Fuzzy Multiple Attribute Decision Making Methods And Applications Lecture Notes In Economics And Mathematical Systems

This monograph is intended for an advanced undergraduate or graduate course as well as for researchers, who want a compilation of developments in this rapidly growing field of operations research. This is a sequel to our previous works: "Multiple Objective Decision Making--Methods and Applications: A state-of-the-Art Survey" (No.164 of the Lecture Notes); "Multiple Attribute Decision Making--Methods and Applications: A State-of-the-Art Survey" (No.186 of the Lecture Notes); and "Group Decision Making under Multiple Criteria--Methods and Applications" (No.281 of the Lecture Notes). In this monograph, the literature on methods of fuzzy Multiple Attribute Decision Making (MADM) has been reviewed thoroughly and critically, and classified systematically. This study provides readers with a capsule look into the existing methods, their characteristics, and applicability to the analysis of fuzzy MADM problems. The basic concepts and algorithms from the classical MADM methods have been used in the development of the fuzzy MADM methods. We give an overview of the classical MADM in Chapter II. Chapter III presents the basic concepts and mathematical operations of fuzzy set theory with simple numerical examples in a easy-to-read and easy-to-follow manner. Fuzzy MADM methods basically consist of two phases: (1) the aggregation of the performance scores with respect to all the attributes for each alternative, and (2) the rank ordering of the alternatives according to the aggregated scores.

Interval neutrosophic fuzzy decision making is an important part of decision making under uncertainty, which is based on preference order.

Single valued neutrosophic hesitant fuzzy set has three independent parts, namely the truth membership hesitancy function, indeterminacy membership hesitancy function, and falsity membership hesitancy function, which are in the form of sets that assume values in the unit interval [0, 1].

Fuzzy information in venture capital can be well expressed by neutrosophic numbers, and TODIM method is an effective tool for multi-attribute decision-making. The distance measure is an essential step in TODIM method. The keystone of this paper is to define several new distance measures, in particular the improved interval neutrosophic Euclidean distance, and these measures are applied in the TODIM method for multi-attribute decision-making.

The neutrosophic cubic sets are an extension of the neutrosophic sets on the cubic sets. It contains three variables, which respectively represent the membership degree, non-membership degree and uncertainty of the element to the set. The score function is an important indicator in the multi-attribute decision-making problem. In this paper, we consider the possibility that an element belongs to a set and put forward the definition of possibility neutrosophic cubic sets. On this basis, we introduce some related concepts and give the binary operation of possibility neutrosophic cubic sets and use specific examples to supplement the corresponding definition. Meanwhile, a decision-making method based on the score function of possibility neutrosophic cubic sets

