

Modeling the Customer Satisfaction Influence on the Long Term Sales: Example with Leading OTC Analgesics INN on National Market

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ABSTRACT

Background: The customer satisfaction models are used to examine brand loyalty and sales. The utilization of the counter medicines depends directly on the level of knowledge of consumers, preferences and their satisfaction could be considered as an important predictor for their revenue. **Objectives:** The goal of the current study is to develop a Markov model for assessing the influence of the customer satisfaction on long term sales of leading OTC international nonproprietary names (INNs) of analgesics on the national market. **Methods:** Two first-order stationary Markov models based on marketing data for OTC analgesics sales and customer satisfaction inquiry, particularly from metamizole (MET), paracetamol (PAR), acetysal (ASA), and ibuprofen (IBU) were created and manipulated. The first model considered the very satisfied customers and the second the very satisfied and the somewhat satisfied customers. **Results:** MET is the INN with the most loyal customers followed by PAR. The product Markov matrix was derived after multiplications of the matrixes with market share and loyal customers' probabilities. The steady state is achieved after 17 years for the group of satisfied customers and after 40 iterations for the group of somewhat satisfied. The market fluctuations are more dynamic in the second model probably due to lower determination of customers purchasing behavior. **Conclusions:** The model allows prediction of the long term changes in sales, differences between the groups of customers and long term marketing fluctuations. It could be useful in companies' strategic sales management.

Keywords: OTC Analgesics; Marketing; Customer Satisfaction; Markov Model

1. Introduction

Customer satisfaction is a broad marketing concept applied towards the companies, products, services, and even relationships [1,2]. Studies of the customer satisfaction are trying to explain the factors that influence it, to range those factors according to their way of impact, measure the satisfaction and follow its relation with brand loyalty [2-5]. The customer satisfaction models are used for analytical purposes to explain its multi factorial structure [6-8].

Modeling the long term satisfaction is a key aspect for market sales and revenue forecasts [9,10]. Pharmaceutical studies provide numerous examples of research using theories and methodologies to predict outcomes by quantifying individuals' behavior according to their personal preferences [11-14].

Over the counter medicines (OTC) are groups of brands with well-established safety and efficacy used to treat self-recognizing and self-limiting symptoms [15]. The latter concerns in a great extend the OTC analgesics most of which have been launched since centuries on the market, like acetysal [16]. Anatomical Therapeutic Chemical Classification (ATC) of medicines includes four main groups of OTC analgesics: salicylic acid derivatives with main representative acetysal (acetyl-salicylic acid); pyrazolones with main representative metamizol; anilides with main representative paracetamol [17]. Recently some antirheumatic medicines, like ibuprofen, have been applied as OTC analgesics as well.

OTC medicines are not an object of physician prescription and their utilization depends directly on the level of knowledge of consumers, past experience, established preferences and satisfaction of the consumers.

Therefore studying the influence of the customer satisfaction on the sales of OTC analgesics is important to predict their revenue. As there are no studies that create models based on the customer satisfaction and exploring its influence in the long term sales of OTC analgesics, this raised our interest on the topic.

Objective and Research Hypotheses

The goal of the current study is to develop a Markov model for assessing the influence of the customer satisfaction on long term sales of leading OTC international nonproprietary names (INNs) of analgesics on the national market.

The following research hypotheses have been tested:

- 1) The Markov model is suitable for the evaluation of the influence of customer satisfaction on the long term sales of OTC analgesics.
- 2) Customer satisfaction leads to differences in long term sales of the OTC medicines.

