

Preface

The group decision making (GDM) can be seen as a task to find a collective solution to a decision problem in the situations where a group of experts express their opinions regarding multiple alternatives. In essence, the GDM reflects the internal relations between the individuals and group and can be defined as a general model as follows:

$$F(op^1, op^2, \dots, op^n) = op^c,$$

where $\{op^1, op^2, \dots, op^n\}$ are the opinions of n individuals, op^c is the opinion of the group, and F is the aggregation function implying the group decision rule to aggregate individual opinions into a collective one.

The GDM is in the important and core position in the economics and management science. From a macro perspective, modern society is essentially a GDM system. In the rational and democratic society, there exit two basic GDM methods: one is “voting”, which is usually used in politics, and the other is “market mechanism”, which is applied in economic issues. Microscopically, there are numerous GDM problems, and people are often faced with the need to work with others in group settings.

The history of the GDM studies can be tracked back to design of voting method (Lull, 1282, 1287; Borda, 1781; Condorcet, 1785). In the last 60 years, the researches of the GDM have gotten great progresses, and some famous theories have been proposed, e.g., social choice theory (Arrow, 1951) and prospect theory (Kahneman and Tversky, 1979, 1992). The social choice theory dates from Condorcet's formulation of the voting paradox, and provides a theoretical framework for analysis of combining individual opinions, preferences, interests, or welfares to reach a collective decision or social welfare in some sense. The Arrow Impossibility Theorem, the Gibbard-Satterthwaite Strategy-proofness Impossibility Theorem and the Sen Libertarian Impossibility Theorem construct the foot stone of social choice theory. The prospect theory is a descriptive model based on psychology, and tries to model real-life choices, rather than optimal decisions, as normative models do. The prospect theory states that people make decisions based

on the potential value of losses and gains rather than the final outcome, and that people evaluate these losses and gains using certain heuristics. The social choice theory and the prospect theory both provide exciting insights for us to better understand and investigate GDM problems.

Consensus is an important area of research in the GDM and is defined as a state of mutual agreement among individuals of a group, where all opinions have been heard and addressed to the satisfaction of the group. A consensus reaching process is a dynamic and an iterative process composed by several rounds where the individuals express, discuss, and modify their opinions until to make a decision. Integrating the consensus reaching process into the GDM offers some advantages: (1) More effective implementation. When individuals' opinions and concerns are taken into account, they are more likely to actively participate in the implementation of the obtained solution, and (2) Building connection among the individuals. Using consensus as a decision tool means taking the time to find unity on how to proceed before moving forward, which promotes communication among individuals.

In the consensus reaching process, individuals often need to adjust their opinions to improve the consensus level among individuals. In this book, we propose a challenge for analysts: how to minimize the adjustment amounts in the consensus reaching process, which can be described as an optimization-based model.

$$\min_{op^k} \sum_{k=1}^n d(op^k, \overline{op^k}),$$

where $\{op^1, op^2, \dots, op^n\}$ are the individuals' original opinions, $\{\overline{op^1}, \overline{op^2}, \dots, \overline{op^n}\}$ are the individuals' adjusted opinions with a consensus, and $d(op^k, \overline{op^k})$ ($k = 1, 2, \dots, n$) is to measure the adjustment amounts associated with the individual k . We investigate the optimization-based model to search the consensus path with minimum adjustments under different GDM contexts. Particularly, in Chap. 2 we clarify the basic idea of the consensus with minimum adjustments (or cost), and investigate the consensus model with minimum adjustments (or cost) under the utility preferences and aggregation functions. Then, in Chap. 3 we propose two consensus models for the GDM with preference relations: the iteration-based consensus model and the LP-based consensus model. Next, we investigate the consensus models with minimum adjustments under the 2-tuple linguistic context and the hesitant linguistic context in Chap. 4. Subsequently, in Chap. 5 we propose two consensus models for the GDM with heterogeneous preference representation structures: the direct consensus model and the prospect theory-based consensus model. Finally, Chap. 6 presents two multiple attribute consensus rules with minimum adjustments: the distance-based consensus rule and the count-based consensus rule. Based on the distance-based and count-based consensus rules, we develop an interactive consensus reaching process for multiple attribute group decision making.

We believe that the optimal adjusted opinions, obtained by the methodology presented in the book, can provide a better decision aid which individuals use as a reference to modify their individual opinions.

We want to express special thanks to Professor Yinfeng Xu, Professor Yihua Chen, Professor Zhi-Ping Fan, Professor Wei-Chiang Hong, Professor Enrique Herrera-Viedma, and Professor Francisco Herrera, for their contributions and great support to this book. We also want to express our sincere thanks to the colleagues and students in our group, Hengjie Zhang, Haiming Liang, Cong-Cong Li, Xia Chen, Yuzhu Wu, Nan Luo, Guiqing Zhang, and Bowen Zhang, who have done much work in this field and made a number of corrections. This book is supported by Grants (Nos. 70425005, 71171160, 71571124) from NSF of China, and a Grant (No. skqx201308) from Sichuan University.

Chengdu, China
July 2015

Yucheng Dong
Jiuping Xu

Consensus Building in Group Decision Making
Searching the Consensus Path with Minimum
Adjustments

Dong, Y.; Xu, J.

2016, XI, 201 p., Hardcover

ISBN: 978-981-287-890-8