Analysis of Brand Loyalty using Homogeneous Markov Model

Aparna Bairagi[1] Sarat Ch. Kakaty[2]

[1]Department of Statistics, ADP College, Nagaon, Assam
[2]Department of Statistics, Dibrugarh University, Dibrugarh, Assam

Abstract: *This paper is an attempt to explain the Brand Loyalty of consumers towards the different brands of beverages. The homogeneous Markov Model is used to explain the Brand Loyalty, and to find out the long-term probabilities of market share of these brands. The commonly used five brands of beverage like Horlicks, Bourn Vita, Viva, Boost and Complan have been brought under consideration while the other brands available have been grouped together as "Others". The data has been collected from 1010 households of Nagaon District. The long-term forecast shows that the brand Horlicks will dominate the future market share with 48.58%, the Bourn Vita will have the second highest market share with 19.86% and Complan will have 12.77%. The Boost, Viva and Others brands will have 8.17%, 3.92% and 6.70% market share respectively.*
Keywords: *Brand Loyalty, Homogeneous Markov Model, Transition Probability Matrix Long-Term Market Share.*

I. Introduction

The brand loyalty represents the consumer behaviour of buying a particular brand of product repeatedly over a specific period. Today, brand loyalty is considered as sensitive issues in the world of marketing, which provides the basis of stable and growing market share of companies. The survival of a firm largely depends on its loyal customers. Brand loyalty provides the encouragement to an organization to maintain some amount of standard of their products and aggressively search strategies to satisfy the existing customers as well as, try to attract new customers. It helps the organization in making large volumes of trade, boosting the level of competition in the business world. Brand loyal consumers are found to be less sensitive to the changes of price of the products and other competitive promotion, which reduces the cost of advertising and marketing.

Many approaches have been developed by different researchers to analyse the brand switching and brand loyalty behaviour of consumers. If it is possible to know the tendency of brand switching and brand loyalty position then using some models the future market share of competitive brand can be forecasted. An ideal model based on random variable, has been widely used in brand loyalty problem of market share forecasting is Markov Chain model. It is a stochastic model which studies the consumer loyalty, consumer choices and forecasts the percentages of market share of a particular brand in future. The prediction of consumer's purchase behaviour of a particular brand is done on the basis of present purchasing of the product.

The Markov Chain Model:
Markov Chain is a special type of stochastic model of random phenomenon which evolves with time in a probabilistic manner.
The stochastic process $\{X_n\}$, n=0, 1, 2... with discrete state space, **S** is a Markov Chain if it satisfies the Markov property.
That is for any $i, j, i_1, i_2 \ldots i_{n-1} \in$ **S**

$$P_r \{x_{n+1} = j \mid x_n = i, x_{n-1} = i_{n-1} \ldots, x_1 = i, x_0 = i_0\}$$
$$= P_r \{x_{n+1} = j \mid x_n = i\}$$

Let $p_{ij} = P_r \{X_{n+1} = j \mid X_n = i\}$, then it is the transition probability of moving from state i in n^{th} step, to the state j in $(n+1)^{th}$ step. These probabilities are one step transition probabilities of Markov Chain. If the one step transition probabilities are irrelevant of time n then the chain is time homogeneous or stationary Markov Chain. The transition probabilities represented in a matrix form known as transition probability matrix and written as

$$\mathbf{P} = [p_{ij}]_{n \times n} \quad, \quad 0 < p_{ij} < 1$$

All the possible states of the Markov Chain are used as rows and columns, so transition probability matrix is always a square matrix and the row sum is always one.
The probability

$$p_{ij}^{(k)} = Pr\{X_{n+k} = j \mid X_n = i\} \ \forall \ k > 0 \ n \geq 0, i \ j \in \mathbf{S}$$

is the k step transition probability of state i to state j in k steps. In the matrix form it is represented as

$$\mathbf{P}^{(k)} = [p_{ij}^{(k)}]_{i,j \in S} \quad \forall \, k > 0.$$

That is the k step transition matrix is the one step transition matrix raised to the power k and the $p_{ij}^{(k)}$ is the (i, j)th element of the matrix $\mathbf{P}^{(k)}$. If the chain is time homogeneous, then it is independent of n and

