MARKET ANALYSIS OF TWO WHEELERS USING LIMITING DISTRIBUTION FOR PARENTS AND OFF SPRING

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Abstract

During the past couple of decades researchers have given much attention about the purchasing behavior of the individual consumer. The basic phenomenon in marketing is the purchasing behavior of the individual consumer. Numerous efforts have been made to arrive at analysed model that would adequately describe this behavior. The influence of social status of a parent on that of his children when they grow up is a major consideration. Some of the researchers such as Nandhini Sen Gupta (1999) and Shankar Iyer (2003) have analyzed the trend of two wheelers. This paper discusses about which two wheeler brands are preferred by the adults using the limiting distribution and the measure of immobility using the geometric distribution.

Introduction

The Indian automobile sector is dominated by two and three wheelers (Bhoopinder Singh Bali,2001). Historically scooters accounted for the maximum production amongst the two wheelers, followed by motor cycles and mopeds. However in recent times motor cycles have snatched the market of scooters (SIAM, 2001).The consumers of the next millennium expect customized products (Nandhini Sen Gupta, 1999). So, it's time to take a fresh look at the younger lower income consumers who expects more from the marketers (Rama Bijapurkar, 2000).

Bajaj plans to offer a vehicle for every member of the family (The Hindu, Rahul Bajaj,2002). Auto companies are now a days increasingly looking for stars to pep up their image (The Hindu B.L, 2002). Hero Honda attributes 40% of its sales to rural India (E.T. 2001). Whereas TVS faces price based competition from Bajaj and product based competition from Hero motor cycles and scooters (E.T. 2002).

The per capita monthly consumption in India is increasing after the XI plan ie. 2007 – 12. The new generation consumers are expected to be convenience oriented and image conscious, which may give a new opening for automobile sector. The participation of women is also expected to rise at a phenomenal pace during the next decade. It will offer market for two wheeler marketers. Low interest rates and easy access to cheap loans afford the consumers to upgrade their durables (Shankar Iyer, 2003). The role of parents

and their purchase patterns on the preference of adults are described with the help of limiting distribution and geometric distribution.

Model Description

Let $\acute{\alpha}_j$ be the number of generations that a family is using j^{th} class in two wheelers at one stretch before moving out into another class

Let the transition probability matrix of the Markov chain be

$$p = \begin{bmatrix} p_{11} & . & P_{1n} \\ . & . & . \\ P_{m1} & . & p_{mn} \end{bmatrix}$$

Then P_{jj} is the probability that a family will remain in state $_j$ from one generation to the next. Thus we have $P(\acute{\alpha} = n)\ P_{jj}^{n-1}\ (1 - P_{jj})$. P_{jj}^{n} denotes the nth power of $P_{jj.}$

This is a geometric distribution and the mean and variance of $\acute{\alpha}_j$ are,

$E[\acute{\alpha}_j] = \frac{1}{(1-P_{jj})}$, $V[\acute{\alpha}_j] = \frac{P_{jj}}{(1-P_{jj})^2}$

Clearly $E[\acute{\alpha}_j]$ is the average number of generation using two wheeler. Prais (1955), U. Narayan Bhat (1972), Senthamarai Kannan et al (2005).

$\Pi = (\Pi_1, \Pi_2, \ldots.. \Pi_m)$ be the limiting distribution of the Markov Chain whose transition probability matrix is given matrix.

The usage time $\acute{\alpha}_j$ has the mean given by $E[\acute{\alpha}_j] = \frac{1}{(1-\pi_j)}$

The ratio of mean usage times, $\frac{E(\alpha_j)}{E(\alpha_j{}')} = \frac{(1-\pi_j)}{(1-P_{jj})}$, it can be considered to be a measure of immobility.

Database

The random sample for the survey consists of 270 adults (above 18 years). The usage of two wheelers by fathers and children were noted during January, 2013 to June, 2013.

