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Application of Markov Chain in Forecasting: A Study of Customers' Brand Loyalty for Mobile Phones

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Abstract:

Markov chains methods are principally used for Brand Loyalty studies in marketing problems. Markov chains method comes out as the primary and most powerful technique in predicting the market share a product will achieve in the long term especially in an oligopolistic environment and in finding out the brand loyalty for a product. The concepts of marketing studies are thought as discrete from the time and place viewpoint and so finite Markov chains are applicable for this kind of process.

The purpose of this study is to examine customers' Brand Loyalty for Mobile Phones with Markov chains method. This paper borrows transition matrix as a forecasting instrument for determining the market environment in the future, and sets out to unveil the potential of Markov chains in sequencing students' brand choice and in determining intensive transitional probabilities for mobile phones. In this study, the data to examine the Brand Loyalty have been obtained from randomly selected 1000 undergraduate students in Moshood Abiola Polytechnic, Nigeria vis-à-vis stratified sampling and simple random sampling technique. The data generated were cast into a Markov matrix to permit meaningful observation of the students' behaviour toward twenty (20) brands of mobile phones. Electronic

Analysis of the collected data was employed using SPSS 21.0 and R 3.2.2.

Key words: Brand loyalty, Markov chains, Mobile phones, Stochastic process.

Introduction

Markov chains were named after their inventor, A. A. Markov, a Russian Mathematician who worked in the early 1900's. A Markov chain method is a mathematical model of a random phenomenon evolving with time in a way that the past affects the future only through the present. The "time" can be discrete (i.e. the integers), continuous (i.e. the real numbers), or, more generally, a totally ordered set. Markov Chains Method is used intensively for research conducted on such social topics as the brand selection of customers, income distribution, immigration as a geographic structure, and the occupational mobility (for examples and references please see Frydman 1984; Geweke, Marshall and Zarkin 1986; Simper and Spilerman 1976). In marketing, Markov Chains Model is frequently used for topics such as "brand loyalty" and "brand switching dynamics". Although it is very complicated to transform marketing problems in to mathematical equations, Markov Chains Method comes out as the primary and most powerful technique in predicting the market share a product will achieve in the long term especially in an oligopolistic environment and in finding out the brand loyalty for a product.

Statement of the Problem

Customer loyalty has been a major focus of strategic marketing planning and offers an important basis for developing a sustainable competitive advantage – an advantage that can be realized through marketing efforts (Dick and Basu 1994). In order for managers to cope with the forces of disloyalty among customers, there is a need to have an accurate method to measure and predict brand loyalty. The statement of the problem therefore seeks to determine students brand loyalty for mobile phones and whether the brand preferences are intensified.

Purpose of the Study

The purpose of this study is to examine customers' brand loyalty for mobile phones using the Markov Chains Method.
Precisely, this research set to do the following:

1. Determine the switching between brands (brand loyalty) in a long period of time.
2. Determine the most important and significance of the determinants of existing brand preference on brand choices.
3. Determine the most important and significance of the determinants of next brand purchase preference on brand choices.
4. Determine whether customers' existing brand preference is independent of their next purchase brand preference.

Scope of the Study

This research work is a case study and it covers students' brand loyalty for mobile phones, limited to randomly selected 1000 students of Moshood Abiola Polytechnic, Abeokuta, Nigeria.

Literature Review

Stochastic process

A *stochastic process* is a mathematical model that evolves over time in a probabilistic manner. A special kind of stochastic process is a *Markov chain*, where the outcome of an experiment depends only on the outcome of the previous experiment. In other words, the next state of the system depends only on the present state, not on preceding states (Aypar Uslu and Tuncay Cam, 2001).

The stochastic process is defined as a set of random variables $\{X_t\}$ where the unit time parameter $\boldsymbol{t}$ is taken from a given set T. All the special values the random variables take on are named as a state. Therefore, a state variable name is given to the X_t random variable. The set that accepts each X_t random variable is called an "example space" or a "state space". If the S state space includes whole number or simply discontinuous values then it is called a stochastic process that is separate stated and these separate stated spaces may be countable and finite or countable and infinite. If X_t is defined in the $t \in (-\infty, \infty)$ interval it is classified as a stochastic process that is real valued (Aypar Uslu and Tuncay Cam, 2001).