$$p_{ij}^{(k)} = Pr\{X_k = j \mid X_0 = i\} \quad \forall \, k > 0, \ i \, j \in \mathbf{S}$$

$$p_{ij}^{(1)} = p_{ij} \quad \text{and} \quad \mathbf{P}^{(1)} = [p_{ij}^{(1)}] = P \text{ and}$$

$$\mathbf{P}^{(k)} = \mathbf{P}^k \quad \text{for all k,}$$

The initial distribution of Markov chain is $\mathbf{V}^{(0)} = Pr\{X_0 = i\}$ which is the row vector of probabilities at time 0. The $\mathbf{V}^{(n)} = \mathbf{V}^{(n-1)} \mathbf{P} = \mathbf{V}^{(n-2)} \, \mathbf{P} . \mathbf{P} = \mathbf{V}^{(n-2)} \, \mathbf{P}^2$

The element of V are the element of unique solution $\mathbf{V} = \mathbf{VP}$ and $\sum_i^n v \, i = 1$ ----- (1)

A Markov Chain is to be an Ergodic chain if it is possible to go between any two states in any number of steps and it tends to an equilibrium situation if the number of steps tends to infinity. The probability vector $\mathbf{V} = (v_1, v_2 \ldots v_n)$ called the limiting probability vector which helps to forecast the long- term evolution of any phenomena.

II. Literature review

Over the last few decades, many studies have been made to study the consumer purchasing behaviours by using Markov model for durable and non-durable goods. Uslu and Cam (2014) studied the consumer Brand Loyalty of sport shoes with Markov chains method, and forecast the behaviour of consumer in a long period. George and Smith (1964) used Markov Chain to study the switching habits of consumer in purchasing of laundry powder and predicted the future purchasing behaviour. Whitaker (1978), Frank and Lipstein (1962) tried to apply the technique of Markov Chain to study the phenomena of brand switching and brand loyalty. Kuehn and Day (1964) used stochastic model to study the pattern of consumer behaviour and evaluating the effects of merchandising activities by studying recent purchase records of consumer.

By this work, it is tried to make an effort to analyse the behaviour of consumers in the line of above works of authors.

Objective of the study:
This paper attempts to study the-
1. Brand loyalty behaviour of consumers for different brands of beverages they use.
2. Steady state probabilities and to forecast the long-term market shares of these brands.

III. Research Methodology

To analyse the long-term probabilities and brand loyalty behaviour of consumers for beverages, using Markov Chain model, the required data have been collected randomly from 1010 households of Nagaon district belonging to different levels of the society, for the month of May, June and July in the year 2013. The five brands of beverages which are popular among the consumers have been brought for consideration and the other brands available in the market have been grouped together. The analysis of brand loyalty is a complex phenomenon, because it purely based on human behaviour. To interpret the brand loyalty by using Markov Chain model, the assumption is that the market is stable and the consumers do not buy two or more brand of products in the same period. The time intervals of buying products are assumed to be same though it is not always true.

IV. Results and Analysis

The brands of beverages, which represent different states of Markov chain, are S_1: Horlicks, S_2: Bourn Vita, S_3: Viva, S_4: Boost, S_5: Complan, and S_6: Others. The survey shows that the number of consumers who used different brand of beverages in the month of May is as follows - 571 consumers used Horlicks, 176 used Bourn Vita, 41 used Viva, 72 used Boost, 85 used Complan and 65 consumers used other brands. The brand Horlicks has its 473 existing consumer in the month of May and it gains 54 consumers from the brand Bournvita, 14 consumers each from brand Viva and Boost, 23 from Complan and 9 from others brand in the month June. Thus, 114 consumers switch from other brand to Horlicks in their next buy. The brand Horlicks loses 47 consumers, which prefer brand Bourn Vita, 9 consumers prefer Viva, 6 consumers Boost, 24 consumers Complan and 11 consumers prefer other brands in the next month. The beverage Horlicks loses 97 consumers in the next month, which represent the switching consumers from Horlicks to the other brand in the month of June. The following transition probability matrices, calculated for the month of May- June and Jun-July.