The states are

1. Hero Honda
2. TVS
3. Bajaj
4. Honda
5. Yamaha

Table 1 The transition frequency of two wheelers preference of father and son

SON / FATHER	1	2	3	4	5
1	19	6	6	2	1
2	13	17	12	3	6
3	5	8	21	3	0
4	4	9	1	5	0
5	1	2	2	1	5

From the data the highest frequency is the state 3 goes to state 3. State 3 goes to state 5 and state 4 goes to 5 are zero frequencies.

$$p = \begin{bmatrix} 0.5588 & 0.1765 & 0.1765 & 0.0588 & 0.0294 \\ 0.2549 & 0.3333 & 0.2353 & 0.0588 & 0.1177 \\ 0.1351 & 0.2162 & 0.5676 & 0.0811 & 0 \\ 0.2105 & 0.4737 & 0.0526 & 0.2632 & 0 \\ 0.0909 & 0.1818 & 0.1818 & 0.0909 & 0.4546 \end{bmatrix}$$

Consider the social mobility as a finite Markov Chain with the five states as given above. To derive the limiting distribution from the transition probability matrix for comparison with the actual distribution of social classes as can be estimated from the survey.

Using the Cheapman Kolmogrove equation

$0.5588X_1+0.2549X_2+0.1351X_3+0.2105X_4+.0909X_5=X_1$

$0.1765X_1+0.3333X_2+0.2162X_3+0.4737X_4+0.1818X_5=X_2$

$0.1765X_1+0.2353X_2+0.5676X_3+0.0526X_4+0.1818X_5=X_3$

$0.0588X_1+0.0588X_2+0.0811X_3+0.2632X_4+0.0909X_5=X_4$

$0.0294X_1+0.1177X_2+0X_3+0X_4+0.4546X_5=X_5$

and $X_1+X_2+X_3+X_4+X_5=1$

Solving this equations we get $X_1=0.2929$, $X2=0.2537$,$X3=0.2977$, $X_4=0.0851$, $X_5=0.0706$

Table 2 Limiting distribution and actual distribution

Class	Limiting distribution	Actual Distribution	
		Father	Son
1	0.2929	0.2237	0.2763
2	0.2537	0.3355	0.2763
3	0.2977	0.2434	0.2763
4.	0.0851	0.1250	0.0922
5	0.0706	0.0724	0.0789

The above limiting distribution reveals that state 3 has the highest probability value. In the actual distribution the highest probability is state 2 for father and state b1,2 and 3 for son.

Table 3 Mean, variance and social mobility

Class	$E[\acute{a}_j]$	$Var[\acute{a}_j]$	$E[\acute{a}_j]$	$E[\acute{a}_j] / E[\acute{a}_j]$
1	2.27	5.15	1.41	1.61
2	1.50	2.25	1.34	1.12
3	2.31	5.34	1.42	1.63
4	1.36	1.85	1.09	1.25
5	1.83	3.35	1.08	1.65

The mean of the state 1 and 3 are almost same. State 2, 4 and 5 are also almost same. Using the variance state 1 and 3 are almost same, state 4 is the low probability value. The social mobility is almost same for all state. From the above analysis using geometric distribution the highest mean is state three.

Table 4 The transition frequency of two wheelers preference of father and daughter

Father \ Daughter	1	2	3	4	5
1	3	30	7	5	0
2	4	19	11	2	2
3	2	6	5	3	1
4	0	2	1	1	2
5	1	6	4	1	0

From the data the highest frequency is the state 1 goes to state 2 and state 1 goes to state 5 and state 4 goes to 1 and state 5 goes to state 5 are zero frequencies.

$$p = \begin{bmatrix} 0.0667 & 0.6667 & 0.1555 & 0.1111 & 0 \\ 0.1053 & 0.5 & 0.2895 & 0.0526 & 0.0526 \\ 0.1116 & 0.3529 & 0.2942 & 0.1765 & 0.0588 \\ 0 & 0.3333 & 0.1667 & 0.1667 & 0.3333 \\ 0.0833 & 0.5 & 0.3334 & 0.0833 & 0 \end{bmatrix}$$

Consider the social mobility as a finite Markov Chain with the five states as given above. To derive the limiting distribution from the transition probability matrix for comparison with the actual distribution of social classes as can be estimated from the survey.

Using the Cheapman Kolmogrove equation

$0.0667X_1+0.1053X_2+0.1116X_3+0X_4+0.0833X_5=X_1$

$0.6667X_1+0.5X_2+0.3529X_3+0.3333X_4+0.5X_5=X_2$

$0.1555X_1+0.2895X_2+0.2942X_3+0.1667X_4+0.3334X_5=X_3$

$0.1111X_1+0.0526X_2+0.1765X_3+0.1667X_4+0.0833X_5=X_4$

$0X_1+0.0526X_2+0.0588X_3+0.3333X_4+0X_5=X_5$

and $X_1+X_2+X_3+X_4+X_5=1$

Solving this equations we get $X_1=0.0923$, $X2=0.4582$,$X3=0.2686$, $X_4=0.1057$, $X_5=0.0752$

Table 5 Limiting distribution and actual distribution

Class	Limiting distribution	Actual Distribution	
		Father	daughter
1	0.0923	0.3814	0.0847
2	0.4582	0.3220	0.5339
3	0.2686	0.1441	0.2373
4.	0.1057	0.0508	0.1017
5	0.0752	0.1017	0.0424

The above limiting distribution reveals that state 2 has the highest probability value. In the actual distribution the highest probability is state 1 for father and state 2 for daughter.