The Markov Chain Method

Markov chain uses a matrix and a vector (column matrix) to model and predict the behavior of a system that moves from one state to another state between a finite or countable number of possible states in a way that depends only on the current state.

Markov Chains model a situation, where there are a certain number of states (which will unimaginatively be called 1, 2, . . . , n), and whether the state changes from state i to state j is a constant probability. In particular, it does not matter what happened, for the state to be in state i in the first place.

Being a special type of stochastic process, the Markov chain:

$$P(X_{t+1} = x_t \backslash X_0 = x_0, X_1 = x_1, \dots, X_t = x_t) = P(X_{t+1} = x_{t+1} \backslash X_t = x_t); \quad \_\_\_\_(i)$$

$(t = 0, 1, \dots)$

is a chain that has Markovian property and the Markovian property stresses that given the present (or preceding) state, the conditional probability of the next state is independent of the preceding states. $P(X_{t+1} = x_{t+1} \backslash X_t = x_t)$ are conditional probabilities and are named as transitional probabilities (Aypar Uslu and Tuncay Cam, 2001).

If the relationship

$$P(X_{t+1} = x_{t+1} \backslash X_t = x_t) = P(X_1 = x_{t+1} \backslash X_0 = x_t); \quad (t = 0, 1, \ldots) \qquad \text{\_\_\_\_(ii)}$$

exists the one step transitional probabilities are usually denoted as P_{ij} and named as stationary and the transitional probabilities that have this property do not change in time and the relationship

$$P(X_{t+1} = x_{t+1} \backslash X_t = x_t) = P(X_n = x_{t+1} \backslash X_0 = x_t); \quad t = 0, 1, 2, \ldots; \; n = 0, 1, 2 \ldots \qquad \text{\_\_\_\_(iii)}$$

becomes valid. These conditional probabilities are named as n-step transitional probabilities and are denoted as $P_{ij}^{(n)}$. The conditional probability $P_{ij}^{(n)}$ explains that the process that is in the i state, will be in the j state n steps later (Aypar Uslu and Tuncay Cam, 2001).

In general, the state that the situation is in will only be known probabilistically; thus, there is a probability of p_1 that it is in state 1, a probability of p_2 that it is in state 2, etc. A row vector v with n entries represents the probabilistic knowledge of the state if each entry is non-negative, and the sum of the entries in v is 1; in that case, v is called a *probability vector*.

The change in state from one point in time to another point in time is determined by an $n \times n$ transition matrix P_{ij}, so that

$$P_{ij} = \begin{pmatrix} P_{00} & P_{01} & P_{02} & \cdots \\ P_{10} & P_{11} & P_{12} & \cdots \\ \vdots & \vdots & \vdots & \vdots \\ P_{i0} & P_{i1} & P_{i2} & \cdots \\ \vdots & \vdots & \vdots & \vdots \end{pmatrix} \qquad \text{\_\_\_\_(iv)}$$

which has the properties that:

(a) $P_{ij} \geq 0$ for all i, j
(b) $P_{i1} + P_{i2} + \cdots + P_{in} = 1$, for all i.

The entry P_{ij} represents the probability of changing from state i to state j.

Suppose a Markov chain has initial *probability vector*

$$v = [p_1 \ \ p_2 \ \ p_3 \cdots p_n] \qquad \text{\_\_\_\_(v)}$$

and transition matrix P_{ij}. The *probability vector* after n repetitions of the experiment is

$$v \cdot {P_{ij}}^n \qquad \text{\_\_\_\_(vi)}$$

Every issue to resolve by a Markov process should be having the following three characteristics:

1. Transition probabilities are dependent on only the current state of the system.
2. Transition probabilities are always fixed.
3. Sum of transition probabilities move to other states in the next time period should be equal one.

The long-term behavior (Equilibrium vector) of the Markov Chain

If a Markov chain with transition matrix P_{ij} is regular, then there is a unique vector V such that, for any probability vector v and for large values of n,

$v \cdot {P_{ij}}^{n} \approx V$ ____(vii)

Vector V is called the equilibrium vector or the fixed vector of the Markov chain.

