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Measuring Customers Satisfaction of E-Commerce Sites Using Clustering Techniques: Case Study of Nyazco Website

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Abstract

Today the use of modern technologies in the daily life for satisfying the needs is unavoidable. Follow the news and searching through the internet has affected organizations to provide platform on the Internet for availability of information for the customers. With the development of e-commerce, online shopping plays an increasingly important role in people's life. With the use of data mining technique prospect, managers of this site can analyze preferences and purchasing patterns of online customers in order to custom product recommendations. Data mining helps to provide services in accordance with customers' requirements. The aim of this research is to identify the customers' requirements in online shopping and cluster these customers based on independent attributes such as gender, product classification, recency, frequency and monetary. For this purpose, the data related to Nyazco website that is an e-commerce website with a variety of products, were examined as a case study in the period of 7 months. The authors of this paper will define four clusters by using k-means algorithm and RFM model by IBM SPSS Modeler 14.2 software. Customers in the third cluster and fourth cluster will be identified as the most important customers. Therefore, providing the demands of these customers should be prioritized.

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Keywords: Clustering, data mining, E-commerce, k-means, online-shopping.

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Introduction

Internet technologies have provided many competitive advantages such as agility, selectivity, individuality and interactivity. The Internet enables customers to search products and services meeting their needs with less time than before. Online shopping malls, where buyers place orders over the Internet, have emerged to become a prevalent sales channel (Shim & et al, 2012)

The rapid development of the World Wide Web has allowed people, as never before, to access information and interact globally with new markets and products (Hamel & Sampler, 1998). Over the last decade, the internet technologies such as electronic commerce have experienced phenomenal growth (McGregor and Vrazalic, 2008). Considering the turbulence and size of these developments, it is not surprising that there has been growing interest in identifying design principles and features that can enhance user satisfaction and loyalty to the proliferation of the electronic commerce (EC) sites that use the Web as their underlying technological platform (Lee & Kim, 2002).

Online shopping plays an increasingly important role in people's life. People can get the commodity they want without going out and the time to shopping out is saved (Hongli & Juntao, 2011). For online business to survive and remain competitive in the virtual marketplace, ensuring customer is imperative. It has often been cited that it is more expensive to acquire a new customer than to retain an existing one. Successful retention starts with the first customer contact and continues throughout the entire lifetime of a relationship. Hence, online firms need to ensure not only customer satisfaction but also its associated factors in repeat purchase (Zamzuri and et al., 2008). Customer satisfaction has been defined as the degree of contentment that measures consumer happiness in the shopping experience (Chen & li, 2007) or consumers' judgment of their internet retail experience as compared to their experiences with traditional retail stores (Evanschitzky & et al, 2004) and in the brand and retailer (Zboja & Voorhess, 2006).

The online shop can provide customers with more convenience through the data analysis of sale goods. And what's more, the online shops can analysis consumer's preferences and shopping patterns by data mining to make the personalized product recommendations (Hongli & Juntao, 2011). How to effectively process and use data is becoming increasingly important. This calls for new techniques to help analyze, understand or even visualize the huge amounts of stored data gathered from business and scientific applications (Liao & Chen, 2004). Among the new techniques developed, data mining is the process of discovering significant knowledge, such as patterns, associations, changes, anomalies and significant structures from large amounts of data stored in databases, data warehouses, or other information repositories (Keim and et al, 2004). Customer knowledge extracted through data mining can be integrated with product and marketing knowledge from research and can be provided to upstream suppliers as well as

downstream retailers. Thus it can serve as a reference for product development, product promotion and customer relationship management. When effectively utilized, such knowledge extraction can enable enterprises to gain a competitive edge through production of customer-oriented goods that provide better consumer satisfaction (Liao and et al., 2008). With properly classified customers, a service or product provider can target a more receptive audience. Recent researches have shown that using data mining algorithms to properly classify customers into various marketing segmentations generates some very promising results. Among those clustering algorithms the k-means method is a robust and efficient algorithm which has been used to address the customer segmentation problems. The k-means is more sensitive to initial clusters, which may lead to unpredictable results (Deng, 2013).

