Chapter 67
Data-Driven Inventory Management in the Healthcare Supply Chain

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ABSTRACT

From 21st century, enterprises combine supply chain management with big data to improve their products and services level. In China healthcare industry, supply chain decisions are made based on experience, due to the environment complexities, such as changing policies and license delay. A flexible and dynamic big data driven analysis approach for supply chain decisions is urgently required. This report demonstrates a case study on CRT forecasting model of inventory data to predict the market demand based on pervious transaction data. First a basic statistic approach has been applied to represent the superficial patterns and suggest some decisions. After that a CRT model has been built based on the several independent variables. And there is also a comparison between CRT and CHAID models to choose a better one to further build an improved model. Finally some limitations and future work have been proposed.

INTRODUCTION

In Chinese healthcare industry, business is highly impacted by changing policies and volatile economy, available information for supply chain management in the ecosystem is in an unstructured manner, which has potential risk to support high growth. Due to environment complexity and dynamics in emerging market, current supply chain processes to capture market intelligence is more or less rely on individual's interpretation, supply chain decision requires data outside the company is facing challenges, the consequence is service and cost implication to end to end supply chain. To facilitate the supply chain decision-making process, inventory management, distribution network, etc. are all important parameters

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in successful supply chain management. Demand forecasting on inventory is an important part to support the supply chain decision making. This chapter is going to forecast the market demand based on the pervious transaction data.

Demand forecasting is commonly used in many filed to support the rescheduling and decision making. Decision tree, naïve Bayesian, regression, K-means and other algorithms are applied to achieve the goal. And machine learning algorithms are adopted, such as random forest and artificial neural networks, to improve the forecasting accuracy. The forecasting technologies are universally used in energy demand prediction (Srinivasan, 2008), power demand prediction (AI-Anbuky, Bataineh, & AI-Aqtash, 1995), water demand prediction(Msiza1, Nelwamondo, & Marwala, 2008) and etc. All these researches were based on basic regression theory and applied different machine learning techniques.

There are some works have been done by other researchers to improve the forecasting accuracy. In 2007, an improvement had been done by Luis Aburto and Richard Weber, they developed a hybrid intelligent system combining auto-regressive Integrated Moving Average (ARIMA) models and neural networks for demand forecasting, which leads to fewer sales failures and lower inventory level (Aburto & Weber, 2007). Another comparative experiment had been done, in 2008, to test that whether neural networks, recurrent neural networks and support vector machines are better than traditional naïve forecasting, trend, moving average and linear regression. The results show that recurrent neural networks and support vector machines are the best in these three methods, but their performance is not significantly better than the regression model (Carbonneau, Laframboise, & Vahidov, 2008). In January 2016, Kausar. S Attar proposed a methodology to use the Artificial Bee Colony (ABC) algorithm to optimize the Support Vector Regression (SVR) parameters (Attar, 2016). According to Saima Aman and other researchers' opinion, comparing with larger group, the smaller group is harder to predict, therefore better models are required (Aman et al., 2015).

This chapter is going to conquer the methodological weakness appearing in the most of the papers cited above. Linear regression algorithm is commonly used in the researches mentioned above, but there are several limitations (D'ALISA et al., 2006): a) the linear regression cannot deal with ordinal data, such as the hospital level; b) potential correlation between apparent independent variables may weaken the variance explanation of the dependent variable; c) the interaction between two or more variables may be more predictive for the model than a unitary change in each individual variable. But it is not easy to explore the meaningful interaction from many candidate variables; d) the linear regression or multiple-linear regression cannot handle the multiple types of data. The regression algorithm is suitable for the dataset only with scale data.

In the chapter, the classification and regression tree (CRT) algorithm has been employed to structure the predictive model. This algorithm overcame the above disadvantages. CRT algorithm has been used to model the variables from the inventory dataset to possibly predict how many products the customer will require. The algorithm can more confidently show the association between the dependent variable (quantity of products) and the independent variables, such as outbound order data, customer province, and seller level, comparing with the ordinary regression algorithm.

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