From (vii),

$v \cdot {P_{ij}}^{n} \cdot P_{ij} \approx V \cdot P_{ij}$ ____(viii)

So that
$v \cdot {P_{ij}}^{n} \cdot P_{ij} = v \cdot {P_{ij}}^{n+1} \approx V \cdot P_{ij}$ ____(ix)

Since $v \cdot {P_{ij}}^{n} \approx V$ for large values of n, it is also true that $v \cdot {P_{ij}}^{n+1} \approx V$ for large values of n (the product $v \cdot {P_{ij}}^{n}$ approaches V, so that $v \cdot {P_{ij}}^{n+1}$ must also approaches V). Thus, $v \cdot {P_{ij}}^{n} \approx V$ and $v \cdot {P_{ij}}^{n+1} \approx V \cdot P_{ij}$, which suggest that

$VP = V$ ____(x)

The vector V gives the long-range trend of the Markov chain.

Methodology

The purpose of this study is to examine the brand loyalty of customers for mobile phones using the Markov Chains Method. For this study data has been collected for brand loyalty from 1000 undergraduate students in Moshood Abiola Polytechnic, Nigeria. In order to analyze brand loyalty using Markov Chain Method, twenty (20) mobile phones brands having the highest market share have been selected and a survey containing appropriate questions has been conducted to 1000 undergraduate students in Moshood Abiola Polytechnic, Nigeria. Four of the questions in the survey are demographic questions, defining sex, age, marital status and monthly income of the students. The next two questions are about the 20 brands that form the foundations of the Markov Matrix where students were asked the present brand of mobile phones they own and the brand preferences they have for their next mobile phones purchase (among the 20 brands selected). The rest of the questions are about the marketing variables that form the basis of the customers' behavior when making a brand selection. These questions that shape the behavior of customers' were designed in the 5 point Likert Scale format (1 = strongly disagree, 5 = strongly agree). Two statistical packages (SPSS 21.0 and R 3.2.2) were employed in the analysis of the collected data.

Data Analysis & Results

Since there are 21 states in this study, the state space is in the form,

S = {Nokia, Samsumg, Blackberry, Tecno, Infinix, HTC, Sony, Huawei, Gionee, LG, Microsoft, Panasonic, Sharp, Wiko, ZTE, Apple, Injoo, Motorola, Lenovo, Xiaomi, Other}

Table 1 shows Brand Insistence and Switching Rates.

As a result of the survey conducted on students, the data collected about the relationship between their existing and next brand purchase brand preferences were transformed into a Markov *Transition Matrix* (P_{ij}) which is shown in Table 2. The transition matrix, P_{ij}, shows the probability of change in brand preference from one phone to the other.

Table 3 shows the *Probability Vector* (v) of the phone brands.

Table 4 shows the computation of steady state Probabilities of the product brands for 11 steps ahead.

Table 5 shows the significance of the determinants of existing brand preference on brand choices.

Table 6 shows the significance of the determinants of next brand purchase preference on brand choices.

Table 7 shows the Chi-square Tests of independence between customers' existing brand preferences and customers' next brand purchase preference.

Table 8 shows the demographic variables.