Accordingly, the aim of this study is to identify and classify online-shopping customers based on gender, recency, frequency, monetary and product classification. For this purpose, we analysis the record sales (2585 records) of a Nyazco website in a period of 7 month, following that, the k-means algorithm is a methodology for implementing cluster analysis to explore the clustering of segmentation for possible promotion and sale designs in order to market to customer cluster. Initially the RFM scoring was used in order to analysis of customer behavior and then, for extracting cluster, the output of RFM is used as an input for k-means clustering algorithm. Based on Silhouette validation measure, four clusters will be identified. The software used is IBM SPSS Modeler 14.2.

The rest of this study is organized as follows: In section 2, we present the background of the research. Section 3 presents the data mining process, including k-means algorithm and RFM model. Section 4 presents the methodology of research and analyzes data mining results. Section 5 presents result of data mining analysis and section 6 presents conclusion.

Background

Electronic Commerce (EC)

The Internet population has been exploding. The World Wide Web (WWW) users have been multiplying so rapidly and have widely spread into all walks of life. It has opened up tremendous business opportunities for its users (Ho and Wu, 1999). Nowadays, E-commerce is seen as an extremely dynamic economic sector and at the same time, as one of the most appealing ways of beginning or expanding a business activity (Aresti and et al., 2008). E-commerce business is one of the most significant developments in decades. More and more consumers exploit new technologies for shopping on the Net, attesting to the potential of e-commerce (Ting and et al, 2013) “Electronic Commerce”, the term first used by Kalakota and Whinston has become the most important trend for doing business in the 21st century (Kalakota and Whinston, 1996).

In the B2C e-commerce context, it is the website that represents the vendor, not a salesperson. To build an online relationship quality in B2C e-commerce, a well-designed, highly usable website becomes the equivalent of a competent salesperson (Zhang and et al, 2011). E-commerce or electronic commerce refers to the transaction of goods and services through electronic mediums or channels (Zamzuri and et al, 2008).

Online Shopping

For online shopping it is very different compared to traditional shopping. Online shopping does not allow consumers to touch, feel and experience the product that they wish to buy. Consumers are only able to decide through the photos or videos that online retailers uploaded and the description written in the website. Consumers no longer need to travel to the shop just to buy an item. Consumers just need to click to confirm the purchase and the online retailers will ship their item to the consumers' door step. Online shopping however can be a disappointment to the consumers because the product they get may not meet their expectation (Lun and Yazdanifard, 2015).

Customer Satisfaction

In this customer-oriented era, all enterprises pursue customer satisfaction as essential to gaining sustainable growth and competitive advantages (Deng et al, 2010). With the advent of a more competitive economic environment, concepts such as customer orientation and customer satisfaction are considered a basis for business, and organizations that do not pay attention to them will be eliminated from the market (Samizadeh et al., 2015). The study of satisfaction had always received large attention by researchers. It is however a subjective concept, as it can be inferred from the different definitions found in literature. Having said that, it must be pointed out that there is wide consensus that "satisfaction is a person's feeling of pleasure or disappointment resulting from comparing a product's perceived performance (or outcome) in relation to his or her expectations." Therefore, satisfaction is closely related to consumers' expectations. More specifically, the narrower the gap is between the consumers.' expectations and the actual performance of the product or service, the higher is the consumer's satisfaction (Santouridis and Trivellas, 2009).

Data Mining

To achieve the customer satisfactions the organization must follow the IT rules for extracting knowledge from the customer database and define new rules and strategies to for their attraction. Data mining is one of the IT strategy through which we can collect the all the information about the customer (Al-Mudimigh and et al, 2009). Since its emergence in the early 90's, Data mining (DM), which is defined as the non-trivial process of identifying valid, novel, potentially useful and ultimately understandable patterns in data (Nadali and et al, 2011).