2. Theoretical Background

Areas such as pharmaceuticals, health management, social support and patient outcomes all are areas to apply the assumptions and techniques of modeling in order to understand how relationships with others surrounding areas are influenced or what is the impact of health on them [18]. One of the major cornerstones of creating and using a Markov models to appraise the brand switching is the work of Ehrenberg [10]. The author stated that the Markov brand switching models aims to present the repeat buying and brand switching behavior. In the example discussed by Ehrenberg the goal of the Markov chain analysis is twofold. From one side it must provide a convenient and effective way of handling a variable and complex data, while from the other side it is suitable for studying the interrelationships. In the marketing Markov chains model is frequently used to explore the topics such as "brand loyalty" and "brand switching dynamics" [19,20]. Loyalty towards a product is defined as probability at time "t" the product to be purchased by the same customer. The persistence of the loyalty indicators towards a product shows the future purchasing behavior of the loyal customer.

Following the proposal of Draper and Nolin and the work of Ehrenberg we choose the first order stationary Markov type of model, which is recommended in the marketing literature [10,21]. Similar to that proposal is the work of Pfeifer and Carraway using the Markov model to explore the customer relationships and calculate the life time value of the customers [22]. The life time value of the customers is important concept in marketing pointing out at the importance of gaining and retaining customers [23-25]. The graphical view of the model cre-

ated by Pfeifer and Carraway is close to that we created for our investigation. Both models belong to Markov chain models, which are considered appropriate for modeling customer relationships and calculate the life time value. Several authors consider as advantage of these models their flexibility, complexity in handling both the customers' migration and retention [26,27]. The models could be applied at customers' level and at products' level [28].

The life time value is a concept close to customer satisfaction because satisfied customers are of the long term value for the producers because of their brand loyalty. There are numerous studies pointing out the importance of the customer satisfaction for the companies and especially in the general sales forecasting [29-31]. Customer satisfaction is defined as "the number of customers, or percentage of total customers, whose reported experience with a company, its products, or its services (ratings) exceeds specified satisfaction goals" [1]. The customer satisfaction is measured by interviewing customers to define their level of satisfaction usually in 5-point Likert scale varying among very dissatisfied and very satisfied [32]. We used this concept in our research and applied it towards the customers which were buying the products of interest at the moment of their purchase.

The choice of OTC analgesics was based on the fact that they are a group of medicines with long standing usage and their sales depend on the customer preferences rather than on the physicians' recommendations. Over 110 years ago Hoffman isolated aspirin, the first non-steroidal anti-inflammatory medicinal product [33]. Currently there are over 50 different medicinal products with anti-inflammatory, analgesic and antipyretic activity, most of them are with OTC status all over the world. Nonsteroidal anti-inflammatory medicines, including aspirin, are now among the most widely prescribed medicinal products in the world [34]. Acetylsalicylic acid (shortly acetysal or ASA) was synthesized one hundred years ago, and was produced under the commercial name of "Aspirin" by the German company Bayer for the treatment of fever and rheumatism [35]. In 1971, Vane discovered the mechanism by which aspirin exerts its anti-inflammatory, analgesic and antipyretic actions. He proved that aspirin and other non-steroid anti-inflammatory medicines inhibit the activity of the cyclooxygenase, which leads to the formation of prostaglandins [36]. The analgesic effect has mostly peripheral mechanism.

Metamizole was first synthesized by the company Hoechst AG in 1920. It remained available worldwide until the 1970s, when several national medical authorities withdrew metamizole from the market or restricted it to be available only with a prescription, due to the fact that may cause agranulocytosis, although it remains available

over the counter in many other countries [37,38].

Many non-steroidal anti-inflammatory medicines (NSAID) are available on the market, but aspirin and ibuprofen are the most used without a prescription. It is estimated that 20% - 30% of Americans use NSAID each year, and 1% - 2% use NSAIDs every day [39]. Eighty-five percent of all analgesics are available without a prescription and as a group they have one of the highest market shares [40]. Ibuprofen was derived from propanoic acid by the research arm of Boots Group during the 1960s and patented in 1961 [41]. Ibuprofen is a non-selective COX inhibitor and its antipyretic and anti-inflammatory activity is mainly through inhibition of COX-2 [42].

Paracetamol is not considered an NSAID because it does not exhibit significant anti-inflammatory activity (it is a weak COX inhibitor) [43]. Paracetamol was first marketed in the United States in 1953 by Sterling-Winthrop Co although was discovered in 1877 [44].

