COMBINING CLUSTERING ALGORITHMS FOR PROVIDE MARKETING POLICY IN ELECTRONIC STORES

Farhad Soleimanian Gharehchopogh¹, Yasin Rahimpour² and Seyyed Reza Khaze³

¹Department of Computer Engineering, Urmia Branch, Islamic Azad University, Urmia, Iran

² Department of Computer Engineering, Science and Research Branch, Islamic Azad University, West Azerbaijan, Iran

³ Department of Computer Engineering, Dehdasht Branch, Islamic Azad University, Iran,

ABSTRACT

One of the main challenges of electronic market is how to attract customers as various products and customers' preferences effect widely on it. In this paper, we have started to categorize electronic markets customers using k-means, En, Farthest first algorithms to determine marketing policies and customer satisfaction and indicated that each algorithm either cover the weakness of cluster analyzing of other algorithms for some customers or integrated data of all algorithm analyses which provided detailed results of customers' behavioral methods and its relation with their shopping basket could finally lead us to more income and increased productivity using obtained analyses.

KEYWORDS

Clustering, E-marketing, EM algorithm, k-mean algorithm, Farthestfirst algorithm

1. INTRODUCTION

Due to the increasing growth of E-commerce in internet world which resulted in commercial affairs facility, costs decrease and sales medium eliminating, the competition in this market wouldn't be so easy and require performing a series of activities which lead to the promotion in this competitive market. The main element of E-commerce in internet is how to attract customer. Certainly, customer clustering will provide an opportunity to more profit and success in marketing in such websites. In clustering the customers of E-commerce websites, the customers buying data and features are collected and stored in databases which can be used them to get the best strategy in the market. So, the main goal of this paper is to provide customer clustering and analyses to get the best strategy on available data in each clustering.

One of the main challenges of electronic market is how to attract customers as various products and customers' preferences effect widely on it. To do so, we need methods such as clustering to categorize the data rapidly. Along with, confidence is also another important factor which highly effected marketing [1].

2. CLUSTERING APPLICATION IN E-STORE MARKETING

Clustering is one of the sub-categories of data mining [2, 3] and is a process in which the similar samples are divided into groups called cluster [4]. Each cluster includes samples in which the members are similar to each other and different with the available samples of other groups [5]. Due to the clustering capabilities in marketing, it is developed to provide more profit to customers. E-commerce websites is a field in which marketing plays an important role in increasing incomes.

To attract more customers, it must be used modern methods such as clustering to increase income rate [6]. In fact, clustering make the websites capable to identify their customers and support them to be successful in obtaining profit and dealing with their competitors. As these websites are designed to develop their strategies and policies considering determined clusters, it would be a defined and specified rating to develop target customers [7].

3. CUSTOMER ELECTRONICS STORES CLUSTERING: A CASE STUDY

In this paper, to represent the clustering applications in relationship among customers behavioral methods while buying and their buying basket and also in determining supportive policies to increase profit and productivity based on similarities and differences of various groups of customers, we begin to cluster customers of Chare E-shopping in Urmia city [8]. Firstly, there were a lot of parameters about customers behavioral and favorite methods in which some of them such as gender, education, occupation, income, type of buying and satisfaction scale are selected. By gathering the noted parameters data from 100 customers of Chare e-shopping which is available in Table 1, we begin to cluster customers and provide analyses and results in following paragraphs.

Table1. Data related to 100 customers of E-shops in Urmia City

sex	age	Level of Education	Job	income	Activity	Satisfaction
MALE	19	diploma	Unemployed	low	Book	Yes
MALE	39	Bachelor	Employee	medium	Audio and video	No
MALE	43	Master's Degree licence	Employee	high	software & hardware	Yes
FEMALE	33	Ph.D.	Employee	high	Multimedia	Yes
MALE	56	under diploma	Free	high	Audio and video	Yes
MALE	20	diploma	Unemployed	low	software & hardware	No
MALE	35	Bachelor	Unemployed	low	Multimedia	Yes
MALE	32	Master's Degree licence	Employee	high	software & hardware	Yes
MALE	50	Ph.D.	Employee	high	Book	Yes
MALE	23	associate degree	Unemployed	low	software & hardware	Yes
MALE	21	diploma	Unemployed	low	Multimedia	No
MALE	28	Master's Degree licence	Free	medium	Book	Yes
MALE	23	Bachelor	Free	low	Multimedia	Yes

