Indian Journal of Science and Technology, Vol 9(38), DOI: 10.17485/ijst/2016/v9i38/102552, October 2016
ISSN(Print) : 0974-6846
ISSN(Online) : 0974-5645

Frequent Pattern to Promote Sale for Selling Associated Items for Recommender in e-Commerce

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Abstract

Background/Objectives: Nowadays, many people enjoy the direct purchase on e-commerce which many kinds of item are increasing explosively. Existing method has a weakness of the accuracy to forecast, leaving customers unsatisfied. **Methods/Statistical Analysis:** We search association rule into customers' buying behavior and discover items of group purchase which promoted cooperative buying. We can also create the table of association rules in the whole purchase history data to join customer's record. If a customer would want additional sale for cross selling and up selling, the system could recommend the items which worked on the rate threshold of association rules to promote sale. **Findings:** We search association rule into customers' purchase data and discover frequent pattern to promote sale for selling associated items, to forecast frequent pattern of customer's interest of item. We need to make clustering the category of associated items to reflect the customer's propensity to reflect customer's interest of associated item as well as to create the table of association rules in the whole purchased history data to join customer's record. Our proposing system is higher 19.15% in F-measure than existing system. We execute the preprocessing for clustering the category of associated items to reflect the customer's propensity. Our proposing system is higher 27.42% in recall, even if it is lower 12.23% in precision than previous system which conducted the analysis of segmentation to have different weights, is advanced than existing system. Our proposing system is better in F-measure than both the previous system and existing system. We could recommend associated items which worked on the rate threshold of association rules to promote sale, if a customer bought associated items. **Improvements/Applications:** We have the improvement that proposing system is higher 12.54% in F-measure than existing system. We make application to promote sale for selling associated items in e-commerce.

Keywords: Association Rules, Clustering, Collaborative Filtering, Segmentation Method

1. Introduction

E-commerce firms such as Amazon, Alibaba and Snapdeal, enlarge the plan of upscale. Nowadays, many kinds of item are increasing on e-commerce. Customers easy find items in the recommender system. In this trend, the personalization is becoming a very important technology that can find exact information to show customers. The explicit method, which is used in existing system, cannot reflect exact items' attributes. Each item has to have different value. We have to reflect the difference of attribute of goods or service. Recently, the researches of recommender have improvement for the accuracy of recommending service in e-commerce. Thus, clients and the company can take some benefit from recommendation system on e-commerce environment. We propose frequent pattern to promote sale for selling associated items for recommender system. We improve proposing system performance than existing system in e-commerce.

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1.1 Collaborative Filtering

This method uses the ratings of other users's preferences or taste information from many users to generate automatic predictions. It adopts the explicit method to use user profiles for rating but the implicit method that does not use the profile for rating. It uses the purchase data or user's weblog to show customer's buying patterns to reflect the customer's preferences[1]. However, the explicit method has a shortcoming of the accuracy of analyzing the customers' propensities and level and interests as well as cost problems. In this paper, we can analyze the attribute of customer and the attribute of item for the various customization using segmentation method and then can generate the category of associated items selected by customers' propensity.

1.2 Segmentation Method

We analyze the segmentation to keep the customers' score and items' score for recommending service. The FRAT means that what the F stands for is frequency, what the R for is recency, what the A for is amount and what the T for is type of merchandise or service[2]. It has five bins. The variables (W_1, W_2, W_3, W_4) are the weight.

$$\text{FRAT score} = F \times W_1 + R \times W_2 + A \times W_3 + T \times W_4$$

We propose that what a customer buys at present will be indicative of what that customer will buy in the future. We make the FRAT score according to the expression. The FRAT score shows how to determine the customers, for instance as seen in Table 1. We make the result of statistics for customer's score and item's score which works on the decision method of segmentation analysis as seen in Table 2 and Table 3. It indicates the result of level as follows Figure 1 and Figure 2.

