the methods or methods that can be used for several problems in data processing[6]. Problems that can or are appropriate by using the Markov method in processing data include inventory, replacement, processing of cash flow, market research by examining and predicting customer behavior and other issues[7]. In other words, the Markov method is very broad in its application as a tool in decision making[8].

The object of this research is a shop in Haruman Sari Village. Rw 01 Rt 03 Kec. Kadungora Garut Regency. This study will discuss changes in the transfer of coffee product purchases made by consumers. From the various brands of coffee sold in the store, there are three types of coffee brands that are most preferred by consumers, namely ABC coffee, Luwak White Koffie coffee, and Kapal Api Mix coffee. The purpose of this research is to find out the opportunity to move from a coffee brand to another coffee brand in a certain period of time and then, make a prediction of the chances of further coffee transfer until the steady state condition is obtained. The analysis process will use the Markov Theory which starts with determining the amount of coffee purchased by consumers in a span of 2 months, then the probability matrix is made and ends with determining the steady state conditions.

2. Methodology
Markov analysis provided probability information about decision situations that could help decision makers to make decisions [6]. In other words, Markov analysis was not an optimization technique; it was a descriptive technique that produces probability information [9]. Markov analysis could be applied mainly to systems that displayed probability movement from one state to another, all the time [8]. Markov analysis could be used to analyze a number of different situations; for example, the analysis of brand shifts carried out by customers [1]. Markov analysis provided information about the probability of moving customers from one brand to one or more other brands [10]. The brand's name of object research in this paper was the various brands of coffee that sold in the store, and there were three types of coffee brands that were most preferred by consumers, namely ABC coffee, Luwak White Koffie coffee and Kapal Api Mix coffee.

3. Results and Discussion
On the sale of Kopi Kapal Api Mix, Luwak White Coffee and ABC Susu Coffee at Haruman Sari Village stalls. Rw 01 Rt 03 Kec. Kadungora Garut Regency, obtained the highest percentage of coffee sold is Kopi Kapal Api Mix with a percentage value of 51% in the first month and 45% in the second month. Then the sale of Luwak White Koffie Coffee in the first month has a percentage value of 18% and 18% also in the second month. Luwak White Koffie Coffee does not experience a decrease or increase in sales of Luwak White Koffie Coffee, in this case, the sale of Luwak White Koffie Coffee is stable, but the sale of Luwak White Koffie Coffee is not selling well in the market or there are not many who like White Koffie Luwak Coffee. ABC Susu Coffee sales in the first month have a percentage value of 32% and in the second month 38%, ABC Coffee Milk has an increase meaning ABC Susu Coffee is quite popular with the community.

After knowing the number of sales of each type of coffee in the first and second months, then the matrix of the transfer of purchases of each type of coffee has been determined by the consumer. The results can be seen in Table 1 below.
Table 1. Transition Matrix

| From the previous status | To the next status     | Total |
|--------------------------|------------------------|-------|
|                          | Kapal Api Mix | Luwak White Koffie | ABC Milk |       |
| Kapal Api Mix            | 32          | 12                  | 20       | 64    |
| Luwak White koffie       | 16          | 4                   | 16       | 36    |
| ABC Susu                 | 16          | 12                  | 8        | 36    |
| Total                    | 64          | 18                  | 44       | 34    |

Based on the displacement matrix, it can be seen that the number of consumers in the first month who bought Kopi Kapal Api Mix products and the second month still bought Kopi Kapal Api Mix products were 32 people, in the second month they moved to buy Luwak Coffee White Koffie products as many as 12 people and who in the second month moved to buy ABC Susu products as many as 20 people. Consumers who bought the Luwak White Koffie Coffee products for the first month and bought the second product of Luwak White Koffie Coffee for the second month, which in the second month moved to buy Kapal Api Mix Coffee products as many as 15 people and the second month moved to buy ABC Susu Coffee products is 16 people.

Consumers who purchased ABC Susu products for the first month and the second month still bought ABC Susu products as many as 8 people, which in the second month moved to buy Kapal Api Mix Coffee products as many as 16 people and in the second month they switched to buying Luwak White Koffie products is 12 people.

After the coffee purchase transfer matrix is determined, the next step is to make a transition probability matrix from this study. The transition probability matrix can be seen in Table 2 below:

Table 2. Transition probability matrix

| From the previous status | To the next status     |       |
|--------------------------|------------------------|-------|
|                          | Kapal Api Mix | Luwak White Koffie | ABC Susu |
| Kapal Api Mix            | 0.50              | 0.19              | 0.31     |
| Luwak White Koffie       | 0.44              | 0.11              | 0.44     |
| ABC Susu                 | 0.44              | 0.33              | 0.22     |

The following is a calculation of the probability of a future event using matrix multiplication to find the steady state value, i.e.