is proposed and a numerical example is given to illustrate the effectiveness of the proposed method.
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Decision Making in Manufacturing Environment Using Graph Theory and Fuzzy Multiple Attribute Decision Making Methods presents the concepts and details of applications of MADM methods. A range of methods are covered including Analytic Hierarchy Process (AHP), Technique for Order Preference by Similarity to Ideal Solution (TOPSIS), VIšekriterijumsko KOmpromisno Rangiranje (VIKOR), Data Envelopment Analysis (DEA), Preference Ranking METHod for Enrichment Evaluations (PROMETHEE), ELimination Et Choix Traduisant la Realité (ELECTRE), COmplex PRoportional ASsessment (COPRAS), Grey Relational Analysis (GRA), UTility Additive (UTA), and Ordered Weighted Averaging (OWA). The existing MADM methods are improved upon and three novel multiple attribute decision making methods for solving the decision making problems of the manufacturing environment are proposed. The concept of integrated weights is introduced in the proposed subjective and objective integrated weights (SOIW) method and the weighted Euclidean distance based approach (WEDBA) to consider both the decision maker’s subjective preferences as well as the distribution of the attributes data of the decision matrix. These methods, which use fuzzy logic to convert the qualitative attributes into the quantitative attributes, are supported by various real-world application examples. Also, computer codes for AHP, TOPSIS, DEA, PROMETHEE, ELECTRE, COPRAS, and SOIW methods are included. This comprehensive coverage makes Decision Making in Manufacturing Environment Using Graph Theory and Fuzzy Multiple Attribute Decision Making Methods a key reference for the designers, manufacturing engineers, practitioners, managers, institutes involved in both design and manufacturing related projects. It is also an ideal study resource for applied research workers, academicians, and students in mechanical and industrial engineering.
Decision makers are often faced with several conflicting alternatives. How do they evaluate trade-offs when there are more than three criteria? To help people make optimal decisions, scholars in the discipline of multiple criteria decision making (MCDM) continue to develop new methods for structuring preferences and determining the correct relative weights for criteria. A compilation of modern decision-making techniques, Multiple Attribute Decision Making: Methods and Applications focuses on the fuzzy set approach to multiple attribute decision making (MADM). Drawing on their experience, the authors bring together current methods and real-life applications of MADM techniques for decision analysis. They also propose a novel hybrid MADM model that combines DEMATEL and analytic network process (ANP) with VIKOR procedures. The first part of the book focuses on the theory of each method and includes examples that can be calculated without a computer, providing a complete understanding of the procedures. Methods include the analytic hierarchy process (AHP), ANP, simple additive weighting method, ELECTRE, PROMETHEE, the gray relational model,

fuzzy integral technique, rough sets, and the structural model. Integrating theory and practice, the second part of the book illustrates how methods can be used to solve real-world MADM problems. Applications covered in the book include: AHP to select planning and design services for a construction project TOPSIS and VIKOR to evaluate the best alternative-fuel vehicles for urban areas ELECTRE to solve network design problems in urban transportation planning PROMETEE to set priorities for the development of new energy systems, from solar thermal to hydrogen energy Fuzzy integrals to evaluate enterprise intranet web sites Rough sets to make decisions in insurance marketing Helping readers understand how to apply MADM techniques to their decision making, this book is suitable for undergraduate and graduate students as well as practitioners.