Data mining is the technique to extract information from the databases. By applying data mining techniques we can discover customer behavior, customer satisfaction, and loyalty or background of the customer (Al-Mudimigh and et al, 2009). Data mining is a powerful tool that can be used to analyze large quantities of data and discover potentially helpful patterns or hidden rules. Data mining is widely used in many fields, but few researchers have applied it to location selection (Chen and Tsai, 2016). Data mining techniques can be used to elicit untapped useful knowledge from a large customer data. Data mining techniques that are useful for the analysis of customer data are association rules and/or sequential patterns analyses (shim and et al, 2012).

The explosive growth in databases has created a need to develop technologies that use information and knowledge intelligently. Therefore, data mining technology has become an increasingly important research area. There are several major kinds of data mining methods, including generalization, characterization, classification, clustering, association, evolution, pattern matching, data visualization and meta-rule guided mining, are herein reviewed (Liao and et al, 2012).

Data mining of online-shopping customers

Shu-hsien Liao and et al. (2011) combines online shopping and home delivery, and attempts to use association rules to determine unknown bundling of fresh products and non-fresh products in a hypermarket. Customers are then divided up in clusters by clustering analysis, and the catalog is design based on each of the cluster's consumption preferences. By this method, to increase the catalogue's attraction to customers, hypermarkets are offered an online shopping and home delivery business model for sales services and propositions. Accordingly, this study investigates on-line shopping and home delivery issues in the Taiwan subsidiary of a leading international retailing company, Carrefour, which is part of the hypermarket segment of retail trade. There are two data mining stages implemented in this study. The Apriori algorithm is a methodology which consists of the association rules for data mining and the K-means algorithm is a methodology for implementing cluster analysis. This study proposes association rules and cluster analysis for data mining to extract market knowledge of customers, brands, products, and purchase data from a database. This study used a field survey questionnaire approach to collect the information from consumers who purchase fresh products and non-perishable products. Fresh food is divided into the vegetables, fruits, seafood, meat and frozen foods and non-fresh food is divided into the drinks, general food, and expendable necessities. In this study, there has been some degree of relevance between ‘‘bundling product”, ‘‘database marketing”, ‘‘home delivery” and online shopping. If the three can be considered in web site features and services, companies can increase the attractiveness of sites to customers and raise the customers' willingness to purchase online.

Zhang and Wang (2014) provided one way to build “Customer Centered” data sheet based on RFM for online shopping, then with K-Means algorithm in SAS EM, succeeded in clustering the samples. In this sheet, data can be chosen from the registered user information and their trade record. Once data is prepared, leading them in Cluster components of SAS EM to build one data flow model, and then do the clustering with K-Means algorithm. The writer summarized the meaning of customer segmentation and inadequate of the model. The customer segmentation is only referring to RFM model. The limit of RFM is about the original data source which should include many trade records about every customer.

Data Mining Techniques for Clustering Customers

Clustering can be defined as the process of organizing objects in a database into clusters/groups such that objects within the same cluster have a high degree of similarity, while objects belonging to different clusters have a high degree of dissimilarity (Cho and

et al, 2012). Clustering algorithm is a kind of customer segmentation methods commonly used in data mining (Cho and et al, 2012).

The process of partitioning a large set of patterns into disjoint and homogeneous clusters is fundamental in knowledge acquisition. It is called Clustering in most studies and it is applied in various fields, including data mining, statistical data analysis, compression and vector quantization. The K-means is a very popular algorithm and is one of the best for implementing the clustering process. K-means clustering proceeds in the following order. Firstly, the K numbers of observations are randomly selected from all N number of observations, according to the number of clusters, and these become centers of the initial clusters. Secondly, for each of the remaining N–K observations, the nearest cluster found in terms of the Euclidean distance with respect to xi = (xi1, xi2, . . . , xip, . . . , xiP). After each observation is assigned to the nearest cluster, the center of the cluster is re-computed. Lastly, after the allocation of all observations, the Euclidean distance between each observation and the cluster's center point is calculated to confirm whether or not they have been allocated to the nearest cluster (Liao and et al, 2011). In addition, several studies have discuss the implementation the K-means algorithm for cluster analysis as a data mining approach has (Ture and et al, 2005; Vrahatis and et al, 2002).