FEMALE	22	under diploma	Unemployed	low	Audio and video	No
MALE	18	under diploma	Unemployed	low	Book	Yes
MALE	18	under diploma	Unemployed	low	Multimedia	Yes
MALE	43	Ph.D.	Employee	high	Book	Yes
FEMALE	60	Ph.D.	Employee	high	Audio and video	Yes
MALE	43	Master's Degree licence	Free	high	software & hardware	Yes
FEMALE	43	Master's Degree licence	Employee	medium	Book	Yes
MALE	40	Diploma	Free	low	Audio and video	Yes
FEMALE	18	Diploma	Unemployed	low	Multimedia	Yes
MALE	17	under diploma	Unemployed	low	Multimedia	Yes
MALE	20	Diploma	Unemployed	low	Multimedia	Yes
MALE	18	Diploma	Free	high	software & hardware	Yes
MALE	19	Diploma	Unemployed	low	software & hardware	No
MALE	32	Bachelor	Free	medium	software & hardware	Yes
FEMALE	42	Bachelor	Employee	medium	software & hardware	Yes
MALE	23	Bachelor	Free	medium	software & hardware	Yes
FEMALE	43	Bachelor	Employee	high	Book	Yes
FEMALE	44	Bachelor	Employee	high	software & hardware	Yes
MALE	22	Diploma	Free	medium	Multimedia	Yes
MALE	22	under diploma	Free	medium	Audio and video	Yes
FEMALE	19	under diploma	Unemployed	low	Audio and video	Yes
MALE	16	under diploma	Unemployed	low	Audio and video	Yes
MALE	30	Master's Degree licence	Employee	medium	Audio and video	Yes
FEMALE	24	Bachelor	Employee	medium	Audio and video	Yes
MALE	16	under diploma	Unemployed	low	Audio and video	Yes
FEMALE	19	under diploma	Unemployed	low	software & hardware	No
FEMALE	32	Bachelor	Employee	medium	software & hardware	Yes
FEMALE	34	Bachelor	Free	low	software & hardware	Yes
MALE	26	Bachelor	Employee	medium	software & hardware	Yes
MALE	24	Bachelor	Free	medium	book	Yes
FEMALE	29	Bachelor	Free	high	book	Yes
MALE	37	Ph.D.	Employee	high	book	Yes
FEMALE	45	Ph.D.	Employee	high	multimedia	Yes
MALE	32	associate degree	Employee	medium	multimedia	Yes
MALE	22	under diploma	Unemployed	low	book	No

MALE	19	under diploma	Unemployed	low	book	No
MALE	21	diploma	Unemployed	low	book	No
FEMALE	27	diploma	Free	medium	multimedia	No
MALE	23	associate degree	Employee	medium	multimedia	Yes
MALE	32	Ph.D.	Employee	medium	Audio and video	Yes
FEMALE	46	Ph.D.	Free	high	Audio and video	Yes
MALE	19	under diploma	Unemployed	low	software & hardware	Yes
MALE	21	diploma	Unemployed	low	multimedia	Yes
MALE	22	diploma	Free	low	book	Yes
MALE	22	associate degree	Free	low	book	Yes
FEMALE	28	Bachelor	Free	high	book	Yes
MALE	23	Bachelor	Unemployed	medium	software & hardware	Yes
MALE	16	under diploma	Unemployed	low	multimedia	Yes
MALE	15	under diploma	Unemployed	low	multimedia	Yes
FEMALE	28	Bachelor	Employee	medium	book	Yes
FEMALE	38	Bachelor	Employee	medium	software & hardware	Yes
MALE	46	Ph.D.	Employee	high	software & hardware	Yes
MALE	24	Bachelor	Employee	medium	multimedia	Yes
FEMALE	24	associate degree	Employee	medium	multimedia	Yes
MALE	24	under diploma	Free	medium	multimedia	No
MALE	17	under diploma	Unemployed	low	multimedia	No
FEMALE	36	Bachelor	Free	medium	software & hardware	Yes
FEMALE	32	Bachelor	Free	medium	software & hardware	Yes
MALE	34	Bachelor	Employee	medium	software & hardware	Yes
MALE	21	diploma	Unemployed	low	book	Yes
FEMALE	29	Master's Degree licence	Employee	high	Audio and video	Yes
MALE	18	under diploma	Unemployed	low	multimedia	Yes
MALE	18	under diploma	Unemployed	low	book	Yes
MALE	17	under diploma	Unemployed	low	book	Yes
MALE	16	under diploma	Unemployed	low	multimedia	Yes
FEMALE	22	Bachelor	Employee	medium	software & hardware	Yes
MALE	52	Ph.D.	Employee	medium	multimedia	Yes
FEMALE	22	diploma	Employee	medium	multimedia	Yes
MALE	23	Bachelor	Employee	medium	book	Yes
FEMALE	21	diploma	Employee	medium	book	Yes
FEMALE	27	diploma	Employee	medium	book	Yes