1.3 Association Rules

This mining is useful tools for discovering a strong relationship in a large database[3]. The purpose is to search customers' buying behavior and discover items of group purchase which promoted cooperative buying. Association rules meet the requirement for threshold of confidence, then the candidate item is inserted to the association rules which

Table 1. The decision method for FRAT score

FRAT / Rank	F (times)	R (months)	A (times)	T	
				Member	Code
5	31>	1 ~ 2	$500>	14>	31>
4	21 ~ 30	3 ~ 6	$200 ~ $499	12 ~ 13	21 ~ 31
3	11 ~ 20	5 ~ 9	$50 ~ $199	8 ~ 11	11 ~ 20
2	6 ~ 10	8 ~ 12	$10 ~ $49	4 ~ 7	6 ~ 10
1	0 ~ 5	12>	0 ~ $9	0 ~ 3	0 ~ 5

Table 2. The level for customer's score

score	Rank	RFM	FRAT
score 90 > =	A	1	1
score 80 > = & < 90	B	3	13
score 60 > = & < 80	C	176	164
score 40 > = & < 60	D	39	41
score 20 > =& < 40	E	3	3
score < 20	F	0	0

Table 3. The level for item's score

	Rank	RFM	FRAT
score 90 > =	A	0	0
score 80 > = & < 90	B	1	0
score 60 > = & < 80	C	48	55
score 40 > = & < 60	D	420	465
score 20 > = & < 40	E	288	237
score < 20	F	0	0

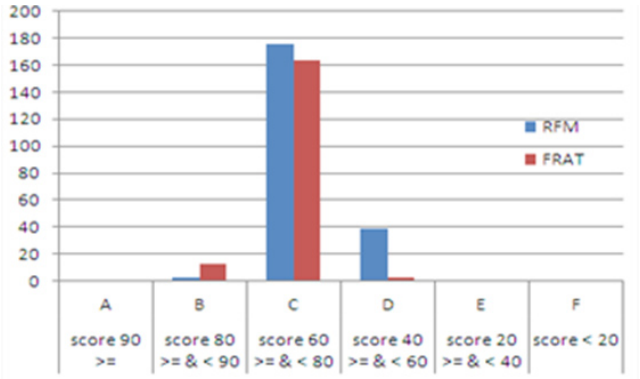

Figure 1. The result of level for customer's score.

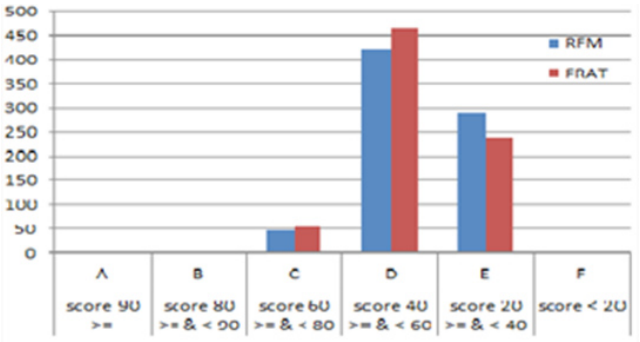

Figure 2. The result of level for item's score.

meet threshold, then created all subsets of a large item sets[4]. In this paper, we make the table of association rules using mining association rule to generate the cluster of associated items. The table of association rules as seen in Table 4.

2. Proposed Work

2.1 Our Proposal for Recommender System using Frequent Pattern in e-Commerce

In this section, we can depict frequent pattern to promote sale for selling associated items to forecast frequent pattern of customer's interest of item. Existing recommending methods are identified with difficulties in analyzing the customers' propensities, level and interest, as well as cost problem, i.e. that method used in existing recommender system can't do to reflect exact items' attributes. To make the preparing of recommender system in e-commerce, there are the several steps of preparing the recommender system using frequent pattern[5,6]. At first, the system takes the analysis of segmentation based on whole purchase history data to join customer's record, i.e it keeps the customers' score and items' score to reflect customers' attributes and items' attributes. Before executing preprocessing for creating the associated items, it generates the cluster with user group as a neighborhood. Using an implicit method, we need to make the task of mining association rule in the whole purchased history data to join customers' data. We also make the task of clustering the category of associated items to reflect the customer's propensity, to reflect customer's interest of associated item. And then, it creates the cluster of associated items sorted by code of item, joined the cluster with user group as a neighborhood to be possible to recommend the items. The procedural steps of proposing system using frequent pattern is depicted as seen in Table 5.