Decision making is the process of determining the best course of action from a finite set of available alternatives. The major concern is that almost all decision problems have multiple, usually conflicting criteria. Research on how to solve such multiple criteria decision making (MCDM) problems has been enormous. These problems are broadly classified into two categories: multiple Attribute Decision making (MADM) or multiple attribute analysis, and Multiple objective Decision Making (MODM) or multiple criteria optimisation. MADM is associated with problems whose number of alternatives has beenpredetermined and the MADM methods are management decision aids in evaluatingand/or selecting a desired one from the finite number of alternatives, which are characterised by multiple attributes. The decision maker is to select/prioritise/rank a finite number of courses of action (or alternatives).On the other hand, MODM is not associated with problems in which the alternatives have been predetermined. The decision maker's primary concern is to design a most promising alternative with respect to limited resources. Current ship-building MADM situations are characterised by the following interrelated problems: Imprecise data,Most of the real world decision making problems involve vagueness and fuzzinessand the decision maker has the difficult task to choose among the many alternativesand to specify the optimal alternative. In many cases the decision maker (or expert) has inexact information about the alternatives with respect to an attribute. The classical MADM methods cannot effectively handle problems with such imprecise information. It is obvious that the Rij value (or rating) cannot be assessed precisely. The imprecision may come from different sources such as incomplete information, unquantifiable information, or non-obtainable information etc..The mixture of fuzzy and crisp data,In real world decision making problems, decision data of MADM problems areusually fuzzy , crisp, or mixture of them..Involvement of multiple decision makers,Most of the ship-building problems involve the work of a team of experts orspecialists (technology experts, design engineers, ship owners, etc.) and are focused on an analysis and evaluation of attributes of decision making process..Attribute based expert weighting, In general, the importance of each decision maker against an attribute is not equal. sometimes there are important experts in decision group, such as the executive manager of a shipyard, or some experts who are more experienced than others, the final decision is influenced by the different importance of each expert.Hence, a useful decision model is to provide the ability to handle above-mentioned problems.It is obvious that much knowledge in the real world is fuzzy rather than precise. Decision making is one of the subjects to which Fuzzzy Set Theory (FST), which was first introduced by Zadeh to deal with vague, imprecise, and uncertain problems, has been successfully applied to in the recent years. Various approaches to different aspects of decision problems with vague data have been published. It has been proved that FST provides a sophisticated framework for describing and processing uncertain or imprecise information in decision problems.Fuzzy multiple Attribute Decision Making (FMADM) methods have been developedto solve MADM problems, which contain fuzzy data. FMADM is a subcategory ofFuzzy Multiple Criteria Decision Making (FMCDM). FMCDM can be classified asFuzzy Multiple Objective Decision Making (FMODM) and FMADM; the formeremphasises on continuous decision making spaces and it mainly deals with multiple objective mathematical programming problems; the latter mainly deals with discrete decision making space problems.The study of FMADM problems is still in its infancy and still has a lot of room for improvement. After a systematic and critical study of the existing FMADM methods, the drawbacks of them have been assessed from a practical point of view in this research. These drawbacks certainly limit their applicability to real world (ship-building) MADM problems.The objective of this research is to overcome the difficulties found in FMAD Mmethods and to contribute to the development of an MADM method with multipledecision makers, capable of working in a fuzzy environment.The proposed FMADM method is designed to overcome the aforementioned difficulties so that MADM problems can be meaningfully and efficiently solved in a fuzzy environment. The basic assumption of the proposed method is that the MADM problem may contain fuzzy and crisp data and it may consist of multiple decision maker (or expert) with the difference degree of importance.The thesis discusses the theoretical background of the proposed method and presents the application of it to two real shipbuilding case studies, demonstrating the versatility and potential of the proposed method for solving FMADM problems.The proposed method is composed of three major states as described below:.Rating state,In the rating state of the proposed method, each expert for decision maker) gives his/her opinions (or performance ratings) about alternatives with respect to each subjective attribute. The first state aims to convert fuzzy data into standardised positive trapezoidal fuzzy numbers. If the fuzzy data are linguistic terms, they are transformed into fuzzy numbers first by using appropriate conversion scale and then converted to standardised positive trapezoidal fuzzy numbers..Attribute based aggregation state,In the second state, attribute based aggregation method for heterogeneous group of experts is employed. Aggregation is necessary only for subjective attributes. After the weights of attributes and the degree of importance of experts are assigned, under each subjective attribute all performance ratings are aggregated for each alternative..Selection state.In the last state of the proposed approach, al1 fuzzy elements of the aggregateddecision matrix are deffuzzified in the deffuzzification phase. The result of this phase is a decision matrix, which contains only crisp data. Then the alternatives of the problem are ranked by TOPSIS (Technique for Order Preference by Similarity to Ideal Solution), which is a classical MADM method.In this dissertation, two real case studies are carried out. The first one is a system (propulsion/manoeuvring system) selection under fuzzy environment and the second one is a component (ship main engine) selection under semi-fuzzy environment.From the work carried out in this thesis, the two main contributions have beenreached. They are classified as contributions to ''multiple attribute decision making theory'' and contributions to ''naval architecture'' points of views.Development of a new FMADM method is the first focus and contribution of this dissertation. From the decision theory point of view, proposed method has thefollowing achievements:It is an entire MADM model which combines FMADM methodologies withGDM techniques,.The proposed method is very suitable for solving the multiple attributive GDM problems under fuzzy environment, .The proposed method enables the researchers to incorporate homo/ heterogeneous group of experts with the different degrees of importance into the FMADM models,.The majority of classical MADM methods are capable of handling large MADM problems. The proposed approach extends that ability to the fuzzy problems withmultiple experts domain,.It is a new FMADM method that is easy to use and to understand, and thealgorithm of the proposed approach is also easy to be coded into a computerprogram due to the stepwise description,The second concern and contribution of this dissertation is to show the applicability of the proposed method into the naval architecture MADM problems. From the naval architecture point of view, the following can be concluded:.As illustrated in the real life examples, the proposed method is a generalised model which can be applied to great variety of practical problems encountered inthe naval architecture from propulsion/manoeuvring system selection to warshiprequirements definition,.As the application grows, the real value of fuzzy decision making tools will find more widespread use, as most of the practical problems from design toproduction involves the aggregation of rational and fuzzy elements in harmony ,.Such an approach will also assist the use of optimisation by placing them within the correct context in problem solving and hence will avoid sub-system or sub-attribute optimisation problems.Finally , the proposed method can efficiently help the decision makers and engineers to make decisions in real world. And it can provide a useful way to solve the selection problems in a fuzzy environment. It is a versatile and flexible system, which covers a vast variety of FMADM problems.This research also concludes by high lighting future directions for research in this area.

