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

This volume comprises the proceedings of the International Conference on Computational Intelligence 2015 (ICCI15). This book aims to bring together work from leading academicians, scientists, researchers and research scholars from across the globe on all aspects of computational intelligence. The work is composed mainly of original and unpublished results of conceptual, constructive, empirical, experimental, or theoretical work in all areas of computational intelligence. Specifically, the major topics covered include classical computational intelligence models and artificial intelligence, neural networks and deep learning, evolutionary swarm and particle algorithms, hybrid systems optimization, constraint programming, human-machine interaction, computational intelligence for the web analytics, robotics, computational neurosciences, neurodynamics, bioinspired and biomorphic algorithms, cross disciplinary topics and applications. The contents of this volume will be of use to researchers and professionals alike.

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.

This book introduces methods for uncertain multi-attribute decision making including uncertain multi-attribute group decision making and their applications to supply chain management, investment decision making, personnel assessment, redesigning products, maintenance services, military system efficiency evaluation. Multi-attribute decision making, also known as multi-objective decision making with finite alternatives, is an important component of modern decision science. The theory and methods of multi-attribute decision making have been extensively applied in engineering, economics, management and military contexts, such as venture capital project evaluation, facility location, bidding, development ranking of industrial sectors and so on. Over the last few decades, great attention has been paid to research on multi-attribute decision making in uncertain settings, due to the increasing complexity and uncertainty of supposedly objective aspects and the fuzziness of human thought. This book can be used as a reference guide for researchers and practitioners working in e.g. the fields of operations research, information science, management science and engineering. It can also be used as a textbook for postgraduate and senior undergraduate students.

Methods and Applications

Fuzzy Sets, Decision Making, and Expert Systems

Decision Making with Spherical Fuzzy Sets

Implementasi Konsep Decision Support System & Fuzzy Multiple Attribute Decision Making (Fmadm)

Fuzzy Multi-attribute Decision-making

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.

The book offers a comprehensive survey of interval-valued intuitionistic fuzzy sets. It reports on cutting-edge research carried out by the founder of the intuitionistic fuzzy sets, Prof. Krassimir Atanassov, giving a special emphasis to the practical applications of this extension. A few interesting case studies, such as in the area of data mining, decision making and pattern recognition, among others, are discussed in detail. The book offers the first comprehensive guide on interval-valued intuitionistic fuzzy sets. By providing the readers with a thorough survey and important practical details, it is expected to support them in carrying out applied research and to encourage them to test the theory behind the sets for new advanced applications. The book is a valuable reference resource for graduate students and researchers alike.

Fuzzy Multiple Attribute Decision MakingMethods and ApplicationsSpringer

Multiple Attribute Decision Making

Fuzzy Multiple Attribute Decision Making

Advances in Computational Intelligence

Multi-objective Group Decision Making

Interval-Valued Intuitionistic Fuzzy Sets

This book provides the readers with a thorough and systematic introduction to hesitant fuzzy theory. It presents the most recent research results and advanced methods in the field. These includes: hesitant fuzzy aggregation techniques, hesitant fuzzy preference relations, hesitant fuzzy measures, hesitant fuzzy clustering algorithms and hesitant fuzzy multi-attribute decision making methods. Since its introduction by Torra and Narukawa in 2009, hesitant fuzzy sets have become more and more popular and have been used for a wide range of applications, from decision-making problems to cluster analysis, from medical diagnosis to personnel appraisal and information retrieval. This book offers a comprehensive report on the state-of-the-art in hesitant fuzzy sets theory and applications, aiming at becoming a reference guide for both researchers and practitioners in the area of fuzzy mathematics and other applied research fields (e.g. operations research, information science, management science and engineering) characterized by uncertain ("hesitant") information. Because of its clarity and self contained explanations, the book can also be adopted as a textbook from graduate and advanced undergraduate students.