Table 4. The table of association rules

item1	→	item2	Support count	support	confident
BBA14	→	AAC63	3	1.33	100
BCA81	→	AAD44	3	1.33	20.00
ABB31	→	ABC53	3	1.33	100
BCA83	→	ABD66	3	1.33	13.04
BCA54	→	BAA3	3	1.33	20.00
AAC63	→	BBA14	3	1.33	60.00
BAA3	→	BCA54	3	1.33	60.00
BCA96	→	BCA83	4	1.78	50.00
AAD44	→	BCA81	3	1.33	100
ABD66	→	BCA83	3	1.33	13.04
BCA83	→	BCA96	4	1.78	17.39

2.2 The Analysis of Customer's Propensity

The statistical result indicates the output of customer's propensity in customer data, which works on social variables, demographic factors as follows Figure 3.

2.3 The Recommender System using Frequent Pattern

The system uses the clusters which works on the same propensity of login user. The procedural steps for recommender system is depicted in Table 6. We execute the preprocessing for clustering of the category of associated items to reflect the customer's propensity, to reflect customer's interest of associated item for recommender system in e-commerce.

3. Experiment and Result

3.1 Experimental Data for Evaluation

We used 222 users who had the experience to purchase items using internet. We used 874 cosmetic items[6,7] used by

Table 5. The procedural steps for recomending service using frequent pattern

Step 1: The system takes the analysis of segmentation based on whole purchased history data to join user's record.
Step 2: It generates the cluster of user group as a neighborhood with social variables.
Step 3: The system runs mining association rule in the whole purchased history data to join customers' data.
Step 4: The system executes clustering the category of associated items to reflect the customer's propensity.
Step 5: The system creates the cluster of associated items sorted by code of item, joined the cluster of user group as a neighborhood.
Step 6: It conducts the task of adjusting the result via mining association rules.
Step 7: The system prepares the task of recommending service using mining if customer bought item for cross selling and up selling.
Step 8: We recommend items with purchasing-power which worked on the rate threshold of association rules.

