The Personalized Recommendation with Bundling Strategy Based on Product Consuming Period

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Abstract: In an intensively competitive environment of e-commerce, how businesses maintain a good customer loyalty and master the consumption trend of customers have become the key factors for today’s business survival. If personalized recommendation is implemented concurrently through bundling or tie-in sales strategies, businesses are likely to increase sales opportunities for their products. Nonetheless, most of the bundling or tie-in sales strategies are business-niche oriented in which the businesses design the product composition and they rarely take into account customer requirement and preferences. Therefore this approach has also failed to offer a prediction and recommendation for customer repurchasing or even to recommend precisely based on the product periodicity. In view of this, with the objective to effectively implement the bundling or tie-in sales strategy into the recommendation system, the study proposes the periodical product bundling recommendation system (PPB-RS), thereby analyze customer’s periodical needs, preferences, and product purchasing periodicity, while taking the product periodicity and preference as reference for product composition of bundling or tie-in sales strategy. The empirical experiment from the study proves the superior performance of PPB-RS.

Keywords: Periodicity, Personalize, Recommendation System, Bundling, Tie-in Sales Strategy

1. Introduction

With prosperity in the development of internet, the number of the global internet-surfing population has an unceasingly climbing tendency, which has also brought effects from digital transaction patterns and E-commerce industries. Following by the availability to all and impacts of E-commerce, business websites in order to increase business profit and to enhance product sales opportunity, shall not adhere and confine to traditional sales strategy but to provide personalized product and services based on personal demand for individual customers. Nonetheless, how businesses conform to customer’s strict budgeting, to stimulate customer’s expensing desire and raise their repurchasing opportunities have become one of the major tasks to cope with. To increase sales, bundling or tie-in sales strategies are frequently applied on the sales of various products. Such type of sales means selling two or more products or services combined bundling or tie-in sales to the market [3,4]. This is a marketing strategy which has been extensively applied on product promotion, with the objective of raising the sales volume of a product, and to enhance the overall sales performance to increase business profits. This strategy can lower production costs, increase product exposure, sales opportunities and to enhance customer royalty, as well as expanding market share. Therefore, bundling or tie-in sales have become a general marketing tool for businesses.
However due to massive amount of data or numerous varieties of products, customers also face problems [5,6,7] overload, which results in customers spending more time to read about product information and to search out the products they really need. Therefore how to reduce the product searching time for customers and to effectively present the truly required products for customers, have literally become the foremost important issues for the businesses nowadays. Accordingly, a recommendation system has been created in response to solving problems of information overload.

Recommendation system is a personalized service means [6,7,8,9] base on information filtering (IF). The main objective here is to analyze customer purchasing behavior and appeals through customers’ personal historic data. The recommendation system in accordance with customers past historic transaction records or through historic transaction records of other customers with similar preferences, is used to successfully predict and to infer product with preferences for customers, and appropriately provide possible potential demand information of customers, hence not only to induce customer’s purchasing desire but also to increase opportunities of product cross-sell.

In order to increase business profit and to raise opportunities for product sales, in the past there have been scholars who have proposed a bundling or tie-in sales recommendation system to raise sales volume. Recommendation system not only possesses analytical and predictive functions, but also can filter out suitable product to accomplish personalized sale according to customer’s historical transaction records. Therefore, this system is applicable for recommending online bundling or tie-in sales to customers. Although bundling or tie-in sales strategies have multiple advantages in product exposure, effects in enhancing customer royalty and market share expansion, the combination method of product composition differs from the traditional single product sales had resulted in the sole consideration of product bundling to reduce stock in the implementation process, while the lack of consideration of consumers (customers) personal demand or preferences has made the product composition not completely fulfilling customer demand and preferences, and usually will disappoint customers in purchasing and fail to stimulate purchasing rate. Even though product exposure increases, customer demand has not been completely been fulfilled. Nonetheless some studies [4] have pointed out that to improve flaws in customer demand through bundling or tie-in sales recommendation system, this however does not proactively recommend personalized product oriented toward customer personal demand, which will ultimately reduce the recommendation efficacy and quality. Therefore, how to choose an appropriate personalized product under existing bundling or tie-in sales strategy has become more important. In view of this, the study will emphasize on improvement on above-mentioned issues and to propose an analytical method on consumer product purchasing with periodical product bundling sales or tie-in sales strategy, thereby enhance recommendation efficacy on personalized product through this concept.

To acquire customer consuming habits more precisely, the study applies RFM (Recency, Frequency, Monetary)[13,26] Analytical Method to analyze customer user profile for personal preference and consuming habit, then assess the acquired customer repeating demand, product preference level and purchasing periodicity after analysis, followed by the result of this assessment to achieve automatic sales combining proactive periodical recommendation through content-
oriented recommendation and personalization method which combines mixed bundling or tie-in sales strategy, in order to provide customers with a periodical recommendation mechanism.

