

Repeat Purchase Factor – Applied Analytics to Understand and Manage Repeat Purchase in Information Driven Markets

Kishore Nath, Database Statistical Consultant, Alliance Data Systems

ABSTRACT

The knowledge and application of statistical theory or probability has made the simple buying/selling exercise into an Information driven Marketing Process.

The important aspect of the second transaction is consumers' independent assessment of the product meeting their expectations. In fact this second transaction is a realistic assessment of the market as it clearly communicates – from the consumers side – a product's acceptance in a real market. As all do not make this second purchase – a measure of acceptance is possible using the right statistical tools.

This paper makes an effort using SAS to develop and define a statistic called REPEAT PURCHASE FACTOR (RPF). This RPF provides knowledge to measure and manage second purchases. Subsequent or more than two purchases are excluded from this paper. A new set of concepts – TIME BUCKETS, WAIT TIME, PRODUCT LIFE and ONE TIME BUYER – are introduced. These concepts are used to generate the RPF. A case study applying these concepts is presented.

It will be shown how the likelihood to make a second purchase drops as the WAIT TIME increases.

INTRODUCTION

The basic market consists of the consumers, prospects, products or services, and marketers or clients (as referred by those offering marketing services) interacting to decisions made.

Marketers invest large dollar amounts on marketing research and acquisition costs to make prospects make a first purchase. Second and subsequent purchases are given little or no attention.

The knowledge and application of statistical theory or probability has made the simple buying/selling exercise into an Information driven Marketing Process.

Most marketing campaigns are one-time promotions and response monitoring. Often due to lack of visibility to consumers, one is unable to manage a more-than-one-time relationship with the consumer.

One solution is Applied Analytics. One will see the importance of understanding the consumer in terms of his/her second purchase. This paper presents a case study that shows as WAIT TIME increases, likelihood of the second purchase drops exponentially. In other words, this data will show marketing opportunity drops as one waits longer. In this paper we assume prospects, consumers and their purchase behavior is maintained on professionally managed databases.

THE MARKETING SCENARIO

The client interprets a number of consumer/prospect behaviors - often without the right analytics. Once a consumer is acquired – a challenge in itself – most marketers compute retention rates one year later. In order to maintain or increase retention rates, certain decisions are made – unaware of the fact that the most important second purchase has never been made.

It is worth repeating that the very first purchase is usually the result of large investments in market research, acquisition costs and so on. Once prospects become customers,

customer service teams manage them. These teams are more troubleshooters and service providers. While the service quality is measured, the repeat purchase is not measured, nor are the first time buyers motivated to buy in a shorter time period.

The more important aspect of the second transaction is consumers' independent assessment of the product meeting their expectations. In fact this second transaction is a better assessment of the market as it clearly communicates – from the consumers side – a product's acceptance in a real market. Then there are large data warehouses, churning out repeated automated communications based on outdated programs and success stories. One-time successful marketing campaigns are repeatedly done forever. A number of new customer acquisition programs are repeatedly performed, unaware of the fact that many make one and only one purchase. Also unaware of the fact that many have service issues not properly addressed.

There are tools to better manage this scenario. This paper puts forward new concepts in this context.

THE CONCEPTS

This discussion uses 24 months transaction data consisting of first and the second purchases. All those making a first purchase during a time period – say a week, a month, or a quarter – are grouped together. In order to arrive at the REPEAT PURCHASE FACTOR, some concepts and their definition are provided.

FIRST TIME BUCKET is a time period consisting of consumers making a first purchase in that time bucket. Thus all consumers making a first purchase in January 2002 have their FIRST TIME BUCKET as January 2002.

Likewise, SECOND TIME BUCKET is a time period consisting of consumers making a second purchase in that time bucket. Thus all consumers making a first purchase in May 2002 have their SECOND TIME BUCKETS as June 2002, July 2002 and so on – depending on when the second purchase is made.

WAIT TIME is defined as the number of time periods between first purchase and second purchase. Assume 1000 have January 2002 as their FIRST TIME BUCKET. 400 of them make a second purchase in February 2002, 170 in March 2002 and 100 in April 2002. The WAIT TIME is 1, 2 and 3 for the three groups of SECOND TIME BUCKETS.

REPEAT PURCHASE FACTOR is percent of consumers in a specific FIRST TIME BUCKET that appear in a specific SECOND TIME BUCKET. Thus, for the above example, February 2002 RPF is 40%. Likewise, March 2002 RPF is 17% and April 2002 is 10%.