P1 =		Transition	Probability	Matrix	May- June 2013		
		S_1	S_2	S_3	S_4	S_5	S_6
	S_1	0.8301	0.0823	0.0158	0.0105	0.0420	0.0193
	S_2	0.3068	0.5398	0.0341	0.0682	0.0511	0.0000
	S_3	0.3416	0.1463	0.1463	0.1463	0.1463	0.0732
	S_4	0.1944	0.1250	0.0695	0.4583	0.1389	0.0139
	S_5	0.2706	0.1059	0.0471	0.0471	0.4705	0.0588
	S_6	0.1385	0.0000	0.0154	0.0000	0.0154	0.8307
Market share		0.5822	0.1644	0.0307	0.0604	0.0891	0.0733

P2 =			Transition	Probability	Matrix	June –July 2013	
		S_1	S_2	S_3	S_4	S_5	S_6
	S_1	0.6735	0.1344	0.0340	0.0408	0.0935	0.0238
	S_2	0.2410	0.4699	0.0542	0.0843	0.1386	0.0120
	S_3	0.1290	0.4194	0.1936	0.1290	0.1290	0.0000
	S_4	0.1148	0.2131	0.0328	0.4918	0.1475	0.0000
	S_5	0.2667	0.1778	0.0555	0.1000	0.4000	0.0000
	S_6	0.1622	0.0811	0.0135	0.0135	0.0811	0.6486
Market share		0.4782	0.2030	0.0426	0.0812	0.1316	0.0634

The diagonal elements of transition probability matrix P1 show the probabilities of loyal consumer of respective brands and have very high values compared to non-diagonal elements. This indicates that they did not like to change their brand in the next buy i.e. they are the repeat buyers of the brand. The rows represent the switching probabilities from existing brand to another and columns represent the switching probabilities to any brand from other brands. The rows represent the loss and the columns represent the gain for the respective brands. For instance the probability value 0.8301 (83.01%) signifies the brand loyalty of Horlicks, that means the probability of purchase the brand again in the next month. The probability 0.0823(8.23%) indicate the switching probability from Horlicks to Bourn Vita, 0.0158(1.58%) is the switching probability to Viva, 0.0105(1.05%) is the switching probability to Boost, 0.042(4.2%) is the switching probability to Complan and 0.193(1.93%) switch to other brand from Horlicks in the month of June. These are the losses for the brand. However, if it considered column wise, the probability 0.3068(30.68%) represents the switching probability from Bournvita to Horlicks, implies the probability of gain for the brand Horlicks and loss for Bournvita in the next purchase. The similar interpretation for other probabilities of the transition matrix holds good accordingly.

In this paper, the homogeneous Markov model is considered, where it is assumed that the process is independent of time. Thus, the transition probabilities are constant over the time; therefore, the average of two matrices P1 and P2 calculated to estimate the final transition probabilities. For example

$P_{11}= (0.8311+ 0.6735)/2 = 0.7517$

Transition probability matrix average

	S1	S2	S3	S4	S5	S6
S1	0.7517	0.1083	0.0249	0.0257	0.0678	0.0216
S2	0.2738	0.5048	0.0442	0.0763	0.0949	0.0060
S3	0.2352	0.2828	0.1700	0.1377	0.1377	0.0366
S4	0.1545	0.1691	0.0512	0.4751	0.1431	0.0070
S5	0.2687	0.1419	0.0512	0.0735	0.4353	0.0294
S6	0.1503	0.0406	0.0145	0.0068	0.0483	0.7395

The initial distribution for the market share of different brands are calculated as
V = [0.4782 0.2030 0.0426 0.0812 0.1316 0.0634]

The market shares forecasting for the next month i.e. for the month of August are calculated using the initial distribution and the transition probability matrix P. Thus

V(1)= VP = [0.48249 0.20127 0.03994 0.08232 .129522 0.0634]

This implies that the market share of Horlicks, Bourn Vita, Viva, Boost, Complan, and Others in the month of August will be 48.25%, 20.13%, 3.99%, 8.12%, 12.95% and 6.44% respectively. Similarly, the market shares for different months are calculated and shown in the Table 1.

Table1: Forecast of market share, by Homogeneous Markov Model.