This book introduces readers to the novel concept of spherical fuzzy sets, showing how these sets can be applied in practice to solve various decision-making problems. It also demonstrates that these sets provide a larger preference volume in 3D space for decision-makers. Written by authoritative researchers, the various chapters cover a large amount of theoretical and practical information, allowing readers to gain an extensive understanding of both the fundamentals and applications of spherical fuzzy sets in intelligent decision-making and mathematical programming.

This book presents some recent specialized works of theoretical study in the domain of fuzzy systems. Over eight sections and fifteen chapters, the volume addresses fuzzy systems concepts and promotes them in practical applications in the following thematic areas: fuzzy mathematics, decision making, clustering, adaptive neural fuzzy inference systems, control systems, process monitoring, green infrastructure, and medicine. The studies published in the book develop new theoretical concepts that improve the properties and performances of fuzzy systems. This book is a useful resource for specialists, engineers, professors, and students.

A Handbook on Multi-Attribute Decision-Making Methods

Theory and Applications

Fuzzy Reasoning in Decision Making and Optimization

Several Intuitionistic Fuzzy Multi-Attribute Decision Making Methods and Their Applications

Multiple Attribute Decision Making Algorithm via Picture Fuzzy Nano Topological Spaces

Clear and effective instruction on MADM methods for students, researchers, and practitioners. A Handbook on Multi-Attribute Decision-Making Methods describes multi-attribute decision-making (MAD methods and provides step-by-step guidelines for applying them. The authors describe the most important MADM methods and provide an assessment of their performance in solving problems across After offering an overview of decision-making and its fundamental concepts, this book covers 20 leading MADM methods and contains an appendix on weight assignment methods. Chapters are arran optimal learning in mind, so you can easily engage with the content found in each chapter. Dedicated readers may go through the entire book to gain a deep understanding of MADM methods and thei theoretical foundation, and others may choose to review only specific chapters. Each standalone chapter contains a brief description of prerequisite materials, methods, and mathematical concepts nee cover its content, so you will not face any difficulty understanding single chapters. Each chapter: Describes, step-by-step, a specific MADM method, or in some cases a family of methods Contains a th literature review for each MADM method, supported with numerous examples of the method's implementation in various fields Provides a detailed yet concise description of each method's theoretical f Maps each method's philosophical basis to its corresponding mathematical framework Demonstrates how to implement each MADM method to real-world problems in a variety of disciplines In MADM stakeholders' objectives are expressible through a set of often conflicting criteria, making this family of decision-making approaches relevant to a wide range of situations. A Handbook on Multi-Attribute Decision-Making Methods compiles and explains the most important methodologies in a clear and systematic manner, perfect for students and professionals whose work involves operations research a decision making.

This book proposes a set of models to describe fuzzy multi-objective decision making (MODM), fuzzy multi-criteria decision making (MCDM), fuzzy group decision making (GDM) and fuzzy multi-object group decision-making problems, respectively. It also gives a set of related methods (including algorithms) to solve these problems. One distinguishing feature of this book is that it provides two decisio systems software for readers to apply these proposed methods. A set of real-world applications and some new directions in this area are then described to further instruct readers how to use these me software in their practice.

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 conflictin 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 m (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 attrib 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 predeterm 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 s 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 pro 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, unquantifiab 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 f 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 the 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 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 c 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 ap 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 in 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 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 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 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 cer 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 dec 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 stu 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 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 da 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 standa 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 necessa 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..S 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 co 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 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-fuzz 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 "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 thefollow 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 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 cl 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 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 dissertatio 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 examp 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 warshiprequ 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 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 proble 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.

Uncertain Multi-Attribute Decision Making

Hesitant Fuzzy Sets Theory

Fuzzy Multi-Criteria Decision Making

Fuzzy Outranking Methods for Multiple Attribute Decision Making

Multiple-Attribute Decision-Making Method Using Similarity Measures of Hesitant Linguistic Neutrosophic Numbers Regarding Least Common Multiple Cardinality

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.