Table 6 Mean, variance and social mobility

Class	$E[\acute{a}_j]$	$Var[\acute{a}_j]$	$E[\acute{a}_j]$	$E[\acute{a}_j] / E[\acute{a}_j]$
1	1.07	1.15	1.10	0.97
2	2	4	1.85	1.08
3	1.42	2.01	1.37	1.04
4	1.2	1.44	1.12	1.07
5	0	0	1.08	0

The mean of the state 1, 3 and 4 are almost same. State 5 is zero. Using the variance state 1 and 4 are almost same, state 5 is the low probability value. The social mobility are almost same for all state except state 5. From the above analysis using geometric distribution the highest mean is state two.

Table 7 The transition frequency of two wheelers preference of father and offspring

Off spring	1	2	3	4	5
1	22	36	13	7	1
2	17	36	23	5	8
3	7	14	26	6	1
4	4	11	2	6	2
5	2	8	6	2	5

$$p = \begin{bmatrix} 0.2785 & 0.4557 & 0.1646 & 0.0886 & 0.0126 \\ 0.1910 & 0.4045 & 0.2584 & 0.0562 & 0.0899 \\ 0.1296 & 0.2593 & 0.4815 & 0.1111 & 0.0185 \\ 0.16 & 0.43 & 0.08 & 0.25 & 0.08 \\ 0.0869 & 0.3478 & 0.2607 & 0.0869 & 0.2174 \end{bmatrix}$$

Consider the social mobility as a finite Markov Chain with the five states as given above. To derive the limiting distribution from the transition probability matrix for comparison with the actual distribution of social classes the mobility chain can be used which is estimated from the survey. Using the Cheapman Kolmogrove equation

$0.2785X_1+0.1910X_2+0.1296X_3+0.16X_4+0.0869X_5=X_1$
$0.4557X_1+0.4045X_2+0.2593X_3+0.43X_4+0.3478X_5=X_2$
$0.1646X_1+0.2584X_2+0.4815X_3+0.08X_4+0.2607X_5=X_3$
$0.0886X_1+0.0562X_2+0.1111X_3+0.25X_4+0.0869X_5=X_4$
$0.0126X_1+0.0899X_2+0.0185X_3+0.08X_4+0.2174X_5=X_5$
and $X_1+X_2+X_3+X_4+X_5=1$
Solving this equations we get $X_1=0.1795$, X2=0.3707 ,X3=0.2883, $X_4=0.0990$, $X_5=0.0625$.

Table 8 Limiting distribution and actual distribution

Class	Limiting distribution	Actual Distribution	
		Father	Off spring
1	0.1795	0.2926	0.1926
2	0.3707	0.3296	0.3889
3	0.2883	0.2	0.2593
4.	0.0990	0.0926	0.0963
5	0.0625	0.0852	0.0629

The above limiting distribution reveals that state 2 has the highest probability value. In the actual distribution the highest probability is state 2 for father and daughter.

Table 9 Mean, Variance and Social mobility

Class	$E[\acute{\alpha}_j]$	$Var[\acute{\alpha}_j]$	$E[\acute{\alpha}_j]$	$E[\acute{\alpha}_j] / E[\acute{\alpha}_j]$
1	1.9	1.92	1.22	1.63
2	1.68	0.25	1.59	1.06
3	1.93	4.26	1.41	1.37
4	1.33	1.78	1.11	1.20
5	1.35	1.63	2.67	0.51

The above analysis using geometric distribution reveals that the state 3 holds highest mean.

Conclusion

The above discussion reveals that the state 2 has the highest probability for father and offspring separately. Using the limiting distribution the highest probability of state one goes to state 2 is 0.3707. The highest mean is in the state three and variance in state three from geometric distribution. Most of the offspring may be using TVS brands. These findings are very useful decision makers and policy makers.

References

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