Sl.No	Month	Horlicks	Bournvita	Viva	Boost	Complan	Others
1	July	0.4782	0.2030	0.0426	0.0812	0.1316	0.0634
2	August	0.48249	0.20127	0.03994	0.08232	0.12952	0.06443
3	September	0.48439	0.20007	0.03948	0.08233	0.12858	0.06512

4	October	0.48524	0.19943	0.03936	0.08216	0.12816	0.06562
5	November	0.48561	0.19910	0.03931	0.08201	0.12796	0.06599
6	December	0.48576	0.19892	0.03928	0.08190	0.12785	0.06626
7	January	0.48582	0.19881	0.03927	0.08183	0.12780	0.06645
8	February	0.48583	0.19875	0.03926	0.08178	0.12776	0.06660
9	March	0.48582	0.19871	0.03925	0.08175	0.12774	0.06670
10	April	0.48581	0.19868	0.03925	0.08174	0.12773	0.06677
11	May	0.48580	0.19866	0.03924	0.08172	0.12772	0.06683
12	June	0.48578	0.19865	0.03924	0.08171	0.12771	0.06687
13	July	0.48578	0.19864	0.03924	0.08171	0.12771	0.06690
14	August	0.48577	0.19864	0.03924	0.08171	0.12770	0.06692
15	September	0.48576	0.19863	0.03924	0.08170	0.12770	0.06693
16	October	0.48576	0.19863	0.03924	0.08170	0.12770	0.06694
17	November	0.48576	0.19863	0.03924	0.08170	0.12770	0.06695
18	December	0.48575	0.19862	0.03924	0.08170	0.12770	0.06696
19	January	0.48575	0.19862	0.03924	0.08170	0.12770	0.06696
20	February	0.48575	0.19862	0.03924	0.08170	0.12770	0.06696

The table shows that, after 19 Months all the brand of beverages attain the state of equilibrium with Horlicks having the highest market share of 48.58% . Bourn Vita has second highest market share with 19.86% and Complan has 12.77%. The Boost, Viva and Others brand have 8.17%, 3.92% and 6.70% market share respectively. The Horlicks is the most popular brand dominating about half of the market share and Viva is the least preferred brand among the five.

V.   Conclusion

There is a wide range of applications of Markov Chain Model in the study of Brand Loyalty and forecasting the long-term market shares. It is assumed that for the stable market, the transition probabilities for different brand of beverages are constant over time. The homogeneous Markov Model is used to analyse the behaviour of consumers and long-term prediction of shares. From analysis, it is found that the Horlicks is the most preferred brand of beverage, having the highest probability of consumer loyalty. After nineteen months, the market share of beverages will attain the state of equilibrium. Horlicks has highest future market share of 48.58%, Bourn Vita has 19.86%, and Complan has 12.77%. The Boost, Viva and Others brand have 8.17%, 3.92% and 6.70% future market share respectively. This type of analysis may help the marketing managers to compare their products in a particular period and make the proper strategies for improvement of their products.

However, by using the Markov Model, the future market share of beverages can be forecasted but it is not possible to find out the actual number of customers who used any one of the brands. Therefore, it is not possible to tell if the overall market and the actual consumer numbers of each brand of beverage are growing or not.

References

[1]. Chan, Ka and Ching, (2015). "Market Share Modelling and Forecasting using Markov Chain Model and others". International Journal of Innovative Computing Information and Control, Vol. 11 Number 4, August 2015. ICIC International 2015 ISSN 1349-4198.
[2]. Colombo, A. R. and Morrison, D.G. (1989), "A Brand Switching Model with Implications for Marketing Strategies", Marketing Science Vol.8 No.1 winter. URL: http://www.jstore.org/stable/184107.
[3]. Whitaker, D.(1978), " The Derivation of a Measure of Brand Loyalty Using a Markov Brand Switching Model". The Journal of the Operational Research Society, Vol.29, and No.10 (Oct 1978, URL: http://www.jstore.org/stable/3009470.
[4]. Kuehn A.A. and Day L.R.(1964), "Probabilistic Models of consumer Buying Behaviour", Journal of Marketing, Vol.28 (October 1964),pp.27-31.
[5]. Harry, F. and Benjamin, L (1962), "The Dynamics of Brand Loyalty A Markovian Approach" Operation Research, Vol. 10, No 1 (Jan.-Feb., 1962), pp. 19-40. URL: http//:www.jstor.org/stable/167867.