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.

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.

Computational Intelligence

Multi-Attribute Decision Making Based on Probabilistic Neutrosophic Hesitant Fuzzy Choquet Aggregation Operators

International Journal of Applied Management Sciences and Engineering (IJAMSE).

A Method for Multiple Attribute Decision-making with the Fuzzy Preference Relation on Alternatives in Selecting the Best House

Multiple Attribute Decision Making with Mixed Numerical and Fuzzy Data

In this article, we extend the original TODIM (Portuguese acronym for Interactive Multi-Criteria Decision Making) method to the 2-tuple linguistic neutrosophic fuzzy environment to propose the 2TLNNs TODIM method. In the extended method, we use 2-tuple linguistic neutrosophic numbers (2TLNNs) to present the criteria values in multiple attribute group decision making (MAGDM) 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.

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.

New Trends and Applications

A Practical Development of Multi-attribute Decision Making Using Fuzzy Set Theory

Decision Making in Manufacturing Environment Using Graph Theory and Fuzzy Multiple Attribute Decision Making Methods

New Methods and Applications in Multiple Attribute Decision Making (MADM)

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 Decisio Support System (DSS), Penyelesaian DSS dengan FMADM, Perancangan Data Base untuk penyelesaian, Perancangan antarmuka, dan Implementasi DSS dengan bahasa Pemrogram Website. Selain memaparkan teori secara gamblang, buku ini juga disertai contoh kasus model penyelesaiannya yang dikutip dari berbagai hasil riset/penelitian yang telah dilakukan. Bu

ini berfokus pada penerapan pengambilan keputusan dengan metode FMADM yang di rancang menggunakan konsep terstruktur dengan perancangan diagram konteks, Data Flow Diag (DFD), dan Entity Relationship Diagram (ERD) kemudian di implementasikan dengan bahasa pemrograman HTML dan java untuk implementasi berbasis mobile.

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].

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 makin (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 examp 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 prioriti 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.

A Fuzzy Multi-attribute Decision Making Approach for the Identification of the Key Sectors of an Economy

GRA Method of Multiple Attribute Decision Making with Single Valued Neutrosophic Hesitant Fuzzy Set Information

Fuzzy Systems

Aggregation Operators

TODIM Method for Multiple Attribute Group Decision Making under 2-Tuple Linguistic Neutrosophic Environment

This book presents a collection of recent research on topics related to Pythagorean fuzzy set, dealing with dynamic and complex decision-making problems. It discusses a wide range of theoretical and practical information to the latest research on Pythagorean fuzzy sets, allowing readers to gain an extensive understanding of both fundamentals and applications. It aims at solving various decision-making problems such as medical diagnosis, pattern recognition, construction problems, technology selection, and more, under the Pythagorean fuzzy environment, making it of much value to students, researchers, and professionals associated with the field.

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.

Many decision-making tasks are too complex to be understood quantitatively, however, humans succeed by using knowledge that is imprecise rather than precise. Fuzzy logic resembles human reasoning in its use of imprecise informa tion to generate decisions. Unlike classical logic which requires a deep under standing of a system, exact equations, and precise numeric values, fuzzy logic incorporates an alternative way of thinking, which allows modeling complex systems using a higher level of abstraction originating from our knowledge and experience. Fuzzy logic allows expressing this knowledge with subjective concepts such as very big and a long time which are mapped into exact numeric ranges. Since knowledge can be expressed in a more natural by using fuzzy sets, many decision (and engineering) problems can be greatly simplified. Fuzzy logic provides an inference morphology that enables approximate human reasoning capabilities to be applied to knowledge-based systems. The theory of fuzzy logic provides a mathematical strength to capture the un certainties associated with human cognitive processes, such as thinking and reasoning. The

conventional approaches to knowledge representation lack the means for representating the meaning of fuzzy concepts. As a consequence, the approaches based on first order logic do not provide an appropriate con ceptual framework for dealing with the representation of commonsense knowl edge, since such knowledge is by its nature both lexically imprecise and non categorical.
Multiple-Attribute Decision-Making Method Based on Normalized Geometric Aggregation Operators of Single-Valued Neutrosophic Hesitant Fuzzy Information
Development of a new fuzzy muptiple attribute decision making approach and its application to decision making in ship design and shipbuilding
Foundations and Applications - Proceedings of the 9th International Flins Conference
Methods and Applications A State-of-the-Art Survey
Methods, Software and Applications with Fuzzy Set Techniques