1) If in the first month consumers buy Kapal Api Mix Coffee products, then the probability calculation is as follows:

$$[Kk(6) \ Lk(6) \ Ak(6)] = \begin{bmatrix} 0.4706 & 0.2166 & 0.3128 \end{bmatrix} \times \begin{bmatrix} 0.50 & 0.19 & 0.31 \\ 0.44 & 0.11 & 0.44 \\ 0.44 & 0.33 & 0.22 \end{bmatrix} = \begin{bmatrix} 0.4706 & 0.2166 & 0.3128 \end{bmatrix} \rightarrow \text{Steady state}$$

Below this is the result of calculating probabilities from the first month:

i) $[1 \ 0 \ 0]$

ii) $[0.5000 \ 0.1875 \ 0.3125]$

iii) $[0.4722 \ 0.2188 \ 0.3090]$
iv) $[0.4707 \ 0.2159 \ 0.3135]$

v) $[0.4706 \ 0.2166 \ 0.3128]$

vi) $[0.4706 \ 0.2166 \ 0.3128] \rightarrow Steady \ state$

vii) $[0.4706 \ 0.2166 \ 0.3128]$

2) If in the first month of buying the product of Luwak White Koffie Coffee, then the probability calculation is as follows:

\[
[K^{(6)}_L \ L^{(6)}_L \ M^{(6)}_U] = [0.4706 \ 0.2179 \ 0.3115] \times \\
\begin{bmatrix}
0.50 & 0.19 & 0.31 \\
0.44 & 0.11 & 0.44 \\
0.44 & 0.33 & 0.22 \\
\end{bmatrix} \\
= [0.4706 \ 0.2166 \ 0.3128] \rightarrow Steady \ state
\]

Below this is the result of calculating probabilities from the first month:

i) $[0 \ 1 \ 0]$

ii) $[0.4444 \ 0.1111 \ 0.4444]$

iii) $[0.4691 \ 0.2438 \ 0.2870]$

iv) $[0.4705 \ 0.2107 \ 0.3188]$

v) $[0.4706 \ 0.2179 \ 0.3115]$

vi) $[0.4706 \ 0.2166 \ 0.3128] \rightarrow Steady \ state$

vii) $[0.4706 \ 0.2166 \ 0.3128]$

viii) $[0.4706 \ 0.2166 \ 0.3128]$

3) If in the first month of buying ABC Susu Coffee products, then the probability calculation is as follows:

\[
[K^{(6)}_A \ L^{(6)}_A \ A^{(6)}_A] = [0.4706 \ 0.2154 \ 0.3140] \times \\
\begin{bmatrix}
0.50 & 0.19 & 0.31 \\
0.44 & 0.11 & 0.44 \\
0.44 & 0.33 & 0.22 \\
\end{bmatrix} \\
= [0.4706 \ 0.2166 \ 0.3128] \rightarrow Steady \ state
\]

Below this is the result of calculating probabilities from the first month:

i) $[0 \ 0 \ 1]$

ii) $[0.4444 \ 0.3333 \ 0.2222]$

iii) $[0.4691 \ 0.1944 \ 0.3364]$

iv) $[0.4705 \ 0.2217 \ 0.3078]$

v) $[0.4706 \ 0.2154 \ 0.3140]$

vi) $[0.4706 \ 0.2166 \ 0.3128] \rightarrow Steady \ state$

vii) $[0.4706 \ 0.2166 \ 0.3128]$

viii) $[0.4706 \ 0.2166 \ 0.3128]$

Based on the results of probability calculations using matrix multiplication, obtained for consumers who in the first month bought Kapal Api Mix Coffee products, they will reach steady state conditions in the sixth month with a probability level for Kapal Api Mix Coffee products of 0.4706, moving to Luwak White Koffie Coffee products amounted to 0.2166 and moved to ABC Susu Coffee products by 0.3128. Whereas for consumers who purchased the first product of Luwak White Koffie Coffee in the first month, it will reach steady state conditions in the sixth month with a probability level for Luwak White Koffie Coffee of 0.2166, moving to Kapal Api Mix Coffee products of 0.4706.
and moving to products ABC Susu coffee is 0.23128. Then for consumers who bought ABC Susu in the first month of coffee, it will reach steady state conditions in the sixth month also with a probability level for ABC Susu Coffee products of 0.3128, moving to Kapal Api Mix Coffee products of 0.47061 and moving to Luwak White Koffie Coffee products is 0.2166. As we know that the steady state is one important goal from the Markov Theory [8], that information can give advantage to the shop owner to make prediction a coffee sales for the next periods.

4. Conclusion
The conclusions that can be obtained in this study that there are three brands of coffee that are most in demand by consumers, namely ABC coffee, Luwak White Koffie coffee and Kapal Api Mix coffee. From the results of the analysis carried out, steady state conditions from the sale of the three coffee brands were obtained when sales are already on the sixth month with a sales probability value for ABC Susu coffee, Luwak White Koffie coffee and Kapal Api Mix coffee, each of 31.28%, 21.66%, and 47.06%. If seen from the results of research that has been obtained, it can be concluded that the probability the sales of all three coffee brands are quite even and this can be taken into consideration for sellers to be able to provide the three coffee brands more than other brands so that it will increase the sales results of the three coffee brands.

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