FEMALE	29	diploma	Employee	medium	book	Yes
FEMALE	22	associate degree	Unemployed	low	Audio and video	No
FEMALE	22	associate degree	Unemployed	low	multimedia	No
MALE	21	diploma	Unemployed	low	multimedia	Yes
FEMALE	28	under diploma	Free	high	multimedia	Yes
MALE	32	Ph.D.	Employee	high	Audio and video	Yes
FEMALE	22	diploma	Unemployed	low	software & hardware	No
FEMALE	27	Master's Degree licence	Employee	medium	software & hardware	Yes
MALE	25	Bachelor	Unemployed	low	book	Yes
MALE	18	Diploma	Unemployed	low	book	Yes
MALE	27	Bachelor	Employee	high	Audio and video	Yes
FEMALE	28	Master's Degree licence	Employee	high	Audio and video	No
MALE	29	Master's Degree licence	Free	medium	software & hardware	Yes
FEMALE	19	Diploma	Unemployed	low	software & hardware	Yes
MALE	18	Diploma	Unemployed	low	book	Yes
FEMALE	25	Bachelor	Unemployed	low	book	Yes

4. CUSTOMERS CLUSTERING USING DATA MINING ALGORITHMS

EM is one of the assigned algorithms of clustering and can determine how clusters can create cross-validation. EM algorithm is used to find maximum possible parameters of statistical model in equations which aren't directly solvable [9]. These models usually include potential variables to increase unknown parameters. It means that either there is lost scales among data or the model can be easily adjusted if it is supposed that there are additional data in unseen points. We, in this paper, assign a possible distribution using this algorithm and indicate the possibility of belonging to each customer cluster. K-means is one of the most popular and simple algorithms which simply solve clustering problem [10]. Here, central K is defined for each cluster of customers. These centers must be selected with high accuracy [11]. Due to the features of this algorithm, the numbers of customer clusters are determined in advance, and then each customer (in the case of similarity) is placed in determined cluster after comparing to customer cluster center. Here, the customers are divided in 4 clusters because if the different centers are selected, it might be created different results. So, the best way to choose centers is that they have the maximum distance from each other. In the next stage, the most similar customer to the cluster centers is assigned to that one. In the next stage, the customers' clusters centers are updated and then the previous stage is repeated as far as no changes occur in cluster. In this case, the customers clustering are finished. Farthestfirst algorithm is another type of k-means which determine the location of cluster center in the farthest point than the available clusters centers [12].

In following, using clustering algorithms to cluster customers, firstly one of the customers is considered as the first cluster center and the next customer as the farthest to the first center and then the third one for the farthest customer to two other customer centers. The final clustering includes the noted stages repetition.

5. DISCUSSION

We, in this paper, use weka tools which are open and free source tool to implement data mining projects [13],[14]. The used k-means results are indicated in Table 2 using this tool to customer clustering.

Table2. Data related to clustering using k-means algorithm

		cluster 0	cluster 1	cluster 2	cluster 3
k-mean	sex	FEMALE	FEMALE	MALE	MALE
	age	20.3333	32.9348	27.4737	20.3478
	Level of Education	under diploma	Bachelor	diploma	diploma
	Activity	Book	soft & hardware	book	Multimedia
	Satisfaction	No	Yes	Yes	Yes
	Clustered Instances	12%	46%	19%	23%

As it is shown, in obtained clusters of –means algorithm, it is assigned clusters 0 and 1 to females and 2 and 3 to males, respectively. Cluster 0 indicated that the women with average 20 years old were mainly under diploma degree, bought books and were displeased about it. The obtained results of Cluster 1 also indicated that women with average 32 years old were bachelor and bought software and hardware and had relative satisfaction about it.

As this cluster includes 46% of sample community, it can be considered marketing policies and customer attracting regarding the requirements of this group of customers and tried to keep their satisfaction. It can also be modified dissatisfaction rate of buying books via customers' feedback. By gathering their comments, it can be provide their desirable books based on age range of buyers and promote the satisfaction rate. The obtained results of Cluster 2 and 3 indicated that the provided books in shop is according to men needs and had medium scientific level. It was also proper for average 27 years old. The provided multimedia is identified appropriately and this approach can be followed in the shop due to its cheerful and youth favorite products.

We also begin to customer clustering using EM algorithm. The results are indicated in Table 3.

Table3. Data related to clustering using EM algorithm

		cluster 0	cluster 1	cluster 2	cluster 3
EM	sex	MALE	MALE	MALE	MALE
	age	40.5116	21.2108	17.6175	26.979
	Level of Education	PH.D	Diploma	under diploma	Bachelor
	Activity	Audio & video	book	multimedia	software & hardware
	Satisfaction	Yes	no	Yes	Yes
	Clustered Instances	26%	16%	21%	37%

The results of this algorithm clustering allocate to the men which brings advantages and challenges as well. The advantage will be that it provides more detailed results about this gender. The challenge is the lack of marketing and the need to do it for females. So, it can be optimally used this clustering to determine marketing policies of male customers. The results indicated that men with average 40 years old were mostly tend to buy audio and video products and as they average grade were PhD, so they had high satisfaction. The obtained data indicated that they had relative satisfaction about provided products in the market and this approved that these products had high quality.