With respect to single-valued neutrosophic multiple attribute decision making problems with completely unknown weight information, some operational laws of single-valued neutrosophic numbers, score function and accuracy function of single-valued neutrosophic numbers are introduced.

In this article, we expand the dual generalized weighted BM (DGWBM) and dual generalized weighted geometric Bonferroni mean (DGWGBM) operator with single valued neutrosophic numbers (SVNNs) to propose the dual generalized single-valued neutrosophic number WBM (DGSVNNWBM) operator and dual generalized single-valued neutrosophic numbers WGBM (DGSVNNWGBM) operator.

Picture fuzzy nano topological spaces is an extension of intuitionistic fuzzy nano topological spaces. Every decision in life ends with an answer such as yes or no, or true or false, but we have an another component called abstain, which we have not yet considered. This work is a gateway to study such a problem. This paper motivates an enquiry of the third component – abstain - in practical problems. The aim of this paper is to investigate the contemporary notion of picture fuzzy nano topological spaces and explore some of its properties. The stated properties are quantified with numerical data. Furthermore, an algorithm for Multiple Attribute Decision-Making (MADM) with an application regarding the file selection of building material under uncertainty by using picture fuzzy nano topological spaces is developed. As a practical problem, a comparison table is presented to show the difference between the novel concept and the existing methods.

Judul : Implementasi Konsep Decision Support System & Fuzzy Multiple Attribute Decision Making (Fmadm) Penulis : Muhamad Muslihudin, Fauzi, Satria Abadi, Trisnawati, Siti Mukodimah Ukuran : 15,5 x 23 cm Tebal : 120 Halaman Cover : Soft Cover ISBN : 978-623-68728-6-4 SINOPSIS : Buku ini berisi tentang konsep dasar sistem informasi, konsep Decision Support System (DSS), Penyelesaian DSS dengan FMADM, Perancangan Data Base untuk penyelesaian, Perancangan antarmuka, dan Implementasi DSS dengan bahasa Pemrograman Website. Selain memaparkan teori secara gamblang, buku ini juga disertai contoh kasus model penyelesaiannya yang dikutip dari berbagai hasil riset/penelitian yang telah dilakukan. Buku ini berfokus pada penerapan pengambilan keputusan dengan metode FMADM yang di rancang menggunakan konsep terstruktur dengan perancangan diagram konteks, Data Flow Diagram (DFD), dan Entity Relationship Diagram (ERD) kemudian di implementasikan dengan bahasa pemrograman HTML dan java untuk implementasi berbasis mobile.

