Chapter 6. Conclusions and future works

6.1 Summary

This work involved the introduction of a novel recommendation methodology that combines AHP, clustering, and association rule-based methods. It clusters customers into segments according to their lifetime value expressed in terms of weighted RFM. Applying AHP to determine the relative importance of RFM variables proved important, since the RFM weights vary with the characteristics of product and industry. Moreover, clustering customers into different groups not only improves the quality of recommendation but also helps decision-makers identify market segments more clearly and thus develop more effective strategies. The experimental results show that the proposed methodology indeed can yield recommendations of higher quality.

However, the methodology is not effective for all customer groups. It is more effective for more loyal customers. Therefore, this work also proposed two hybrid recommendation approaches. The hybrid1 method overcomes the drawback of WRFM-based method by using preference-based CF method to improve the quality of recommendation for less loyal customers. The proposed WRFMCP method integrated these two dimensions to group customers and then extracted recommendation rules from each group to improve the quality of recommendation. The experimental results demonstrate that the proposed hybrid1 and WRFMCP methods outperformed the WRFM-based, preference-based CF and the KNN-based CF methods. The WRFMCP method outperformed the hybrid1 method, especially when the CLV was weighted more heavily than purchase preferences.

Either WRFM-based or hybrid approaches of making recommendations are based on the lifetime values and purchase preferences of customers to improve overall quality of recommendation and to make more soundly based recommendations with regards to less loyal customers. However, both of these methods belong to the collaborative filtering (CF) recommendation. In fact, CF method suffers several limitations. This work uses customer demands derived from frequently purchased products in each industry as valuable content information to integrate CF to make recommendations.

This work uses customer demands derived from frequently purchased products in each industry to integrate CF to make recommendations. This work also combines customer demands and past purchasing preferences to reduce the sparsity of customer-item matrix, named extended-preferences to improve recommendation accuracy. Customer demands is then included as a factor in making recommendations for re-ranking candidate products. This work ran several experiments to confirm the differences between methods.

According to the analytical results, generally, the performance ranking of these methods with extended-preferences is WRFMEP $\succ$ CFEP $\succ$ EP-based *k*-NN method; while the ranking of these methods without extended preferences is WRFMCP method $\succ$ WRFM-based CF method $\succ$ preference-based CF method $\succ$ KNN-based method. This ranking implies that extended-preferences, combining customer demands and purchased preferences are useful for improving the quality of recommendation. Furthermore, re-ranking candidate products according to customer demands that offers a promising method of improving recommendation accuracy. Finally, the results of proposed hybrid method not only improves the overall quality of recommendation, but also can be extended to recommend product items to customers who purchased few product items based on extended-preferences. And generally, the quality of recommendation improves with increasing number of purchased items.

In conclusion, these results have implications for research and practice. There has been little prior research for recommendations based on customer lifetime value. Our results suggest that the WRFM-based method or the hybrid methods based on CLV improve the quality of recommendations.

From the commercial viewpoint, one-to-one marketing has become more and more important. Personalized techniques are not generally easy to implement and thus this dissertation proposes different methods for focusing separately on high loyal customers, less loyal customers and customers who purchase few products. A very important issue is how to build, maintain, and enhance customer relationships in a fiercely competitive environment. Our results, therefore, indicate that recommender systems can be a valuable strategy for marketers. Such systems increase the probability of cross-selling, which can help practitioners predict customer needs and manage goods in stock.

6.2 Future works

Future works will address following themes. First, the proposed approach was evaluated experimentally using a data set obtained from a hardware retailer. Further studies can evaluate the application of the proposed approach to other application domains. Second, the present work focused on product recommendation of retail transaction data contains binary choice of shopping basket data; the customer preference is represented as one, if the customer purchased the product; and otherwise is zero. Further investigation is needed to evaluate the effectiveness of the proposed methods when applied to data set with non-binary preference rating. Furthermore, owing to limitations available content information, this work could not deal with new and unseen items. Hopefully future studies can experiment with other real cases that can support more content information to verify the proposed methods.

The empirical case of this dissertation, the unit price of the hardware products is relatively low and decision makers mainly care only about customers purchase continuously. But in other application such as the sales of luxury goods, the relative importance of monetary may be higher than recency and frequency. Therefore, for further study is needed to verify the proposed methods to these high consumption industries. Additionally, in this study, the relative importance of RFM values is determined by decision makers. Proper weightings of RFM values may be determined by systematically analyzing the weighting combinations of RFM values and their effects on recommendation quality. Further investigations are needed to explore systematic approaches for determining the proper weightings of RFM values.

We have previously discussed that different industries might response to different weightings of the RFM variables. Besides, purchasing patterns might be another factor to affect the relative importance of RFM. For example, the CLV is high for those customers with large amount of spend, low frequency of purchasing and long latest recency, where the importance of M (monetary) is higher than the R (recency) and F (frequency). The CLV is also high for those customers with small amount of spend, high frequency of purchasing and short latest recency, in which the importance of frequency is higher than the recency and monetary. Accordingly, the influence of purchasing patterns on the relative importance of RFM is not considered in this dissertation and further study is needed. In addition, product demands for these purchasing patterns of customers might be different. Therefore, purchasing patterns may play a factor on product recommendation, and should be investigated in further study.