The youth men who tend to buy books with average 20 years old have shown dissatisfaction. The similar one is also obtained in results of K-means algorithm which provided for women with the same age range. Clearly, due to the obtained results, it must be reviewed about the provided books appropriate to the different age range in the market. In clusters 2 and 3, it is also shown that either men or women feel satisfied about the provided software and hardware products. Considering the results of EM and K-means algorithms, the buying average rates of these products belong to those who had bachelor degree. FM algorithm is also demonstrated the obtained results of 17-20 age range for men. These results have shown that the multimedia products of this shop provided full satisfaction for the customers who had mean degree. The obtained results of Farthestfirst have been solved some challenges of other algorithms in customers' clustering. The obtained results are indicated in Table 4.

Table 4: data related to clustering using Farthestfirst algorithm

		cluster 0	cluster 1	cluster 2	cluster 3
farthestfirst	sex	FEMALE	MALE	FEMALE	MALE
	age	22	52	29	40
	Level of Education	associate degree	Ph.D.	bachelor	diploma
	Activity	Audio & video	multimedia	book	Audio & video
	Satisfaction	No	yes	Yes	Yes
	Clustered Instances	17%	27%	26%	30%

The clustering we have had with previous algorithms has brought ambiguity for young women customers who proposed to by audio and video products in finding marketing policies type. By using achieved results of farthestfirst algorithm, it is shown that women with average 22 years old feel dissatisfied about provided audio and video products in the market. It is also indicated that women who averaged 29 years old purchase book and feel satisfied about it. It must be note that the average grade of this cluster was bachelor. The men with average 52 years old begin to purchase multimedia products and feel satisfied about it. Men with diploma who bought audio and video products had average 40 years old and feel satisfied. The achieved data of 3 algorithms results are shown in Table 5.

Table5. Analyzed data of customer clustering

Type of product	Analysis	Analytical results
Audio and Video (Normal quality for playback on Mobile)	Gender-based	Among people at all levels of school satisfaction there, but there is dissatisfaction among young women. Therefore take gender-specific and product-related men.
Hardware and Software	education-based	Most applicants for such products have a bachelor's degree and are satisfied with the purchase. This product has not bought the other Degrees
Book	Age-based	Who range in age from 20 to 21 and have put them under graduate degree has been reluctant to purchase books. There is no difference between men and women. People in the age range 27 to 29 years have been, men with diploma And women with bachelor's degrees, have been satisfied from buying books.
Multimedia (high quality for playback on computer)	Gender-based	None of the clusters, buy Multimedia has been done by women. All purchases from the monopoly of men And in all age ranges and for all qualifications have satisfied.

7. CONCLUSIONS

Each clustering algorithms are solely capable of focusing on particular parts of customers' data in electronic shops. This focus brings better and more detailed results to the same parts. Meanwhile, in analysing other parts, due to the lack of clustering analyses, it brings challenges to them. So, each algorithm is capable of doing detailed analyses of some parts of customers' data. To provide comprehensive results and clustering analyses, it must be used several integrated and clustering algorithms. We, in this paper, investigate different types of methods and clustering algorithms. Finally, by using K-means, farthest first, EM samples of customers of an E-commerce websites, we made clustering vie Weka software.

We indicated that each algorithm covers the clustering analyses weaknesses of other algorithms for some customers. The integrated data of all algorithms analyses brings detailed results from customers' behavioural method and its relation with shopping basket as well. So, by using integrated collective data, it can be determined marketing policies and customer satisfaction appropriate to all customers' clustering and their orientation which finally lead to increased productivity and incomes.

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Authors

Farhad Soleimanian Gharehchopogh is currently Ph.D. candidate in department of computer engineering at Hacettepe University, Ankara, Turkey. And he works an honour lecture in computer engineering department, science and research and Urmia branches, Islamic Azad University, West Azerbaijan, Iran. He is a member of editorial board and review board in many international journals and international Conferences. His interested research areas are in the Operating Systems, Software Cost Estimation, Data Mining and Machine Learning techniques and Natural Language Processing. For more information please visit www.soleimanian.net

Yasin Rahimpour is a M.Sc. student in Computer Engineering Department, Science and Research Branch, Islamic Azad University, West Azerbaijan, Iran. His interested research areas are Meta Heuristic Algorithms, Data Mining and Machine learning Techniques.

Seyyed Reza Khaze is a Lecturer and Member of the Research Committee of the Department of Computer Engineering, Dehdasht Branch, Islamic Azad University, Iran. He is a Member of Editorial Board and Review Board in Several International Journals and National Conferences. His interested research areas are in the Software Cost Estimation, Machine learning, Data Mining, Optimization and Artificial Intelligence.