Aggregation function is an important component in an information aggregation or information fusion system. Interrelationships usually exist between the input arguments (e.g., the criteria in the multicriteria decision making) of an aggregation function. In this paper, we make a comprehensive survey on the aggregation operators (AOs) that consider the argument interrelationships in crisp and fuzzy settings. In particular, we discuss the mechanisms of modeling the argument interrelationships of the Choquet integral (CI), the power average (PA), the Bonferroni mean (BM), the

Heronian mean (HM), and the Maclaurin symmetric mean (MSM) operators, and introduce their extended (e.g., generalized or weighted) forms and their applications in different fuzzy sets. In addition, we compare these ve types of operators and summarize their advantages and disadvantages. Furthermore, we discuss the applications of these operators. Finally, we identify some future research directions in the AOs considering the argument interrelationships. The reviewed papers are mainly about the development of the CI, the PA, the BM, the HM, and the MSM in (fuzzy) MCDMs, most of which fall in the period of 2009 2018.

This book introduces readers to the latest advances in and approaches to intuitionistic fuzzy decision-making methods. To do so, it explores a range of applications to practical decision-making problems, together with representative case studies. Examining a host of decision-making methods, most of which are based on intuitionistic fuzzy aggregation operators, its goal is to offer readers a new way to study decision-making methods in the intuitionistic fuzzy environment. Chiefly intended for practitioners and researchers working in the areas of risk management, decision-making under uncertainty, and operational research, the book can also be used as supplementary material for graduate and senior undergraduate courses in these areas.

This book offers a comprehensive guide to the use of neutrosophic sets in multiple criteria decision making problems. It shows how neutrosophic sets, which have been developed as an extension of fuzzy and paraconsistent logic, can help in dealing with certain types of uncertainty that classical methods could not cope with. The chapters, written by well-known researchers, report on cutting-edge methodologies they have been developing and testing on a variety of engineering problems. The book is unique in its kind as it reports for the first time and in a comprehensive manner on the joint use of neutrosophic sets together with existing decision making methods to solve multi-criteria decision-making problems, as well as other engineering problems that are complex, hard to model and/or include incomplete and vague data. By providing new ideas, suggestions and directions for the solution of complex problems in engineering and decision making, it represents an excellent guide for researchers, lecturers and postgraduate students pursuing research on neutrosophic decision making, and more in general in the area of industrial and management engineering.

Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) is a popular strategy for Multi-Attribute Decision Making (MADM). In this paper, we extend the TOPSIS strategy of MADM problems in trapezoidal neutrosophic number environment.

As a generalization of both single-valued neutrosophic element and hesitant fuzzy element, single-valued neutrosophic hesitant fuzzy element (SVNHFE) is an efficient tool for describing uncertain and imprecise information. Thus, it is of great significance to deal with single-valued neutrosophic hesitant fuzzy information for many practical problems. In this paper, we study the aggregation of SVNHFEs based on some normalized operations from geometric viewpoint. Firstly, two normalized operations are defined for processing SVNHFEs. Then, a series of normalized aggregation operators which fulfill some basic conditions of a valid aggregation operator are proposed. Additionally, a decision-making method is developed for resolving multi-attribute decision-making problems based on the proposed operators.

This mono graph is intended for an advanced undergraduate or graduate course as weIl as for the researchers who want a compilation of developments in this rapidly growing field of operations research. This is a sequel to our previous work entitled "Multiple Objective Decision Making--Methods and Applications: A State-of-the-Art Survey," (No. 164 of the Lecture Notes). The literature on methods and applications of Multiple Attribute Decision Making (MADM) has been reviewed and classified systematically. This study provides readers with a capsule look into the existing methods, their char acteristics, and applicability to analysis of MADM problems. The basic MADM concepts are defined and a standard notation is introduced in Part 11. Also introduced are foundations such as models for MADM, trans formation of attributes, fuzzy decision rules, and methods for assessing weight. A system of classifying seventeen major MADM methods is presented. These methods have been proposed by researchers in diversified disciplines; half of them are classical ones, but the other half have appeared recently. The basic concept, the computational procedure, and the characteristics of each of these methods are presented concisely in Part 111. The computational procedure of each method is illustrated by solving a simple numerical example. Part IV of the survey deals with the applications of these MADM methods.

Linguistic neutrosophic numbers (LNNs) are a powerful tool for describing fuzzy information with three independent linguistic variables (LVs), which express the degrees of truth, uncertainty, and falsity, respectively. However, existing LNNs cannot depict the hesitancy of the decision-maker (DM). To solve this issue, this paper first defines a hesitant linguistic neutrosophic number (HLNN), which consists of a few LNNs regarding an evaluated object due to DMs' hesitancy to represent their hesitant and uncertain information in the decision-making process.

With respect to a combination of hesitant sets, and single-valued neutrosophic sets which are a special case of neutrosophic sets, the single valued neutrosophic hesitant sets (SVNHFS) have been proposed as a new theory set that allows the truth-membership degree, indeterminacy membership degree and falsity-membership degree including a collection of crisp values between zero and one, respectively.

Bipolar neutrosophic sets are the extension of neutrosophic sets and are based on the idea of positive and negative preferences of information. Projection measure is a useful apparatus for modeling real life decision making problems. Multi-objective programming (MOP) can simultaneously optimize multi-objectives in mathematical programming models, but the optimization of multi-objectives triggers the issue of Pareto solutions and complicates the derived answers. To address these problems, researchers often incorporate the concepts of fuzzy sets and evolutionary algorithms into MOP models. Focusing on the methodologies and applications of this field, Fuzzy Multiple Objective Decision Making presents mathematical tools for complex decision making. The first part of the book introduces the most popular methods used to calculate the solution of MOP in the field of multiple objective decision making (MODM). The authors describe multi-objective evolutionary algorithms; expand de novo programming to changeable spaces, such as decision and objective spaces; and cover network data envelopment analysis. The second part focuses on various applications, giving readers a practical, in-depth understanding of MODM. A follow-up to the authors' Multiple Attribute Decision Making: Methods and Applications, this book guides practitioners in using MODM methods to make effective decisions. It also extends students' knowledge of the methods and provides researchers with the foundation to publish papers in operations research and management science journals.

Take the third-party logistics providers (3PLs) as an example, according to the characteristics of correlation between attributes in multi-attribute decision-making, two Choquet aggregation operators adoping probabilistic neutrosophic hesitation fuzzy elements (PNHFEs) are proposed to cope with the situations of correlation among criterions. This measure not only provides support for the correlation phenomenon between internal attributes, but also fully concerns the incidental uncertainty of the external space. Our goal is to make it easier for decision makers to cope with this uncertainty, thus we establish the notion of probabilistic neutrosophic hesitant fuzzy Choquet averaging (geometric) (PNHFCOA, PNHFCOG) operator. Based on this foundation, a method for aggregating decision makers' information is proposed, and then the optimal decision scheme is obtained. Finally, an example of selecting optimal 3PL is given to demonstrate the objectivity of the above-mentioned standpoint.

This work examines all the fuzzy multicriteria methods recently developed, such as fuzzy AHP, fuzzy TOPSIS, interactive fuzzy multiobjective stochastic linear programming, fuzzy multiobjective dynamic programming, grey fuzzy multiobjective optimization, fuzzy multiobjective geometric programming, and more. Each of the 22 chapters includes practical applications along with new developments/results. This book may be used as a textbook in graduate operations research, industrial engineering, and economics courses. It will also be an excellent resource, providing new suggestions and directions for further research, for computer programmers, mathematicians, and scientists in a variety of disciplines where multicriteria decision making is needed.

Recently, the TODIM has been used to solve multiple attribute decision making (MADM) problems. The single-valued neutrosophic sets (SVNSs) are useful tools to depict the uncertainty of the MADM.

Single-valued neutrosophic hesitant fuzzy set is a merged form of single-valued neutrosophic sets and hesitant fuzzy sets. This set is a useful tool to handle imprecise, incomplete and inconsistent information existing in multi-attribute decision making problems. In multi-attribute decision making, distance measures play an important role to take a decision regarding alternatives.