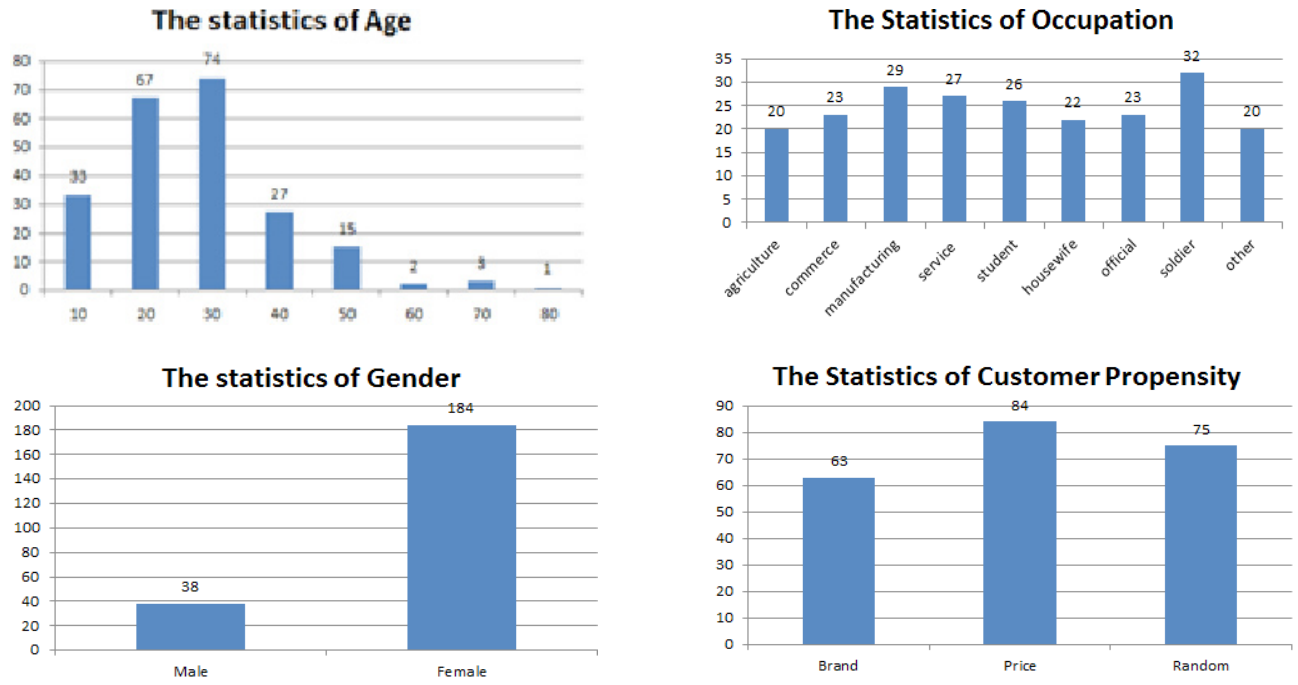

Figure 3. Satistical result of the output for analyzing customer's propensity in customer data.

Table 6. The procedural steps for recomender system

Step 1: When user enter the system, the system scans user-group selected by the same propensity for login user. The system recognized customer's propensity and score.
Step 2: The cluster is classified by social variable and the same propensity for login user.
Step 3: It uses cluster selected by the same propensity of login user.
Step 4: The system scans customer's preference for the category of associated items in the selected cluster.
Step 5: The system selects the items by frequent pattern according to the preference of the categories of associated items.
Step 6: The system put items selected items by the same propensity for login user into recommending list. The system recommends TOP-4 of items to customer.
Step 7: If a customer purchased more associated items, the recommender took the service to have items which worked on the rate threshold of association rules to promote sale.

current industry, 1975 counts for purchase history data to evaluate proposing system. We make the implementation of prototyping for cosmetics professional mall. We did the implementation of prototyping for recommender system. We did the evaluation for proposing system. The 1st system of clustering the category of associated items to reflect the customer's propensity is proposing system designated as "proposal," the 2nd system is the previous system to reflect the weight based on FRAT method designated as "Previous" and the 3rd system is existing system designated as "Existing".

3.2 Experiment and Result Analysis

We use the tool of measurement for system performance evaluation, which are including Precision, Recall and F-measure for proposing system. The system performance was performed to prove the validity of recommendation and the system's overall performance evaluation. We use the tool most widely used for recommender systems using learning data set and testing data set. The measurement was used in the field of information retrieval commonly[8]. It presents the evaluation for recommendation system as seen in Table 7. It also indicates the result of measurement as follows. Figure 4 to Figure 6 The numbers of cluster (C1~C11) had finished grouping the category of associated items. Although the recall for proposing system was a little lower (0.61) than the recall for the existing system but the precision for proposing system are higher (23.11) than the precision for existing system. The F-measure for proposing system are higher (19.15) than the F-measure for existing system. The previous system has conducted the analysis of segmentation to have different weights based on more advanced FRAT method than existing system. Proposing

Table 7. The result of system evaluation for recommender

Cluster	Proposal			Previous			Existing		
	Precision 1	Recall 1	F-measure 1	Precision 2	Recall 2	F-measure 2	Precision 3	Recall 3	F-measure 3
C1	28.16	55.32	37.33	50.00	15.48	23.64	12.00	60.29	20.02
C2	26.05	50.56	34.39	33.33	16.67	22.22	10.71	52.54	17.80
C3	24.26	53.90	33.46	100	16.67	28.58	10.86	54.14	18.09
C4	28.27	57.95	38.00	29.16	15.48	20.23	11.35	55.44	18.84
C5	50.16	26.54	34.71	37.38	13.86	20.22	11.00	27.55	15.72
C6	34.26	47.68	39.87	38.89	14.82	21.46	10.70	46.81	17.42
C7	37.34	41.40	39.26	43.33	25.00	31.71	12.37	41.67	19.07
C8	45.70	29.44	35.81	48.52	14.05	21.80	11.07	30.33	16.21
C9	35.96	39.74	37.76	41.67	15.48	22.57	10.68	41.01	16.94
C10	34.77	40.63	37.47	54.00	25.33	34.49	10.86	40.32	17.11
C11	32.11	46.43	37.96	35.33	15.12	21.18	11.26	46.25	18.11

