Chapter 17

Optimal Ordering Policy With Inventory Classification Using Data Mining Techniques

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ABSTRACT

Data mining is a technique to identify valid novel, potentially useful, and understandable correlations and patterns in existing data. Data mining techniques, such as clustering, association rule mining, classification, and sequential pattern mining, have attracted a great deal of attention in the information industry and in society as a whole in recent years. Some research studies have also extended the usage of this concept in inventory management. Yet, not many research studies have considered the application of data mining approach on determining both optimal order quantity and loss profit of frequent items. This helps inventory manager to determine optimum order quantity of frequent items together with the most profitable item for optimal inventory control. In this chapter, two different cases for determining ordering policy and inventory classification based on loss rule are presented. An example is illustrated to validate the results.

INTRODUCTION

Inventory management is one of the most important business processes during the operation of a manufacturing company as it relates to purchases, sales and logistic activities. It concerned with the control of stocks throughout the whole supply chain. In real life situations, we have a very large number of items in an inventory and it is not computationally feasible to set stock and service control guidelines for each individual item. ABC classification is usually applied to control the inventory level of the items. ABC classification is a method of classifying inventory items according to the money value to a firm. Class A items though smaller volumes but tends to generate higher sales value followed by the class B items. The

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class C items are of a very large volume but generate a very small sales value. Class ‘A’ items normally range from 5% to 20% of all inventory items and account for between 50% and 80% of sales value. The class B items normally range from 20% to 40% of all inventory items and account for 20% to 40% of sales value. The class C items normally constitute 50% to 70% of all inventory items and account for 5% to 25% sales value. ABC classification is simple to understand and easy to use. However, traditional ABC analysis is based on only single measurement such as annual dollar usage. It has been recognized that other criteria, such as inventory cost, part criticality, lead time, commonality, obsolescence, substitutability, number of requests for the item in a year, scarcity, durability, substitutability, reparability, order size requirement, stock-ability, demand distribution, and stock-out penalty cost are also important in inventory classification.

Several researchers suggested that multiple criteria should be used in the classification of inventories (Flores & Whybark, 1987; Cohen & Ernst, 1988; Lenard & Roy, 1995). However, the problem is that the profit of one item not only comes from its own sales, but also from its influence on the sales of other items or reverse, i.e., the cross-selling effect (Anand et al., 1997). In such a situation, it should be explained clearly whether the cross-selling effects would influence the ranking of items or not, and how to group the items if such effects existed, not concerning what and how many criteria could be used. The management of inventory can become more effective, if inventory is classified into categories based on some criteria like ABC classification, loss profit, and cross-selling effect. In this chapter, the application of data mining approach on determining both optimal order quantity and loss profit of frequent items is considered. We discuss two cases for finding optimal order quantity of frequent items and their classification with respect to cross-selling effect.

Firstly, the ordering policy can be redesigned by including clustering and cross-selling effect. Further inventory can be classified based on loss profit in each cluster. In this method, transactional database is clustered to obtain homogeneous clusters and association rules are mined in each cluster to estimate optimal order quantity. Further, loss profit is calculated for each frequent item. The obtained loss profit is used to rank frequent items in each cluster.

The loss profit of item is the total profit that the item may takes away when it is out of stock. The results indicate that a considerable large part of inventory items change their positions in the ranking list of traditional ABC classification. Some items that traditionally do not belong to the A group in each cluster have been moved into the group A by the cross-selling effect to reconfigure their inventory policies, and also some items that traditionally belong to C group in each cluster have been promoted into higher group because of their high values of loss profits and should not be ignored as these were treated before. Thus, the ranking of frequent items in each cluster facilitate optimal inventory control.

Secondly, the ordering policy can be redesigned by including time expressions into association rules. Further, inventory can be classified based on loss profit in each time-span. Temporal association rule algorithm is used to find the items for frequent item-set based on minimum support and generate association rules based on threshold confidence. The opportunity cost of frequent item-sets is used to determine the optimal order quantity considering cross-selling effect. Further, the loss profit of frequent items in each time span, viz. January to March, February to March, and March only, found by temporal association rule mining algorithm, is calculated. Then, the frequent items in particular time-periods are ranked according to descending order of loss profits. Under this classification scheme, some items with small value of itself may be considered to be a valuable item because they can influence the sales of some other items with larger dollar usage in each time-span. Therefore, some items being considered trivial in the old ABC classification may be considered more important and their positions are changed.