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Buying scenario and Recommendation of purchase by Constraint based Sequential Pattern Mining from time stamp based Sequential Dataset

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Abstract

In today's competitive world, one of the most important drivers for sustainability and growth of a business is retention of customer. For retention of customer, it is important to understand customers' current needs and wants. Understanding of customers' buying behavior helps in designing products by businesses for ensuring product attributes that will result in customer satisfaction on purchase and consumption. Proposed work mainly focuses on prediction of few items that customer is in all probability more likely to purchase in future than other items based on data analysis done using sequential pattern mining technique. Proposed work additionally focuses on recommendations to be made for items of purchase in near and long term future, based on incorporation of *Gap* constraint in conventional FP-growth based PrefixSpan algorithm. Combination of *Length*, *Gap* and *Item* constraints help to recommend next highly probable items for purchase, based on increasing support and confidence values. Simulation and experimental study done on six IBM generated synthetic dataset which throw light on customers' buying patterns in terms of purchases that happened regularly or happened just once. Average 45%-55% purchase happens only once which doesn't lead to probability of customer making next purchase (IBM generated synthetic dataset). Proposed system focuses on next purchase item prediction based on support, confidence and gap constraint. Decision maker can analyze the reasons of current situation and accordingly make vital recommendations in terms of next products to be offered to customer for purchase, thereby increasing the probability of sales actually happening.

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1. Introduction and Related work

With rapid growth of e-commerce businesses, marketing decision makers need reliable recommender systems for analyzing customer's shopping behavior and recommending next-items that users are most probably likely to purchase going forward [1,2]. Recommender systems can be classified into two categories: (i) *content-based filtering*: It analyzes the association between customers' profiles and the description of their choices. It recommends items similar to those that the customer liked in the past [3,4] (ii) *Collaborative filtering method*: It depends on past transactions or ratings. Recommendations can be made by following two types: (i) memory-based [5,6] and (ii) model-based [7]. Parameswaran et al., proposed a precedence mining model that estimates the probability of future buying based on past buying behavior of customer [8].

Association rule mining is used to find the items which were purchased together majority of times in the past but it fails to recommend next item(s) to be purchased in the future [9,10]. The recommendation method works on sequential pattern mining (SPM) techniques, worked purely on *support* count of patterns. SPM can be classified as follows: (i) Apriori based: GSP [11] (ii) FP-Growth based: Freespan [12], Prefix Span [13]. Numerous empirical studies have demonstrated that SPM based next-items recommendation is effective in many different domains [14,15]. Current SPM methods treat all sequences in the SDB as equally important. But in real world all the items are not equally important which is highlighted in weighted sequential pattern mining (WSPM) [16, 17, 18, 19, 20, 21]. Weight learning and sequential pattern mining based next-items recommendation is proposed by Yap et al [22]. A significant shortcoming of SPM and Weighted SPM is that, all current methods do not perform *user-specific* sequential pattern mining. Constraint based SPM focuses on only those patterns which are of users' interest [23, 24].

Proposed system (section III) discusses on *next item recommendation system* worked on Constraint based SPM. Sequential mining is applied to predict customers' usual buying behavior which will help to understand current scenario of purchase. Conventional recommender system recommends few item(s) for next purchase based on support and confidence values of past transactions. Conventional system are fail to recommend item(s) based on purchase time duration. e.g. people usually buy gold pendent after buying gold chain within period of 6 months. But people may also buy earring, along with pendent after 12-14 months because of more funds. Recommender system should be smart enough to recommend next item(s) based on purchase duration. Section IV, discusses on inclusion of *Gap* constraints in conventional PrefixSpan which throws light on long term and short term recommendation of purchase by large and small gap values respectively. Proposed framework recommends different set of item(s) based on time duration for earlier purchased item. Inclusion of *Item* and *Length* focused on detailed buying behavior of customers, which would provide scope to business maker for investigating the reasons, why customers are not attracted for next purchase. Such analysis will help to retain customer by providing them more attractive options for next purchase according to their need.

2. System framework

2.1. System frame work of Next Item Recommendation

The Model is divided into three main tasks which are described below:

A. Initial task

Sequential frequent patterns are mined based on support values. FP-growth based PrefixSpan is used as base algorithm [13]. Sequence database is scanned only once. Infrequent items are eliminated based on support threshold

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