First time buyers are monitored and their second purchases recorded during a reasonable period of time, say twenty four months. PRODUCT LIFE is defined as the time period within which 95% of first time buyers who are going to make a second purchase, make that second purchase.

ONE TIME BUYERS are all those who FAIL to make a second purchase within the PRODUCT LIFE period. Here, we are accepting a 5% error. By accepting this error, we were able to arrive at the concept of PRODUCT LIFE.

ANALYTICAL APPROACH

TIME BUCKETS

We define TIME BUCKET as a group of time periods, say days, weeks, months and so on. The TIME BUCKETS are mutually exclusive and must make necessary business sense. Associated with an event of interest (say purchase), we define a variable

$X_t = 1$ if the event occurs in time bucket 't'
 $= 0$ otherwise

Two special cases are first occurrence and second occurrence of the event.

This paper focuses only on the two occurrences. Subsequent occurrences are excluded.

Thus,

$X_f = 1$ if event occurs for the first time
 $= 0$ otherwise

$X_s = 1$ if the event occurs for the second time
 $= 0$ otherwise

Where 'f' is the time bucket having the first occurrence – FIRST TIME BUCKET

And 's' is the time bucket having the second occurrence – SECOND TIME BUCKET

WAIT TIME

We define WAIT TIME as

WAIT TIME = $s - f$

WAIT TIME is the number of time buckets between the first and second occurrence of the event.

We will consider only those events where $X_f = 1$

And study those events where $X_s = 1$ or $X_s = 0$

In the case study given later, the TIME BUCKETS are Feb 2000, Mar 2000, ..., Jan 2002. There are 19,444 consumers with $X_f = 1$. On these, 886 have $X_s = 1$ for time bucket 's' = May 2000. Note that May 2000 – the SECOND TIME BUCKET – is not necessarily the time bucket following the first time bucket Feb 2000. It is the time bucket where the second event occurred.

REPEAT PURCHASE FACTOR

Let, P_s be the estimated probability that the second event will occur.

Let, P_{sw} = estimated probability that the second event will occur at wait time 'w'

Where, $w = 0, 1, 2, \dots, \infty$

REPEAT PURCHASE FACTOR = P_{sw}

In the case study,

$P_{s0} = 0.13$ $P_{s1} = 0.12, \dots, P_{s23} = 0.02$

As the second event may occur in any time bucket 'w' = 0, 1, ..., ∞ , we may write,

$$P_s = P_{s0} + P_{s1} + P_{s2} + \dots + P_{s\infty}$$

$$P_s = \sum_{w=0}^{\infty} P_{sw}$$

In a realistic world, marketers are interested in time periods that make business sense, say 12 months, 24 months, 5 years and so on.

In our example, time period is 24 months.

Maximum wait time will be $24 - 1 = 23$.

We then compute,

$$\begin{aligned} P_s &= \sum_{w=0}^{23} P_{sw} \\ &= 0.13 + 0.12 + \dots + 0.02 \\ &= 0.57 \end{aligned}$$

Thus, the estimated probability of the second event is 0.57

PRODUCT LIFE

The next concept is PRODUCT LIFE. Let 'T' be the maximum time bucket of interest. We know that the estimated probability that the second event will occur is

$$\begin{aligned} P_s &= \sum_{w=0}^T P_{sw} \\ &= \sum_{w=0}^k P_{sw} + \sum_{w=k+1}^T P_{sw} \end{aligned}$$

We compute 'k' such that,

$$\sum_{w=0}^k P_{sw} = 0.95P_s$$

The wait time 'k' is defined as PRODUCT LIFE.

In the example PRODUCT LIFE works out to 16 time buckets.

ONE TIME BUYER

The last concept is ONE TIME BUYER.

Let, ΣX_f be all first time buyers in time bucket 'f'.

Let,

$$\sum_{w=0}^k X_{swf}$$

be all second time buyers that were first time buyers in time bucket 'f',

where 'k' is PRODUCT LIFE.

Then, ONE TIME BUYERS are defined as,

$$OTB = \Sigma X_f - \sum_{w=0}^k X_{swf}$$

The example has 8,933 ONE TIME BUYERS.