In general studies of the satisfaction from the OTC medicines are very limited [45]. They are suitable for our research due to their long standing usage that allows long term forecasting and the possibility of customers to choose the product themselves based on their past experience.

3. Methodology

This study was developed following several study steps. During the first step information about the sales and market share of four leading OTC analgesics INN on the national market-metamizole, paracetamol, acetyl-salicylic acid, and ibuprofen (MET, PAR, ASA and IBU) was collected. The information for the sales and market share was collected from the website of the Bulgarian Drug Agency (BDA) and from the officially published International Medical Statistics reviews during one year period [46]. Both datasets were compared for consistency and average value was considered as final market sales value and share. Only the mono products, containing one active substance were selected for the study. Combinations and pediatric dosage forms were excluded, as well as the low dose acetyl-salicylic acid tablets used as anti-platelet agent.

From the website of the Ministry of health officially published information about the maximal retail prices of all brands of mono products containing the INNs of interest and the average price per INN was derived [47].

Within one month period on a random basis 300 individuals were questioned, who were buying OTC analgesics of interest from the pharmacies to state their general satisfaction from the products in 5-point Likert scale (very dissatisfied; somewhat dissatisfied; neither satisfied, not dissatisfied; somewhat satisfied; very satisfied).

Based on both datasets the two first-order stationary Markov models were created and manipulated (Figure 1) [10]. The first model considered that the very satisfied customers are the loyal ones that will always buy the same INN and the rest are equally distributed during the year between the other INNs. Those were considered as switchers. In the second model the very satisfied and the somewhat satisfied customers were considered as loyal and the rest were considered as switchers that are equally distributed among the other INNs.

The initial state matrix for the model is a row vector with probabilities derived from the market share values of the four OTC INNs of analgesics as shown with formula (1):

$$\text{Formula (1)} [P_{\text{MET}}, P_{\text{PAR}}, P_{\text{ASA}}, P_{\text{IBU}}]$$

For the first model a 4 ($n \times n$) matrix was created, where the main diagonal comprises of the probabilities derived from the relative share of the very satisfied customers for every OTC INN. In this model we suppose that there is a probability for the rest part of the customers to switch to another INN during their following purchases. We assume that this probability is equal for all INNs. Thus the rest probabilities were derived as shown with formula 2.

$$\text{Formula 2: } "p_{\text{switchers}} = (1 - p_{\text{loyal customers}})/3"$$

For the second model different 4 ($n \times n$) matrix was created where the main diagonal comprises of the probabilities derived from the relative share of the sum of very satisfied and somewhat satisfied customers. Those were considered as "somewhat loyal" customers, who are expected to prefer the same INN. The other probabilities were derived as in the first model following Formula 2.

By multiplying the initial matrix with that of the loyal customers' matrix was calculated the expected probabilities of customers to remain loyal till the moment of steady state. The same way was calculated the probabilities of "somewhat loyal" customers.

The expected long term sales of the OTC analgesics' INN were calculated for both groups of customers-the loyal ones and "somewhat loyal" ones by multiplying the Markov probabilities with the initial sales values of every INN in the beginning of the observation. The length of the Markov chain was determined to be one year.

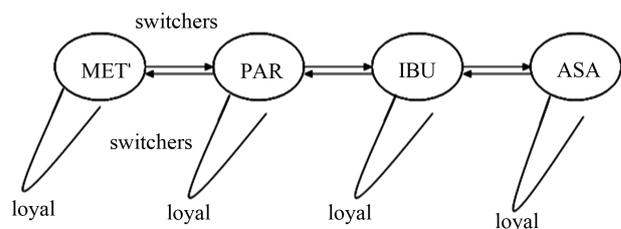


Figure 1. The first-order stationary Markov model for OTC sales and loyalty.