Cheng and Chen (2009) proposed a new procedure, joining quantitative value of RFM attributes and K-means algorithm to extract meaning rules. Hosseini, Maleki, and Gholamian (2010) adopted K-means algorithm to classify the customer based on RFM values.

The RFM analytic model is proposed by Hughes (1994) which differentiates important customers based on the values of three variables, i.e., recency (R), frequency (F) and monetary value (M). They are defined as follows: R refers to the time interval between the last purchasing behavior and current. F refers to the number of transactions over a certain period of time. M refers to the amount of money spent on products or services over a certain period of time (Shim and et al, 2012).

Methodology

A small-sized online shopping mall in Iran provided its transaction data for analysis. It sells throughout the country some products such as mobile, tablet, PC and etc. The entire data was collected from September, 2014 till May, 2015. The dataset consists of five columns such as gender, recency, frequency, monetary, product classification. The number of customers registered is 2585, and the number of their purchasing items is 2751, respectively. After deleting the duplicated records or those with many missing or inaccurate values, we obtained 1151 customers who have purchased products at the shop. We defined 4 clusters by using k-means algorithm and RFM model by IBM SPSS Modeler 14.2 software.

Many validity measures have been proposed for evaluating clustering results based on a single realization of the random point-set process. Validity measures fall broadly into three classes: internal validation is based on calculating properties of the resulting clusters; relative validation is based on comparisons of partitions generated by the same algorithm with different parameters or different subsets of the data; and external

validation compares the partition generated by the clustering algorithm and a given partition of the data. In this study, Silhouette measure is used.

The silhouette is the average, over all clusters, of the silhouette width of their points. Where a(**x**) is the average distance between **x** and all other points in Ck, and b(**x**) is the minimum of the average distances between **x** and the points in the other clusters.

$$S(x) = \frac{(b(x)-a(x))}{\max\{b(x),a(x)\}}$$

For a given point **x**, its silhouette width ranges from −1 to 1. If the value is close to −1, then it means that the point is closer, on average, to another cluster than the one to which it belongs. If the value is close to 1, then it means that its average distance to its own cluster is significantly smaller than to any other cluster. The higher the silhouette, the more compact and separated are the clusters (Brun and et al, 2007).

In the k-means method, the number of the cluster must be entered manually. For clustering, the results of the entering different numbers in the k-means algorithm shows in table 1:

Table 1 entering different numbers in the k-means algorithm

Silhouette	Clusters
0.2 fair	3
0.3 fair	4
0.2 fair	5
0.2 poor	6
0.2 fair	7
0.3 fair	8

As is shown in table 1, if the number of the clusters is 4 and 8, silhouette measure is maximized compared to other clusters. As a result, four clusters were entered in the k-means model. Figure 1 shows the modeling of clustering by using k-means algorithm.

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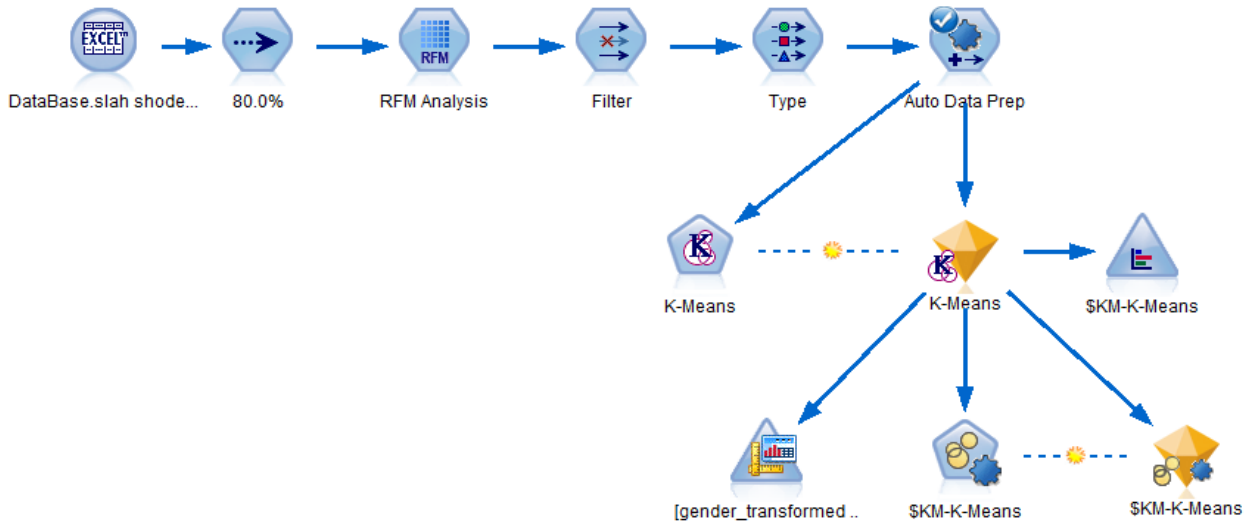