Table 1: Brand Insistence and Switching Rates

	Nokia	Samsung	Blackberry	Tecno	Infinix	HTC	Sony	Huawei	Gionee	LG	Microsoft	Panasonic	Sharp	Wiko	ZTE	Apple	Injoo	Motorola	Lenovo	Xiaomi	Other	Total
Nokia	40	39	52	36	28	14	4	1	5	2	1	0	3	0	1	23	2	0	0	1	4	256
Samsung	27	17	28	11	11	6	1	1	0	3	3	2	0	0	0	15	1	0	1	0	1	128
Blackberry	15	20	55	2	39	8	0	0	2	6	12	1	0	0	0	29	4	0	4	0	0	197
Tecno	14	19	13	14	42	6	4	1	0	2	9	0	2	0	1	23	1	0	0	0	0	151
Infinix	17	2	17	2	30	2	3	2	0	0	5	0	0	0	0	15	0	0	0	0	1	96
HTC	1	2	3	3	2	1	1	1	1	0	3	0	0	0	1	1	1	0	0	0	0	21
Sony	1	1	2	1	4	1	7	0	1	1	0	1	0	0	0	5	1	0	0	0	0	26
Huawei	0	0	3	0	3	5	0	2	0	0	0	0	0	0	0	0	0	0	0	1	0	14
Gionee	1	1	0	3	1	2	0	0	0	2	1	0	0	1	0	1	0	0	0	0	0	13
LG	2	1	1	1	3	5	1	1	0	1	0	0	0	0	1	1	1	0	0	0	0	19
Microsoft	0	3	0	0	1	0	0	0	0	1	3	0	0	0	0	2	1	0	0	0	1	12
Panasonic	0	0	0	0	0	0	1	0	0	0	0	0	1	0	0	0	0	0	0	0	0	2
Sharp	0	1	0	0	0	0	2	0	0	0	0	1	0	0	0	0	0	0	0	0	0	4
Wiko	0	1	0	0	1	0	0	0	0	0	0	0	0	0	0	4	0	0	1	1	0	8
ZTE	2	1	0	0	2	1	0	2	0	0	0	0	0	1	0	0	0	0	0	0	0	9
Apple	0	4	4	2	2	0	0	0	0	0	1	0	0	0	0	5	0	0	0	0	1	19
Injoo	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	1	2
Motorola	0	0	0	1	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	5
Lenovo	2	0	1	4	1	0	0	0	1	1	0	0	0	0	0	0	0	0	0	0	0	10
Xiaomi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other	3	0	0	1	1	2	0	0	0	0	0	0	0	0	0	1	0	0	0	0	0	8
Total	125	112	180	81	175	53	24	11	10	19	38	5	6	2	4	125	12	0	6	3	9	1000

Source: From Field Survey (2015)

Table 2: Transition Matrix (P_{ij})

	Nokia	Samsung	Blackberry	Tecno	Infinix	HTC	Sony	Huawei	Gionee	LG	Microsoft	Panasonic	Sharp	Wiko	ZTE	Apple	Injoo	Motorola	Lenovo	Xiaomi	Other
Nokia	0.156	0.152	0.203	0.141	0.109	0.055	0.016	0.004	0.020	0.008	0.004	0	0.012	0	0.004	0.090	0.008	0	0	0.004	0.016
Samsung	0.211	0.133	0.219	0.086	0.086	0.047	0.008	0.008	0	0.023	0.023	0.016	0	0	0	0.117	0.008	0	0.008	0	0.008
Blackberry	0.076	0.102	0.279	0.010	0.198	0.041	0	0	0.010	0.030	0.061	0.005	0	0	0	0.147	0.020	0	0.020	0	0
Tecno	0.093	0.126	0.086	0.093	0.278	0.040	0.026	0.007	0	0.013	0.060	0	0.013	0	0.007	0.152	0.007	0	0	0	0
Infinix	0.177	0.021	0.177	0.021	0.313	0.021	0.031	0.021	0	0	0.052	0	0	0	0	0.156	0	0	0	0	0.010
HTC	0.048	0.095	0.143	0.143	0.095	0.048	0.048	0.048	0.048	0	0.143	0	0	0	0.048	0.048	0.048	0	0	0	0
Sony	0.038	0.038	0.077	0.038	0.154	0.038	0.269	0	0.038	0.038	0	0.038	0	0	0	0.192	0.038	0	0	0	0
Huawei	0	0	0.214	0	0.214	0.357	0	0.143	0	0	0	0	0	0	0	0	0	0	0	0.071	0
Gionee	0.077	0.077	0	0.231	0.077	0.154	0	0	0	0.154	0.77	0	0	0.077	0	0.077	0	0	0	0	0
LG	0.105	0.053	0.053	0.053	0.158	0.263	0.053	0.053	0	0.053	0	0	0	0	0.053	0.053	0.053	0	0	0	0
Microsoft	0	0.250	0	0	0.083	0	0	0	0	0.083	0.250	0	0	0	0	0.167	0.083	0	0	0	0.083
Panasonic	0	0	0	0	0	0	0.500	0	0	0	0	0.250	0	0	0	0	0	0	0	0	0
Sharp	0	0.250	0	0	0	0	0.500	0	0	0	0	0.250	0	0	0	0	0	0	0	0	0
Wiko	0	0.125	0	0	0.125	0	0	0	0	0	0	0	0	0	0	0.500	0	0	0.125	0.125	0
ZTE	0.222	0.111	0	0	0.222	0.111	0	0.222	0	0	0	0	0	0.111	0	0	0	0	0	0	0
Apple	0	0.211	0.211	0.105	0.105	0	0	0	0	0	0.053	0	0	0	0	0.263	0	0	0	0	0.053
Injoo	0	0	0.500	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0.500
Motorola	0	0	0	0.200	0.800	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Lenovo	0.200	0	0.100	0.400	0.100	0	0	0	0.100	0.100	0	0	0	0	0	0	0	0	0	0	0
Xiaomi	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Other	0.375	0	0	0.125	0.125	0.250	0	0	0	0	0	0	0	0	0	0.125	0	0	0	0	0