2. Related work
Due to the participants in this study mainly involve on periodical consumer product for bundling or tie-in sales, the objective of the study is to achieve recommendation for personalized product, thereby this chapter will review with an emphasis on the relevant techniques and theories adopted by this study.

2.1 Bundling or Tie-in Sales
From the practical perspective of marketing, promotional strategy is one marketing activity used by businesses to stimulate customer needs, providing inducing factors which are beneficial to customer purchasing in short-term period, while stimulation of customer purchasing desire has been on the strategies commonly applied to product promotion [34, 7-13, 15, 16]. Simply put, it is the bundling or tie-in sales strategy. In real life, promotional activities can be easily recognized in that bundling or tie-in sales Strategy is part of the product promotion techniques, for example, a red-labeled product when bundles with a green-label product aims for raising product sales volume, therefore increase the overall sales performance and business profits.

2.2 Recommendation System
Recommendation system refers to an information-filtering service technique [17-20] according to customer’s preferences or appeals, which assists customers in solving problems with information overload, and in delivering out useful information to recommend to the customers. on the other hand [18], considers the general information-filtering system could also be addressed in a more general term of recommendation system. Recommendation system is an approach to shift out information and to provide a personalized service through applying techniques in statistics, information filtering information capture and knowledge discovery, thereby provide personalized recommendation [17,33] on a real-time interactive approach for products or services.

However, how to effectively implement recommendation mechanism in an intensively competitive environment of E-commerce in order to increase market share and to enhance competitiveness, has become relatively more important. Scholar as [19,20] has suggested the application of recommendation on E-commerce will bring more effects for businesses. Due to this study places emphasis on the study of regular purchasing products (known as the consumer products), analysis on the relationship between customer purchasing behavior and product purchasing periodicity is used to discover customer’s periodical purchasing behaviors and to reinforce the importance for customer demand. The study adopts a content-oriented recommendation, in expectation to comply with the objectives of recommendation for personalized preferences or required commodities, consequently to stimulate customer repurchasing.

2.3 Personalized
Traditional marketing strategy is nothing more than regarding customer group as a single selling target and to provide promontional services to customers within this group. Personalized demand is a starting point for recommendation system [22, 23], which is analyzed through the customers’ historical transaction records and appeals in the past, then be given with appropriate
recommendation. In recent years, scholars (N. Weißenberg et al., 2004) have proposed on using user profile to collaborate in personalization. Due to the advantages of descriptive self-portraits, interests, preferences and basic information in user profile, user profile is often referred to the information representing personal characteristics. Therefore a detailed user profile is commonly used to build and to support the one-to-one marketing strategy to accomplish personalized recommendation.

Customer lifetime value (CLV) refers to the life cycle of customer royalty, which is beneficial in developing personalized marketing strategy for target customers. In order to favor drafting personalized marketing strategy for customers, some scholars [24-29] proposed RFM on the analytical method, to evaluate customer lifetime values, consequently allowing businesses to obtain information on customer royalty and contribution and thereby find an efficient customer by applying appropriate marketing strategies to raise customer repurchasing opportunities and their royalty. In addition, RFM analytical method can also used as a responsive pattern to market segmentation [26,27,28]

2.4 Assessment on Recommendation Efficacy

Assessment on the efficacy of the recommendation system generally adopts precision and recall as the for assessment indicator [31,32] of recommendation quality. However, is it usually difficult of obtain an equilibrium position between precision and recall, for example, an increase in system recommendation items (meaning the number in the denominator is larger) will result in a lower precision and higher recall, therefore the F1(Fallout) indicator [23]combines precision and recall to improve the paradox between the two, in order to achieve a more precise evaluation through the indictor evaluation. The study uses the above-mentioned three assessment indicators for assessing the recommendation efficacy. The philosophy of the recommendation lies on whether if the objective of a successful recommendation could be genuinely achieved at each assessment. Therefore quantitative issue is not included in the recommendation product.

3. Our Algorithm

3.1 Periodical Product Bundling Recommendation System (PPB-RS)

The study hopes to derive an effective recommendation mechanism of personalized product purchasing periodicity from product purchasing periodicity. The term periodical is defined as the periodical consumption behavior of a customer at a certain time. The study combines mixed bundling or tie-in sales strategy, content-oriented recommendation techniques and personalized concepts, then proposes a PPB-RS. This system is mainly consisted of two major sections (See Figure 1), with the first section analyzing on personal historical transaction records and calculating customers’ preferences and periodical needs on various products, then obtain the recommendation period and level of appeal for the products. The second section recommends products based on customer requirement or degree of preference, in order to achieve objectives in recommending personalized product.