4. Results

The initial matrix with the probabilities derived from the market shares of the four INNs is shown on **Table 1**. Market shares are nationally determined and are results of long standing traditions where the metamizole as nationally produced is the OTC analgesics leader, followed by the acetyl-salicylic acid probably as the product with longest history of utilization within the group.

The loyal customers correspond to the relative share of the individuals who were very satisfied by the particular INN (**Table 2**). Logically determined by the historical market situation MET is the INN with most loyal customers followed by PAR. If all other customers switch to any one of the other INNs on an equal basis the other probabilities will vary as is calculated on **Table 2**. On the main diagonal are the probabilities of the very satisfied customer considered as loyal ones.

The product Markov matrix derived after several multiplications of the matrices in **Tables 1 and 2** is presented on **Table 3**. The steady state is achieved after 17 periods, meaning that under the given assumptions after 17 years the market shares will become unchanged for all analgesics.

Figure 2 represents the range of the probabilities including the steady state period for the loyal customers. In spite of the fact that the steady state is achieved after 17 iterations, the intensive market changes are observed till the 6th iteration.

The probability matrix of “somewhat satisfied” and “very satisfied” customers is shown on **Table 4**, where it is evident that metamizole again is the leader, and ibuprofen is the second one ranged product.

In this second model the steady state is achieved after 40 iterations (**Figure 3, Table 5**).

The market fluctuations are more dynamic in comparison with the first model as evident from **Figure 3**. It could be supposed that the customers are not so definitive in their purchasing behavior.

The market made from loyal and loyal plus somewhat loyal customers differs in term of their length and value predictability (**Figure 4**). Logically the sales to loyal customers are with smaller cumulative value and for the shorter period, while the sales to loyal and somewhat loyal customers are for the longer period and higher cu-

mulative long term value.

5. Discussion

To our knowledge this is the first Markov model built on the basis of the customer satisfaction data for OTC analgesics and their market share. It is based on official information for analgesics national market and prices and thus it is trying to present the reality as much as possible. Although is complicated to transform medicines utilization problems into mathematical equations Markov chain

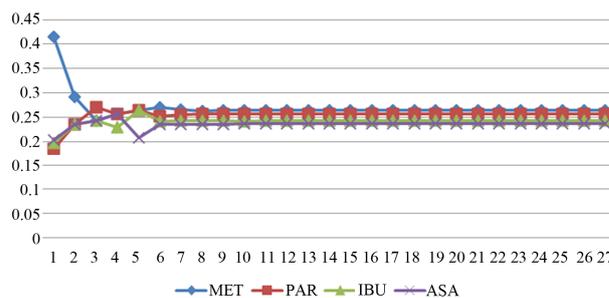


Figure 2. Graphical view of the Markov chain for loyal customers.

Table 1. Initial matrix for both models.

	Probabilities in the state zero (year of observation)
Metamizole (MET)	0.415
Paracetamol (PAR)	0.185
Ibuprofen (IBU)	0.197
Acetysal (ASA)	0.203

Table 2. Probabilities of loyal customers.

	MET	PAR	IBU	ASA
Methamizole	0.292	0.243	0.257	0.264
paracetamol	0.236	0.271	0.257	0.264
Ibuprofen	0.236	0.243	0.229	0.264
Acetysal	0.236	0.243	0.257	0.208

Table 3. Markov chain probabilities for the loyal customers.

	S1	S2	S3	S4	S5	S5	S7	S17	S18	
MET	0.270356	0.265568	0.263412	0.264196	0.264	0.264581	0.264365	-	0.264311	0.264311
PAR	0.252296	0.255824	0.257392	0.257	0.256608	0.256505	0.256657	-	0.256697	0.256697
IBU	0.2416	0.242608	0.243	0.243392	0.241824	0.242676	0.242701	-	0.242714	0.242714
ASA	0.235748	0.236	0.236196	0.235412	0.237568	0.236239	0.236278	-	0.236278	0.236278

appears to be powerful technique to predict the long term market share and in forecasting the influence of the customer satisfaction on the sales of a product INN. On the other side it is a demonstrative tool with possibility for application in marketing management and decision making [48].

