A Three-Stage Decision Model Integrating FAHP, MDS and Association Rules for Targeting Smartphone Customers

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Abstract. Human living consists of a series of decision making that involves a lot of decision objectives and factors. Decision makers would be concerned with the best selection among different alternatives. In this study, we propose a three-stage decision making model combining with Fuzzy Analytic Hierarchy Process (FAHP), Multidimensional Scaling (MDS) and Association Rules (AR). The proposed model enables decision makers to find out the importance of each decision criterion and select the optimal alternative for solving decision problems. We applied the proposed model to understand the consumer’s evaluation factors in their smartphone purchasing. In stage I, the FAHP analysis results indicate the decision criteria as follows. When customers intend to buy a smartphone, the order of importance of their decision criteria is as follows: display size, thickness, and hardware efficiency. Further, in stage II, several interesting AR analysis rules reveal that consumers of high self-glory would consider the hardware efficiency and the pixel of lens of the product when they purchase a smartphone. Finally, through the perceptual map of MDS in stage III, we can classify consumers into four groups, namely, “students”, “IT professionals”, “house brokers and bankers & insurers”, and “teachers and healthcare workers”. Customers in the same group have similar evaluation criteria in their smartphone purchasing. The integrated decision model proposed in this study can help the suppliers in making right marketing strategies for different consumer groups, and can also be applied in various fields for decision marking in the future.

Keywords: Multi-Criteria Decision Making (MADM), Association Rules, Fuzzy Analytic Hierarchy Process (FAHP), Multidimensional Scaling (MDS).

1 Introduction

Human living consists of a series of decision making that ranging from trivial things to important business issues. Facing all these decision problems, decision makers need to consider with so many objects and factors. When making selections among multiple alternatives, most people become hesitant and unable to make the correct decision due to insufficient information and unclear outcome. In view of this, the principal concern for the decision makers is how to pick and act on the optimal plan out of the others.

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Some decision methods assist decision makers to resolve difficulty of decision making, as well as make the best decision. Keeney and Raiffa proposed Multiple Criteria Decision Making (MCDM) that facilitated the decision maker to consider correctly and make the rational decision when multiple objects need to be evaluated and selected [1]. The primary part of this method is to find out the optimal decision during the decision making process based on multiple criteria. MCDM have been widely applied in many fields, including industrial R&D [2], Environmental Engineering [3] and financial analysis [4].

Among various decision making methods, Analytic Hierarchy Process (AHP) is a MCDM method which is most commonly used [5]. It could structuralize the complicated decision making issues and provide criteria and weight for assessment, then verifies the consistency of each criterion [6], and builds a hierarchical decision-making structure [7]. Via this structure, decision maker can see the relation between hierarchies and take the priorities of the factors into consideration. However, the traditional AHP is unable to well represent the human thought by fuzziness, result in the experts determine the priority of the factors, whose may cause deviation of the consequence [8], [9]. Therefore, Buckley proposed the Fuzzy Analytic Hierarchy Process (FAHP) integrating the Fuzzy theory with AHP [10]. It primarily improved the shortcomings of fuzziness and subjective opinion, when conducting the AHP questionnaire, which might result in the deviation of the evaluation results.

In addition to the AHP, Association Rule (AR) analysis is the most common method in decision science area, which could find out the hidden correlating rules among a mass of datum. These rules can effectively provide the results of prediction and decision making. AR has been widely applied in the fields of production process [11], marketing solution [12] and supply chain [13] and so on. Furthermore, recent research devoted to represent the alternative solution for decision problem solving, e.g., Multidimensional Scaling (MDS). MDS is a method to simplify the data, which presents the complicated relation between the alternatives in a visualized way. The principal purpose of MDS is to allow decision makers to observe the similarities and differences between the alternatives quickly from the Perceptual Map. MDS has been widely applied in various fields such as psychology or marketing [14].

Overall, FAHP can facilitate the decision maker to find out the optimal solution from evaluative factors. If combining with MDS and AR, it would assist decision makers to make decisions more accurately, and to understand the relation among all alternatives more clearly. Based on above reasons, this study combines with these three methods, FAHP, MDS, and AR to propose a three-stage integrated decision model. First, it applies FAHP and MDS to assist decision makers to select appropriate plans for decision making issues. Moreover, the proposed model would apply AR to reveal the criteria with correlation, to provide foundation for decision makers when carrying out the alternative.

2 Literature Review

2.1 Fuzzy Analytical Hierarchy Process

Analytic Hierarchy Process (AHP) was proposed by Saaty in 1977, and has been widely applied in ranking, evaluation and prediction. The application of AHP assumes