3.2 Study Methodology and Process Procedures

The study suggests that the purchasing periodicity of product is the core of bundling or tie-in sales strategy and thereby proposes a
PPB-RS which implements content-oriented recommendation system to generate personalized product recommendation and therefore analyzes towards consumer habits, preference and product purchasing periodicity. The recommendation system consists of three modules, which are: Periodical Purchasing Module (PPHM), Personal Preference Module (PPRM) and Personalized Bundling Module (PBM), as illustrated in Figure 2. The processing procedures for system framework are as follows:

Step 1: Acquire relevant data and pre-process
To fully understand the relationship between consumer habits and product categories, it is important to acquire customer information, product information and history transactions records in order to obtain effective data sheet through integration of relational queries, then use filtering algorithms to filter out customers with few purchase and without a fixed purchasing habits, which will benefit to the future establishment of user profile.

Step 2: Establish user profile
Due to the objective of personalized product recommendation is emphasized in the study, establish user profile has become the primary task for achieving personalization. A unique user profile $CP^a$ will be established for customer $a$, and through their transaction table, customer data sheet and product information table, product categories table and time table, to obtain the content of each transaction, then record on the unique user profile and store in personalized data base (DB) in order for analysis on customer habits. Nonetheless, this recommendation system updates on the transaction records of the customer’s user profile through each increment in truncation records, while simultaneously and dynamically updates the purchasing periodicity and the degree of preference for products.

Step 3: Find out the customer’s purchasing periodicity on product (Using PPHM)

**Fig. 2 PPB-RS system structure**

Acquire user profile $CP^a$ from personalized DB and through history transactions of product categories to analyze customer’s consumer behaviors and their
purchasing periodicity of products, then predict the possible consumer behaviors for the next periodicity. Analyze the time frame from customer’s last transaction and to predict on the next purchasing time from customer using the \( R \)-value from RFM. The transaction records following pre-processing will be used to calculate the \( R \)-value of the purchased product category, \( i \) at each transaction, \( t \) by customer \( a \), then obtain the time frame, \( TF_i^t \) of the last transaction from customer while analyzing on the periodicity between customer and each product category, finally find out periodical time, \( PF_i^t \) for category, \( i \) from the customer, the average periodical purchasing time, \( \overline{PT} \), the minimum periodical purchasing time, \( PT_{min} \) and the recommender product periodical range for product category, \( RPR_i[d_{min}, d_{max}] \). When the time has fallen into the recommendation periodicity range, \( RPR_i[d_{min} + T(i)_{non}, d_{max} + T(i)_{non}] \), this product will be listed onto the PPB-RS.

Step 4: Find out customer preference

Find out the product with preference from the customer’s past spending habits. Calculate the degree of customer preference for the category, based on the analysis of the total quantity \( SP_i \) and the number \( CPC_i \) of purchasing frequency, \( F \)-value for category \( i \), based on the number of total transactions for customer \( a \), then calculate the Degree of preference for the category from the customer, and thereby analyze customer’s purchasing behavior and their preference, finally collect and record the degree of preference for all product \( PD_i^a = \{P_1, P_2, ..., P_l\} \) on the user profile as well as the user buying habit DB, by categorizing products with customer preference in accordance with product bundling strategy.

Step 5: Generating personalized bundling strategy and personalized recommendation.

After understanding customer’s purchasing habits for product, choose a suitable and a matching personalized bundling strategy for customer, according to the result of the purchasing periodicity and personal preference module. When the periodicity of category \( i \) has fallen onto the recommendation periodicity range \( RPR_i[d_{min}, d_{max}] \) for category \( i \), recommend this periodical product or personal Top-\( n \) preference product to the customer before the next periodical consumption behavior takes place. Finally, assess the recommendation efficacy for the periodical product bundling recommendation system proposed by the study, using precision, recall, F1 indicator and successfully sale rate (SSR).

4 Assessment of Recommendation Results

Figure 3 presents the precision efficacy of the three types of mixed bundling strategies on the min, average and max conditions. When the precision is larger than 50\%, all three conditions have higher recommendation efficacy in precision for periodical product bundling strategy, with the max condition reaching as high as 90\% precision, 632 people out of the totally 1,426 participants reach 100\% precision, and the other bundling strategies also have evidently higher precision. In addition, periodical product bundling Top-\( n \) preference product strategy will achieve better recommendation efficacy than single recommendation based on Top-\( n \) preference product bundling Top-\( n \) preference product bundling strategy.
Figure 4 shows the recommendation efficacy of the three bundling strategies evaluated by recall. It is clearly shown that under the min, average and max conditions, periodical products bundling with Top-n preference product strategy will have a higher recommendation efficacy than the other two strategies, and among them the max condition has a 50% recommendation efficacy for 1,508 people which accounts for 95% of the total participants in the experiment, thereby we are aware that this bundling strategy will bring the customers with the best recommendation efficacy.

6. Conclusion and future work

This system emphasizes on the customer’s periodical demand and degree of product preference, as well as taking into account the demand conditions for different product, from customers at different periods of time, stressing the importance of customer’s spending habits thereby improving the traditional bundling strategy which were once business-niche oriented, consequently increase customer purchasing desire and enhance sales opportunities for other product. Then timely and proactively provide personalized products suitable for customers according to different demand and preference, thereby settle deficiencies of inefficient recommendation resulting from untimely recommendation.

References


