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An analysis of several novel frameworks and models in the consensus reaching process

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Abstract

Usually, at the beginning of the group decision making (GDM) problem, experts' opinions may differ substantially. Therefore, the consensus reaching process is often a necessity in GDM, and numerous approaches for modeling the consensus process have been proposed. This paper provides an analysis for several novel consensus frameworks and models, investigated by our group. They are the consensus models with minimum adjustments, the consensus models based on consistency and consensus measures, and the direct consensus framework for GDM with different preference representation structures. The advantages of these consensus frameworks and models are analyzed. Meanwhile, the drawbacks and future researches are discussed.

Keywords: Group decision making; consensus; consistency; minimum adjustments; preference representation structures.

1. Introduction

Group decision making (GDM) can be seen as a task to find a collective solution to a decision problem in situations where a group of experts express their opinions regarding multiple alternatives[5]. In general, there are two processes to implement before obtain a final solution[18,22], namely: (i) the selection process; and (ii) the consensus

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process. The selection process obtains the final solution according to the preferences given by the experts. The consensus process involves maximizing consensus or agreement among a group of experts.

Consensus reaching process is a key issue in GDM. Classically, consensus is defined as the full and unanimous agreement of all the experts regarding all the alternatives. However, this definition is inconvenient, and a complete agreement is not always necessary in practice. This has led to use of different consensus measures[25], and numerous approaches for modeling the consensus reaching process have been presented[18,22,24,29]. Cabrerizo et al.[6] and Herrera-Viedma et al.[20] gave excellent surveys of consensus models.

Recently, several novel frameworks and models of the consensus reaching process are proposed.

(1) Consensus models with minimum adjustments. In consensus reaching process, the feedback adjustment rules are often used to help experts adjust their opinions in order to reach a consensus. A natural question is how to minimize the adjustments amounts, which reflects the deviation between experts' original opinions and adjusted opinions. To do so, several consensus models[3,4,14,33,35,37] have been presented.

(2) Consensus models based on consistency and consensus measures. There are two kinds of measures in GDM with preference relations[19,23]: (i) individual consistency, and (ii) consensus. The individual consistency is performed to ensure the expert is being neither random nor illogical in his/her pairwise comparisons, and the consensus means the preferences among a group of experts are similar. In consensus reaching process, the individual consistency may be destroyed. To maintain individual consistency in consensus reaching process, several approaches[12,16,34,36] have been proposed.

(3) Direct consensus framework for GDM with different preference representation structures. In GDM problems, the experts may use different preference representation structures to express their individual preference information, due to different experience, cultures and educational backgrounds. Using transformation functions[7,8,9,22] to uniform different preference representation structures may cause internal inconsistency issues. To avoid inconsistency issue, a direct consensus framework is proposed by Dong and Zhang[15], meanwhile the Pareto principle of social choice theory is satisfied.

The aim of this paper is to analyze these novel consensus frameworks and models. The advantages of these consensus frameworks and models are pointed out. Meanwhile, the drawbacks and future researches are discussed.

The rest of this paper is organized as follows. Section 2 introduces the consensus models with minimum adjustments. Following this, the consensus models based on consistency and consensus measures are presented in Section 3. Subsequently, the direct framework for GDM with different preference representation structures is introduced in Section 4. Finally, Section 5 analyzes the advantages, drawbacks and future researches.

2. Consensus models with minimum adjustments

Let $E=\{e_1,e_2,...,e_m\}$ be a set of m experts. Let $o_k \in R$ and $\overline{o}_k \in R$ represent the original and adjusted preferences of the expert $e_k \in E$, respectively. And the original and adjusted collective preferences are denoted as o and $\overline{o}$, respectively.

The key issue in consensus reaching process is to obtain the $\overline{o}_k \ \ (k=1,2,...,m)$ and $\overline{o}$ with minimum adjustments amounts. To do so, two versions of minimum adjustments consensus models are proposed. One of these two versions seeks to minimize the distance between the original and adjusted preferences[37], and the other one seeks to minimize number of adjusted preference values[33].

2.1. Minimizing the distance between the original and adjusted preferences

If $|o_k - o| \le \alpha$, for all $k=1,2,...,m$, the expert opinions reach acceptable consensus, where α is the predefined consensus threshold. For convenience, the threshold of consensus throughout this paper denote as α, which is set according to actual situations. To minimize the distance between the original and adjusted preferences for all experts, Zhang, Dong, Xu and Li[37] proposed an optimization consensus model as follows: