Preface

Decision making is one of the most common activities in the real world. In the process of decision making, an expert (or decision maker) is usually asked to give his/her preferences by comparing the relation of each pair of the considered objects (or alternatives). Preference relations (or called pairwise comparison matrices, judgment matrices) are the efficient and common tools used widely to describe decision arguments in amounts of decision making problems, such as investment decision making, agroecological region assessments, weapon system efficiency evaluation, supply chain management, personnel evaluation, Internet-service and robot selection, project prioritization, and so on. The existing preference relations mainly include multiplicative preference relations, fuzzy preference relations, linguistic preference relations, and intuitionistic preference relations. Among these four types of preference relations, the former three have been systematically investigated over the last decades and applied extensively in a variety of fields, such as society, economy, medicine, management and military affairs, etc., while the latter one has been introduced in the last few years, which has received more and more attention recently due to its powerful information depiction capability. Each of the elements of an intuitionistic preference relation is characterized by a satisfaction degree, a dissatisfaction degree and an indeterminacy degree, which can describe the fuzzy characters of the expert's preferences more detailedly and comprehensively compared to the other types of preference relations, and thus, it is very useful in dealing with vagueness and uncertainty in the modern socio-economic environments with increasing complexity. Some interesting studies have been done in recent years on decision making with intuitionistic preference relations.

Atanassov (1983, 1986) extended the traditional fuzzy set characterized by a membership function to the intuitionistic fuzzy set (IFS), which is characterized by a membership function, a non-membership function and a hesitancy function. Many researchers have been applying IFSs to multi-attribute decision making under various different situations, especially interactive decision making with intuitionistic fuzzy information, which is an interesting research direction.

This book offers an in-depth and comprehensive introduction to the priority methods of intuitionistic preference relations, the consistency and consensus improving procedures for intuitionistic preference relations, the approaches to group decision making based on intuitionistic preference relations, the approaches and models for interactive decision making with intuitionistic fuzzy information, and the extended results in interval-valued intuitionistic fuzzy environments. The book is organized as follows:

Chapter 1 gives a systematic introduction to the existing research results on intuitionistic preference relations, which covers the following contents:

Section 1.1 introduces some basic concepts and operations related to intuitionistic preference relations. In Sect. 1.2, we present two estimation algorithms for the intuitionistic preference relations in which some elements are missing. The first algorithm is used to estimate the missing elements using only the known preference values in an acceptable incomplete intuitionistic fuzzy preference relation with the least judgments. The second one is given for the estimation of missing elements of the acceptable incomplete intuitionistic fuzzy preference relations with more known judgments. Section 1.3 introduces a procedure to construct an interval-valued intuitionistic preference relation with multiplicative transitivity from an incomplete interval-valued intuitionistic preference relation with the only known off-diagonal elements, and extends this procedure to deal with more general cases with much more known evaluation information. Moreover, an approach is built to group decision making with incomplete interval-valued intuitionistic preference relations. In Sect. 1.4, we give an approach to constructing the consistent (or approximate consistent) intuitionistic preference relation from any intuitionistic preference relation, and establish some convergent iterative algorithms to improve the consistency of intuitionistic preference relations. Section 1.5 introduces two algorithms where the former constructs a multiplicative consistent interval-valued intuitionistic preference relation with respect to the only known off-diagonal elements, and the latter builds an approximate one in general cases with much more known information. A convergent iterative procedure is constructed to improve the consistency level of an interval-valued intuitionistic preference relation, and a convergent iterative algorithm to improve the consensus level of an individual interval-valued intuitionistic preference relation is pointed out. Section 1.6 gives a compatibility measure between intuitionistic preference values and a compatibility measure between intuitionistic preference relations, respectively. Based on the compatibility measures, a consensus reaching procedure in group decision making with intuitionistic preference relations is given, and a method for comparing intuitionistic fuzzy values is pointed out, by which the considered alternatives are ranked and then selected. The extensions of these results to interval-valued intuitionistic fuzzy situations are also introduced. For the multi-attribute decision making problems with intuitionistic fuzzy information, we introduce a method in Sect. 1.7 for estimating attribute weights from an intuitionistic preference relation, and then extend the method to group decision making based on intuitionistic preference relations. Section 1.8 introduces an error-analysis-based method for the priority of an intuitionistic

preference relation, and in Sect. 1.9, we give several ranking methods for alternatives on the basis of the intuitionistic preference relation from various angles, which are based on the intuitionistic fuzzy ordered weighted averaging operator, the intuitionistic fuzzy ordered weighted geometric operator, the uncertain averaging operator, the uncertain geometric operator, the uncertain ordered weighted averaging operator, and the uncertain ordered weighted geometric operator, respectively. Considering that the denser the distribution of the data is, the higher their consensus degree is, Sect. 1.10 introduces some intuitionistic fuzzy density-based aggregation operators, and uses them to put forward an approach to group decision making with intuitionistic preference relations. In addition, Sect. 1.11 introduces the concept of intuitionistic multiplicative preference relation, reviews some basic operational laws, investigates its properties, proposes some operators to aggregate intuitionistic multiplicative information, and then applies these results to decision making based on multiplicative intuitionistic preference relation. Finally, in Sect. 1.12, we further introduce some intuitionistic multiplicative aggregation operators with the extended t-conorms and t-norms, and in group settings, an approach based on the intuitionistic multiplicative power averaging operator and the intuitionistic multiplicative Choquet ordered averaging operator is provided to decision making with inutionistic multiplicative preference relations.

Chapter 2 considers interactive multi-attribute decision making with intuitionistic fuzzy information. The chapter introduces the concept of dominated alternative, and gives a method to identify the dominated alternatives. Then the chapter presents an interactive method for eliminating any dominated alternatives by updating the decision maker's preferences gradually so as to find out the optimal one eventually. Moreover, the chapter introduces the concepts of the overall attribute ideal solution, the overall attribute negative ideal solution of alternatives, and the satisfaction degree of each alternative. Based on which, some optimization models are built to establish an interactive method for multi-attribute decision making with intuitionistic fuzzy information, and the extended results in interval-valued intuitionistic fuzzy situations are also investigated.

This book can be used as a reference for researchers and practitioners working in the fields of fuzzy mathematics, operations research, information science, management science and engineering, etc. It can also be used as a textbook for postgraduate and senior undergraduate students.

This work was supported by the National Natural Science Foundation of China under Grant 71071161.

Nanjing, June 2012 Zeshui Xu

http://www.springer.com/978-3-642-28402-1

Intuitionistic Preference Modeling and Interactive Decision Making

Xu, Z.

2014, XI, 233 p., Hardcover
ISBN: 978-3-642-28402-1