THE CASE STUDY

Twenty-four months of transactional data are analyzed for all those who made a first purchase. A random sample of 19,444 consumers that made a first purchase in February 2000 was selected. Date of first purchase and date of second purchase was extracted. The first SAS data set has the following data elements:

CONSUMER_ID fp_date sp_date
FIRST_TIME_BUCKET SECOND_TIME_BUCKET
WAIT_TIME

Where,

fp_date is first purchase date

sp_date is second purchase date

FIRST_TIME_BUCKET is derived from the sas functions month(fp_date) and year(fp_date)

SECOND_TIME_BUCKET is derived from the sas functions month(sp_date) and year(sp_date)

WAIT_TIME is the sas function

intck('month', fp_date, sp_date)

The univariate procedure is used to determine the 95th percentile for WAIT_TIME. This determines the PRODUCT LIFE.

All consumers with WAIT_TIME greater than PRODUCT LIFE or those that never made a second purchase during the 24 month period are ONE TIME BUYERS.

The REPEAT PURCHASE FACTOR is the percentage of those in second time bucket to those in the first time bucket.

The Appendix provides 40 observations of raw data, the product life calculator, repeat purchase tables and wait time chart for consumers making second purchase.

THE LEARNINGS

1. FIRST TIME BUCKET is February 2000. It has 19,444 consumers.
2. There are 24 SECOND TIME BUCKETS ranging from February 2000 to February 2002.
3. The PRODUCT LIFE works out to 16 months.
4. ONE TIME BUYERS works out to 8,933 or 46%.
5. Observe the drop in repeat percent post December.
6. One out of eight first-time-bucket consumers made a second purchase in the same month. Thus having a WAIT TIME of zero months. Likewise, another one in eight bought in the next month, resulting in a WAIT-TIME of one month.
7. While only 57% made a repeat purchase in 24 months, 50% did it within 11 months.
8. The REPEAT PURCHASE FACTOR for Feb-00 is 12.7%. This drops to 4.6% by May-00.
9. After 12 months, the REPEAT PURCHASE FACTOR is less than 1% every month.

10. Thus, the likelihood of second purchase drops exponentially as WAIT TIME increases.
11. The 46% one-time buyers, that never buy again, may be used for market research to determine why they bought in the first place, why they stopped buying and what product improvement they recommend.

CONCLUSIONS

This paper introduced the importance of the second purchase in understanding a real market. It explained concepts like TIME BUCKETS, WAIT TIME and PRODUCT LIFE that helped to measure and manage second purchases. A statistic REPEAT PURCHASE factor was defined and applied. A case study was presented. The repeat purchase table with RPFs' in each cell has been provided to compare various TIME BUCKETS.

In the case study, these concepts helped to understand the exponentially declining relationship between WAIT TIME and REPEAT PURCHASE FACTOR.

Thus, marketing to first time buyers can be better timed or managed with the knowledge of these concepts and their relationships.

ACKNOWLEDGEMENT

I wish to express my sincere thanks to Philip Clemance, Director, Analytical Development Alliance Data Systems for his continued support, reviews and improvements in this paper.

REFERENCE:

SAS Institute Inc (1989) SAS/STAT User's Guide, Vol. 1 & 2.,

AUTHOR CONTACT:

Kishore Nath
Database Statistical Consultant
Analytical Development Department
Alliance Data Systems
800 Techcenter Drive
Gahanna OHIO 43230 - 5318

Telephone: 614-729-4040
Fax: 614-729-4297
knath@alldata.net

APPENDIX

Raw Data

Forty (40) Observations

Observation	Consumer_id (Masked)	Trips	First Time Bucket	Second Time Bucket	Wait Time
1	049678	3	200002	200005	3
2	053603	32	199901	199904	3
3	055434	13	199911	200002	21
4	056413	5	199912	200002	22
5	057815	11	199902	199906	4
6	059745	8	200002	200003	1
7	060441	18	199901	199901	0
8	060787	42	199901	199903	2
9	060812	7	199901	199903	2
10	064054	3	199906	199907	1
11	064661	20	199901	199902	1
12	064709	61	199906	199906	0
13	065304	9	199902	199902	0
14	065566	17	199902	199904	2
15	067938	38	199901	199903	2
16	068578	1	200002		
17	068851	2	200002	200002	0
18	070460	38	199902	199904	2
19	071166	28	199903	199904	1
20	071492	15	199907	199911	4
21	071728	4	199904	200002	14
22	071929	47	199911	199912	1
23	072090	10	199908	199908	0
24	072148	31	199904	199904	0
25	072659	6	200002	200005	3
26	073139	6	199903	199904	1
27	073723	1	200002		
28	074181	27	199901	199901	0
29	075011	38	199901	199902	1
30	075063	6	199902	200002	12
31	075082	40	199901	199901	0
32	075284	9	199903	199907	4
33	075543	6	200002	200006	4
34	076842	28	199901	199902	1
35	076921	4	199901	199905	4
36	076978	5	199907	200002	17
37	077247	16	199902	199905	3
38	077969	103	199901	199901	0
39	078016	32	199901	199904	3
40	079101	26	199910	199910	0