Source: From Field Survey (2015)

Table 3: Probability Vector (*v*)

Brands	Probability
Nokia	0.256
Samsumg	0.128
Blackberry	0.197
Tecno	0.151
Infinix	0.096
HTC	0.021
Sony	0.026
Huawei	0.014
Gionee	0.013
LG	0.019
Microsoft	0.012
Panasonic	0.002
Sharp	0.004
Wiko	0.008
ZTE	0.009
Apple	0.019
Injoo	0.002
Motorola	0.005
Lenovo	0.010
Xiaomi	0.000
Other	0.008

Source: From Field Survey (2015)

Table 4: Computation of Steady State Probabilities {Equilibrium/Balanced Vector} of the Product Brands (11 STEPS AHEAD FORECAST)

After Purchase *n*	Nokia	Samsumg	Blackberry	Tecno	Infinix	HTC	Sony	Huawei	Gionee	LG	Microsoft	Panasonic	Sharp	Wiko	ZTE	Apple	Injoo	Motorola	Lenovo	Xiaomi	Other
0	0.256	0.128	0.197	0.151	0.096	0.021	0.026	0.014	0.013	0.019	0.012	0.002	0.004	0.008	0.009	0.019	0.002	0.005	0.010	0.000	0.008
1	0.125	0.112	0.180	0.081	0.175	0.053	0.024	0.011	0.010	0.019	0.047	0.006	0.005	0.002	0.004	0.125	0.012	0	0.006	0.003	0.009
2	0.107	0.114	0.184	0.069	0.171	0.043	0.026	0.012	0.008	0.018	0.062	0.006	0.003	0.001	0.005	0.142	0.014	0	0.005	0.002	0.021
3	0.107	0.116	0.183	0.066	0.169	0.044	0.024	0.011	0.008	0.019	0.063	0.006	0.002	0.001	0.004	0.147	0.015	0	0.005	0.001	0.024
4	0.108	0.117	0.184	0.067	0.168	0.045	0.023	0.011	0.007	0.019	0.063	0.006	0.002	0.001	0.004	0.148	0.015	0	0.005	0.001	0.025
5	0.108	0.117	0.185	0.067	0.168	0.045	0.023	0.011	0.007	0.019	0.063	0.006	0.002	0.001	0.004	0.148	0.015	0	0.005	0.001	0.025
6	0.109	0.118	0.186	0.068	0.169	0.045	0.023	0.011	0.008	0.019	0.063	0.006	0.002	0.001	0.004	0.148	0.015	0	0.005	0.001	0.025
7	0.109	0.118	0.186	0.068	0.169	0.045	0.023	0.011	0.008	0.019	0.063	0.006	0.002	0.001	0.004	0.149	0.015	0	0.005	0.001	0.025
8	0.109	0.118	0.187	0.068	0.170	0.045	0.023	0.011	0.008	0.019	0.063	0.006	0.002	0.001	0.004	0.149	0.015	0	0.005	0.001	0.025
9	0.109	0.119	0.187	0.068	0.170	0.045	0.023	0.011	0.008	0.019	0.063	0.006	0.002	0.001	0.004	0.150	0.015	0	0.005	0.001	0.025
10	0.110	0.119	0.188	0.068	0.171	0.045	0.023	0.011	0.008	0.019	0.064	0.006	0.002	0.001	0.004	0.150	0.015	0	0.005	0.001	0.025
11	0.110	0.119	0.188	0.068	0.171	0.046	0.023	0.011	0.008	0.019	0.064	0.006	0.002	0.001	0.004	0.150	0.015	0	0.005	0.001	0.025