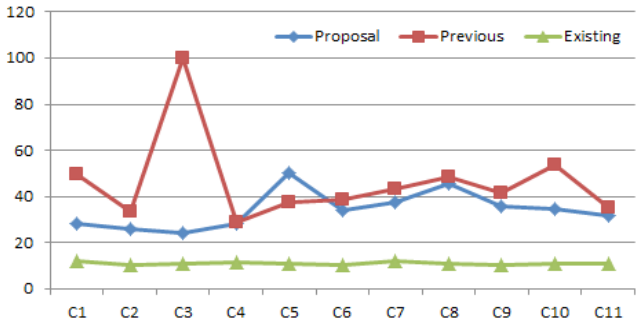

Figure 4. The result of precision for recommender.

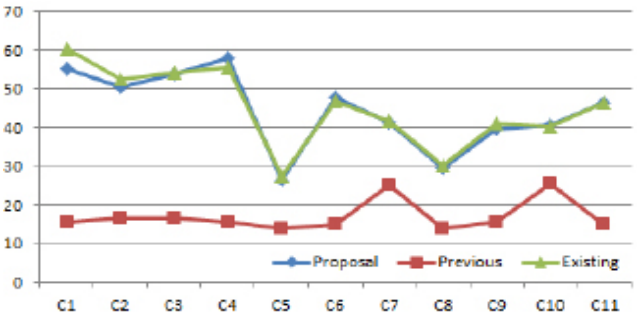

Figure 5. The result of recall for recommender.

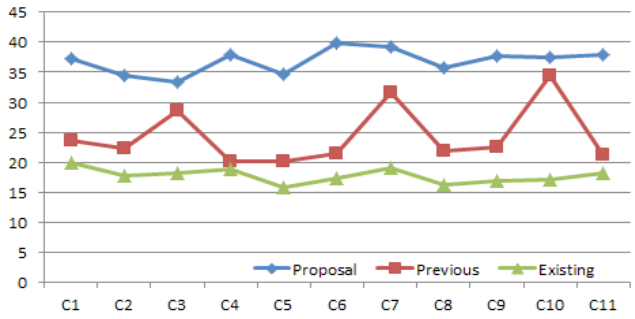

Figure 6. The result of F-measure for recommender.

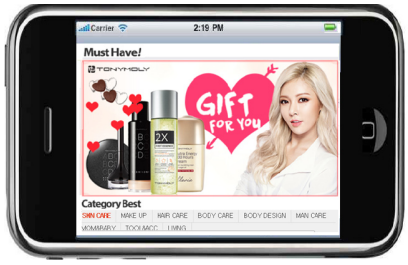

Figure 7. The screen of recommender system.

system using clustering the category of associated items to reflect the customer's propensity is higher 27.42 in recall, higher 12.54 in F-measure although it is lower 12.23 in precision than previous system. The proposing system is better than both the previous system and existing system. It indicates the screen of recommender system on a smart phone as above. In Figure 7, proposing system is improvement of performance than existing system.

4. Conclusion

From e-commerce to e-services, there are many areas where recommender systems have proven their worth[9]. Recommendation system makes recommendations to the consumers regarding user and product profiles based on feature values[10]. Today it does, indeed, have recommender system it is crucial elements in a competitive e-commerce application. We proposed a recommender system in e-commerce using frequent pattern to promote sale for selling associated items to forecast customer's interest of item. The proposing system using clustering the category of associated items to reflect the customer's propensity was different from both previous system and existing

system. We could recommend the item with purchasing-power using frequent pattern to promote sale for selling associated items to forecast customer's interest of item. We could recommend associated items which worked on the rate threshold of association rules to promote sale, if a customer bought associated items as additional request. It is meaningful to present recommending service using frequent pattern to promote sale for selling associated items to forecast customer's interest of item in e-commerce. It represent much to present recommending service using frequent pattern to promote sale for selling associated item to forecast customer's interest of item in e-commerce.

5. Acknowledgement

It was supported from Namseoul University. This paper is a revised and expanded version of a paper entitled "A Study of Frequent Pattern to promote sale for selling associated items for Recommender in e-Commerce" presented at [moon, January 19–21, 2016, The 3rd International Conference for Small and Medium Business, Ho Chi Minh City, Vietnam].

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