PRODUCT LIFE CALCULATOR

FIRST TIME BUCKET

Feb-00

Two time buyers in 24 Months

11,030

PRODUCT LIFE

16 months

(95% buy in 16 months)

(See table below)

FIRST TIME BUCKET	SECOND TIME BUCKET	WAIT TIME	Consumers	Percent	Cuml. Consumers	Cum. Percent
Feb-00		Feb-00 0 months	2,472	22%	2,472	22.4%
		Mar-00 1 month	2,397	22%	4,869	44.1%
		Apr-00 2 months	1,078	10%	5,947	53.9%
		May-00 3 months	886	8%	6,833	61.9%
		Jun-00 4 months	625	6%	7,458	67.6%
		Jul-00 5 months	404	4%	7,862	71.3%
		Aug-00 6 months	462	4%	8,324	75.5%
		Sep-00 7 months	370	3%	8,694	78.8%
		Oct-00 8 months	332	3%	9,026	81.8%
		Nov-00 9 months	279	3%	9,305	84.4%
		Dec-00 10 months	380	3%	9,685	87.8%
		Jan-01 11 months	153	1%	9,838	89.2%
		Feb-01 12 months	164	1%	10,002	90.7%
		Mar-01 13 months	186	2%	10,188	92.4%
		Apr-01 14 months	108	1%	10,296	93.3%
		May-01 15 months	122	1%	10,418	94.5%
		Jun-01 16 months	93	1%	10,511	95.3%
		Jul-01 17 months	74	1%	10,585	96.0%
		Aug-01 18 months	98	1%	10,683	96.9%
		Sep-01 19 months	65	1%	10,748	97.4%
		Oct-01 20 months	67	1%	10,815	98.1%
		Nov-01 21 months	64	1%	10,879	98.6%
		Dec-01 22 months	106	1%	10,985	99.6%
		Jan-02 23 months	45	0%	11,030	100.0%
		Total	11,030			

REPEAT PURCHASE TABLE						
FIRST TIME BUCKET			Feb-00			
First time Consumers			19,444			
ONE TIME BUYER			8,933	46%		
PRODUCT LIFE			16 months			
(95% buy in 16 months)						
(See table below)						
FIRST TIME BUCKET	SECOND TIME BUCKET	WAIT TIME	Consumers	Percent	Cuml. Consumers	Cum. Percent
Feb-00	Feb-00	0 months	2,472	12.7%	2,472	12.7%
	Mar-00	1 month	2,397	12.3%	4,869	25.0%
	Apr-00	2 months	1,078	5.5%	5,947	30.6%
	May-00	3 months	886	4.6%	6,833	35.1%
	Jun-00	4 months	625	3.2%	7,458	38.4%
	Jul-00	5 months	404	2.1%	7,862	40.4%
	Aug-00	6 months	462	2.4%	8,324	42.8%
	Sep-00	7 months	370	1.9%	8,694	44.7%
	Oct-00	8 months	332	1.7%	9,026	46.4%
	Nov-00	9 months	279	1.4%	9,305	47.9%
	Dec-00	10 months	380	2.0%	9,685	49.8%
	Jan-01	11 months	153	0.8%	9,838	50.6%
	Feb-01	12 months	164	0.8%	10,002	51.4%
	Mar-01	13 months	186	1.0%	10,188	52.4%
	Apr-01	14 months	108	0.6%	10,296	53.0%
	May-01	15 months	122	0.6%	10,418	53.6%
	Jun-01	16 months	93	0.5%	10,511	54.1%
	Jul-01	17 months	74	0.4%	10,585	54.4%
	Aug-01	18 months	98	0.5%	10,683	54.9%
	Sep-01	19 months	65	0.3%	10,748	55.3%
	Oct-01	20 months	67	0.3%	10,815	55.6%
	Nov-01	21 months	64	0.3%	10,879	56.0%
	Dec-01	22 months	106	0.5%	10,985	56.5%
	Jan-02	23 months	45	0.2%	11,030	56.7%
		Total	11,030			

Wait Time for Consumers Making Second Purchase