Table 5: Significance of the determinants of existing brand preference on brand choices.

	t-value	*Sig.value*	**Significance**
Quality of the product	-0.021	0.099	Not significant
Brand image	1.129	0.983	Not significant
Market share of the brand	-1.803	0.262	Not significant
Advertising of the brand	1.491	0.075	Not significant
Satisfaction after buying process	-1.502	0.139	Not significant
Accessibility of the brand	0.856	0.137	Not significant
Sales price of the brand	-2.030	0.394	Not significant
Marketing of the product in different varieties	-0.024	0.045	Significant
Availability of the brand in other mobile phone articles	0.439	0.981	Not significant
Other	1.267	0.662	Not significant

$\alpha = 0.05$

Table 6: Significance of the determinants of next brand purchase preference on brand choices.

	t-value	*Sig.value*	**Significance**
New introduction of the brand in to the market	1.813	0.072	Not significant
Desire to try the new brand	0.142	0.887	Not significant
Discount sales of the brand	-1.517	0.131	Not significant
Promotions of the brand	1.871	0.063	Not significant
Renewing the image of the brand	0.527	0.599	Not significant
Advertising of the brand	-1.610	0.110	Not significant
Sales campaigns of the brand	-0.002	0.998	Not significant
Other	0.381	0.704	Not significant

$\alpha = 0.05$

Table 7: Chi-square test of independence (α = 0.05)

Chi-Square Tests

	Value	df	Asymp. Sig. (2-sided)
Pearson Chi-Square	1004.523[a]	361	.000
Likelihood Ratio	553.092	361	.000
Linear-by-Linear Association	12.279	1	.000
N of Valid Cases	1000		

a. 361 cells (90.3%) have expected count less than 5.
The minimum expected count is .00.

Table 8: Demographic variables

Sex

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Female	599	59.9	59.9	59.9
	Male	401	40.1	40.1	100.0
	Total	1000	100.0	100.0	

Age

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	15-20	382	38.2	38.2	38.2
	21-30	562	56.2	56.2	94.4
	31-40	45	4.5	4.5	98.9
	41-50	9	.9	.9	99.8
	51-60	2	.2	.2	100.0
	Total	1000	100.0	100.0	

Marital Status

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Single	856	85.6	85.6	85.6
	Married	124	12.4	12.4	98.0
	Divorce	20	2.0	2.0	100.0
	Total	1000	100.0	100.0	

Monthly Income

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Less than 5000	259	25.9	26.0	26.0
	5000-10000	356	35.6	35.7	61.6
	10001-15000	161	16.1	16.1	77.8
	15001-20000	72	7.2	7.2	85.0
	20001-25000	56	5.6	5.6	90.6
	Above 25000	94	9.4	9.4	100.0
	Total	998	99.8	100.0	
Missing	System	2	.2		
Total		1000	100.0		

Discussion of Results

From Table 1, 40(15.6%) of the respondents were of the opinion that they would not use any other mobile phone apart from Nokia phones. 17(13.3%) of the buyers believed that they would only use Samsung phones. Those that insisted that they would use Blackberry phones were 55(27.9%). 14(9.3%) of the respondents were of the opinion that they would not use any other mobile phone apart from Tecno phones. 30(31.3%) of the buyers believed that they would only use Infinix phones. Only 1(4.8%) mobile phone customer insisted he/she would use HTC phones. Those that insisted that they would use Sony phones were 7(26.9%). Of the respondents, 2(14.3%) believed that they would only use Huwaei phones. Only 1(5.3 %) mobile phone customer insisted he/she would use LG phones. Those that insisted that they would use Microsoft phones were 3(25.0%) and those that were of the opinion that they would not use any other mobile phone apart from Apple phones were 5(26.3%).