Figure 1. Modeling in SPSS Modeler Software

In RFM Analysis nod, we are applying the binning technique the recency, frequency, and monetary values of all customers were divided to 5 bins. Consequently, the amounts of recency, frequency, and monetary scores ranged from 1 to5. In figure 1, after the model was implemented and the k-means algorithm was run, clusters were identified. Application of the K-means algorithm results in the 4 clusters of Figure 1. Next to each cluster one can see the number of appearances as well as the average value of each variable.

Bin	Lower	Upper
1	>=1	<2
2	>=2	<3
3	>=3	<4
4	>=4	<5
5	>=5	<=15

Bin	Lower	Upper
1	>= 4000	< 185000
2	>= 185000	< 440000
3	>= 440000	< 778000
4	>= 778000	< 1514000
5	>= 1514000	<= 12132000

Bin	Lower	Upper
1	>= 2014-11-01	< 2014-12-19
2	>= 2014-12-19	< 2015-02-05
3	>= 2015-02-05	< 2015-03-11
4	>= 2015-03-11	< 2015-04-11
5	>= 2015-04-11	<= 2015-05-03

Figure 2. K-means result, Binning Technique for Frequency, Monetary and Recency

The above clustering results in the distribution of Figure 3. Value, proportion, percentage and count of each cluster are shown in Figure 3.

Value	Proportion	%	Count
cluster-1		37.09	336
cluster-2		21.3	193
cluster-3		20.09	182
cluster-4		21.52	195

Figure 3. Distribution of KM-K-Means

Proportion of each cluster is determined by running k-means algorithm. As is shown in Table 2, the first cluster proportion is 37.09%, the second cluster proportion is 21.3%, the third cluster proportion is 20.09% and the fourth cluster proportion is 21.52%.

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Figure 4. Running k-means algorithm, cluster quality and model summary

As is shown in Figure 4, the silhouette measure quality is 0.3 and this value is shown at the yellow part. It means that four clusters are useful for all 1151 records of customers.

Results

This section provides analysis based on RFM model and k-mean method. The product classification can be classified into 13 groups, i.e. group 1: mobile, group 2: laptop, group3: tablet, group 4: PC, group 5: office equipment, group6: camera, group 7: video and audio, group 8: software, group9: household, group 10: decorative and antique, group 11: perfumes and cosmetic, group 12: toys and group 13: group discount.

The information of gender, recency, frequency, monetary and product classification is stated below. The last purchase dates (recency) in the fifth group, where the farthest purchased date is first group. The frequency is counted by the times of purchase from September, 2014 till May, 2015, where the maximum and minimum values of frequency are more than 5 and 1, respectively. Finally, monetary is defined as the amount of spending per visit since each purchase varies significantly from 40.000 Rials to 121.320.000 Rials.