The performed study shows that the first-order stationary Markov models could be successfully used to

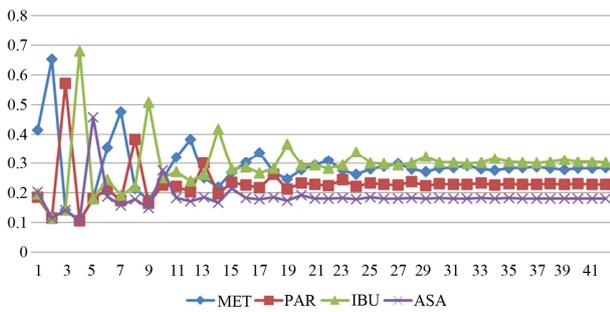


Figure 3. Graphical view of the Markov chain for loyal and somewhat loyal customers.



Figure 4. Market value and length predictability.

Table 4. Markov probabilities for the fully and partly loyal customers.

	MET	PAR	IBU	ASA
Metamizole	0.652	0.143	0.107	0.181
Paracetamol	0.116	0.571	0.107	0.181
Ibuprofen	0.116	0.143	0.679	0.180
Acetysal	0.116	0.143	0.107	0.458

Table 5. Markov probabilities for the loyal and somewhat customers.

	S1	S2	S3	S4	S5	S5	S7	S39	S40	
MET	0.354857	0.4751	0.216073	0.177085	0.246053	0.321975	0.383914	-	0.283869	0.28526
PAR	0.211597	0.175276	0.383813	0.165529	0.226505	0.222335	0.204278	-	0.229459	0.229323
IBU	0.244898	0.191864	0.221078	0.508014	0.251539	0.271664	0.238849	-	0.305112	0.30386
ASA	0.188648	0.15776	0.179036	0.149372	0.275903	0.184027	0.17296	-	0.18156	0.181557

analyze the influence of the customer satisfaction on the long term sales of OTC analgesics. The latter is evident from the differences in the dynamics and necessary time to reach the steady state in the two formulated models. In the case of very satisfied customers the time to steady state is shorter than might be explained with the fact that customers are loyal to the particular brand and their purchasing behavior is very stable. In contrast the model formulated with the probabilities of very satisfied and somewhat satisfied customers is reaching the steady state after three times more iterations. It is also characterized with lots of fluctuations in almost two third of the years that might be considered as not so stable customer behavior.

The differences in the both models let to the different long term sales of the observed OTC analgesics that prove our second research hypothesis. Lots of researchers pointed out that the customer satisfaction is a key for market success of the products that is also evident from our results [49]. As heterogeneous are the groups in terms of their satisfaction as unstable are the sales values and necessary time to reach the steady state. The model with the very satisfied customers is smooth with limited fluctuations than the model with very satisfied and somewhat satisfied customers probably due to the heterogeneity of the group.

The current study possesses some limitations. The first is the fact that interventions on the market were not performed and the changes after such an intervention were not measured. This might be considered as strength of the study because the attempt was to measure the real life as it is without any particular influence on the sales.

For some the one year length might be too long period but OTC analgesics have seasonal utilization and if we measure short term periods we have to comply with the seasonal differences. The seasonal differences are not a valuable indicator for the long term sales. Never mind that the OTC analgesics are with long standing tradition of utilization their sales are not stable and are influenced by lots of other factors, as well as by customer satisfaction.

The third limitation might be considered the fact that only two models were created with the very satisfied and somewhat satisfied customers in addition to the first one model. Theoretically and practically all models are pos-

sible in combination with the other three possibilities as neither satisfied nor dissatisfied etc., but we consider them as relatively indifferent for this study that might not add new evidences.

6. Conclusion

The customer satisfaction influence on long term OTC analgesics could be modeled with first-order Markov chain model. The model allows evaluating the long term changes in satisfaction, differences between the groups of customers and long term marketing fluctuations. It could be useful in companies' strategic sales management.

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