The total demands for Nokia, Samsumg, Blackberry, Tecno, Infinix, HTC, Sony, Huawei, Gionee, LG, Microsoft, Panasonic, Sharp, Wiko, ZTE, Apple, Injoo, Motorola, Lenovo, Xiaomi, Other are 256, 128, 197, 151, 96, 21, 26, 14, 13, 19, 12, 2, 4, 8, 9, 19, 2, 5, 10, 0 and 8 respectively. However, if customers of mobile phones keep to their switch brand decisions, then the future demand for Nokia would be 125 as against 256; 112 as against 128 for Samsumg; 180 as against 197 for Blackberry; 81 as against 151 for Tecno; 175 as against 96 for Infinix; 53 as against 21 for HTC; 24 as against 26 for Sony; 11 as against 14 for Huawei; 10 as against 13 for Gionee; still 19 for LG; 38 as against 12 for Microsoft; 5 as against 2 for Panasonic; 6 as against 4 for Sharp; 2 as against 8 for Wiko; 4 as against 9 for ZTE; 125 as against 19 for Apple; 12 as against 2 for Injoo; 0 as against 5 for Motorola; 6 as against 10 for Lenovo; 3 as against 0 for Xiaomi and 9 as against 8 for Other. This shows that while the number of customers for Infinix, HTC, Microsoft, Panasonic, Sharp, Apple, Xioami would increase, the number of customers for Nokia, Samsung, Blackberry, Tecno, Sony, Huawei, Gionee Wiko, ZTE, Injoo, Motorola, Lenovo would decrease.

The transition matrix table shows the probability of change in brand preference from one phone to the other.

From Table 4, the balanced vector was analyzed using R 3.2.2 and sequel to the examination of Table 4, and interpretation of the brand preferences, we discovered that with the value of 0.188, Blackberry seemed to be the preferred brand compared to others in the long run. The implication of this is that customers showed the most brand loyalty towards Blackberry followed by Infinix with a value of 0.171, Apple with a value of 0.150, followed by Samsung, Nokia, Tecno, Microsoft, HTC, Other, Sony, LG, Injoo, Huawei, Gionee, Panasonic, Lenovo, ZTE, Sharp, Wiko, Xiaomi and Motorola.

The variables that determine the existing brand preferences are given in Table 5. As can be seen from Table 5, when making a brand preference, "Advertising of the brand" is the determinant that is most important. However, this does not exert significance influence on customers' existing brand preference.

The preference of the second brand that is thought of being used (bought) is most importantly determined by "promotions of the brand". This also does not exert significance influence on customers' next brand purchase preference.

The Chi-square test from Table 7 revealed that customers' existing brand preferences and customers' next brand purchase preference are dependent.

The demographic variables of the students that has joined the survey is given in Table 8.

Conclusion and Recommendation

We have used Markov chain (transition matrix) as a forecasting tool that could be used to determine market environment in the future. This would in no small way assist marketing managers to compare the intensiveness gained in a particular period of time with product life cycle and also allow them to measure the effect of structural changes such as promotions and price cuts. It is evident that when consumers cannot derive satisfaction from a product, they switch to other brands. This makes a product to lose market to others which eventually reduces the profit level of the product that loses market to others. For the level of switching and market share to be minimized, producers of products must be consumer oriented in totality and maintain quality of their products. Marketing managers should not also allow their products to be out of market to avoid irreversible substitute.

In this study, a survey was conducted on 1000 undergraduate students from Moshood Abiola Polytechnic Abeokuta, Ogun State, Nigeria and the result were transformed into a Markov Matrix and the switching between brands (brand loyalty) in a long period of time was observed. Due to the fact that the matrix that is formed is a systematic matrix, it was possible to reach a balance condition. According to the mentioned balance condition, it was observed that the students are brand loyal and the brand preferences intensified on Blackberry and Infinix brand. Although there are some disadvantages to the Markov Matrix, it is obvious that the Markov Matrix is an important technique in showing the tendency of a customer to be brand loyal in a long period of time and in determining the market share of the brands. In this study it was observed that in forming the tendency of customers on becoming brand loyal, the advertising of the brand play an important role.

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