Table 2. Frequency Distribution for first cluster of customers

First cluster	Gender		Recency					Frequency					Monetary					
	F	M	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	
	15	336	72	45	63	80	74	345	0	2	2	0	11	158	128	60	0	
	Product Classification																	
	1	2	3	4	5	6	7	8	9	10	11	12	13					
	315	4	10	6	1	2	4	0	0	0	5	1	1					
Second cluster	Gender		Recency					Frequency					Monetary					
	F	M	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	
	45	154	27	88	53	18	10	113	48	13	8	11	172	10	5	4	0	
	Product Classification																	
	1	2	3	4	5	6	7	8	9	10	11	12	13					
	7	2	1	20	5	0	7	5	13	4	13	3	116					
	Gender		Recency					Frequency					Monetary					
	F	M	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5	
	15	168	26	21	31	39	61	34	39	27	26	57	21	22	46	80	34	

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Third cluster	Product Classification												
	1	2	3	4	5	6	7	8	9	10	11	12	13
	136	18	8	6	3	2	4	1	1	2	6	0	1

Fourth cluster	Gender		Recency					Frequency					Monetary				
	F	M	1	2	3	4	5	1	2	3	4	5	1	2	3	4	5
	7	172	54	24	31	41	32	0	150	30	4	1	0	0	1	0	183
	Product Classification																
	1	2	3	4	5	6	7	8	9	10	11	12	13				
	170	2	3	5	1	1	9	0	0	1	6	1	0				

Table 2 indicates that customers in third clusters are recent customers. However, it is not clear whether these customers are new customers or old customers coming back recently. The structure of frequency distribution for all clusters in table 2 is similar, skewing towards 2 times or less, except for third cluster, which has 57 customers with the frequency value above 5. Thus third cluster can be defined as customers with extremely high loyalty. The distribution of amount of money per visit in four clusters is different from each other. All customers in cluster 1 and 2 spent 4.400.000 Rials or less during each visit but customers in cluster 3 and 4 are high spenders in general.

The above table shows that first cluster has the second-highest average recency, but the lowest average frequency and the second-lowest average monetary. This group of customers brings the outfitter limited value due to their low share of wallet. The outfitter may design promotion for up- and cross- selling to increase the average amount of money spent by these customers. For second cluster, the marketing strategies are similar to those designed for first cluster. The major objectives of marketing strategies for second cluster will increase the shopping frequency and persuade customers to spend more money. Customers in third cluster are new customers but they spend more money than two previous clusters. Thus they have higher profit potentials if the outfitter can turn these customers into long-term relationship, the outfitter should consider to limit its investment in this cluster. Customers in fourth cluster have the highest average amount of money compared with the other three previous clusters and thus the outfitter may consider devoting more resources into this cluster.

Conclusion

One of the most effective methods for identifying customers is customer segmentation by clustering technique. A comprehensive customer segmentation method would be used in acquisition as well as customer retention and development. In this present paper, we proposed a new clustering method using independent attributes (such as gender, recency, frequency, monetary and product classification) based on RFM model and k-means algorithm in order to customers segmentation in the period of 7 month. Based on silhouette measure, four clusters have been generated. With this method, valuable customers are identified for Nyazco website and led the website to choose its target customers and investing on them. This means that the website allocate adequate funds for marketing to valuable customers, thus keeping these customers satisfied.

Customers in third cluster and fourth cluster are more important; therefore provide the demands of these customers should be prioritized. These customers have the highest

average amount of money compared with other clusters. Also the gender of most customers is men and most of the products which purchased are in the mobile category. Therefore, it is suggested that that the website tailored marketing strategy to the characteristics of this category of customers. The author offers some suggestion for future research.

To better and more accurate generalization of this research, the method of this paper can be used for other online shopping and results of it can be compared with the result of this research. Since the customers of different online shopping are somewhat similar to each other, we can extract clusters with such features. Also the implementation of this study in different part of the country can help to generalize the findings of this research.

In this study, according to the popularity of k-means algorithm in the literature, this algorithm was applied. Therefore, it is suggested that other data mining techniques, such as neural network and decision tree can be used in future research.

In this research, k-means algorithm was applied for clustering customers. So, in the future research other clustering method, such as kohonen and two steps, can be used.

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