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.

1. The increasing number of research papers appeared in the last years that either make use of aggregation functions or contribute to its theoretieal study asses its growing importance in the field of Fuzzy Logie and in others where uncertainty and imprecision play a relevant role. Since these papers are pub lished in many journals, few books and several proceedings of conferences, books on aggregation are partieularly welcome. To my knowledge, "Agrega tion Operators. New Trends and Applications" is the first book aiming at generality , and I take it as a honour to write this Foreword in response to the gentle demand of its editors, Radko Mesiar, Tomasa Calvo and Gaspar Mayor. My pleasure also derives from the fact that twenty years aga I was one of the first Spaniards interested in the study of aggregation functions, and this book includes work by several Spanish authors. The book contains nice and relevant original papers, authored by some of the most outstanding researchers in the field, and since it can serve, as the editors point out in the Preface, as a small handbook on aggregation, the book is very useful for those entering the subject for the first time. The book also contains apart dealing with potential areas of application, so it can be helpful in gaining insight on the future developments.

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.

Theory and Applications with Recent Developments
Proceedings of International Conference on Computational Intelligence 2015
The Case of Indonesia
Fuzzy Multiple Objective Decision Making
Pythagorean Fuzzy Sets

In the two decades since its inception by L. Zadeh, the theory of fuzzy sets has matured into a wide-ranging collection of concepts, models, and tech niques for dealing with

complex phenomena which do not lend themselves to analysis by classical methods based on probability theory and bivalent logic. Nevertheless, a question which is frequently raised by the skeptics is: Are there, in fact, any significant problem areas in which the use of the theory of fuzzy sets leads to results which could not be obtained by classical methods? The approximately 5000 publications in this area, which are scattered over many areas such as artificial intelligence, computer science, control engineering, decision making, logic, operations research, pattern recognition, robotics and others, provide an affirmative answer to this question. In spite of the large number of publications, good and comprehensive textbooks which could facilitate the access of newcomers to this area and support teaching were missing until recently. To help to close this gap and to provide a textbook for courses in fuzzy set theory which can also be used as an introduction to this field, the first volume ofthis book was published in 1985 [Zimmermann 1985 b]. This volume tried to cover fuzzy set theory and its applications as extensively as possible. Applications could, therefore, only be described to a limited extent and not very detailed.
This book presents 27 methods of the Multiple Attribute Decision Making (MADM), which are not discussed in the existing books, nor studied in details, using more applications. Nowadays, decision making is one of the most important and fundamental tasks of management as an organizational goal achievement that depends on its quality. Decision making includes the correct expression of objectives, determining different and possible solutions, evaluating their feasibility, assessing the consequences, and the results of implementing each solution, and finally, selecting and implementing the solution. Multiple Criteria Decision Making (MCDM) is sum of the decision making techniques. MCDM is divided into the Multiple Objective Decision Making (MODM) for designing the best solution and MADM for selecting the best alternative. Given that the applications of MADM are mostly more than MODM, wide various techniques have been developed for MADM by researchers over the last 60 years, and the current book introduces some of the other new MADM methods.
FLINS, originally an acronym for Fuzzy Logic and Intelligent Technologies in Nuclear Science, is now extended to Computational Intelligence for applied research. The contributions to the ninth in the series of FLINS conferences cover state-of-the-art research, development, and technology for computational intelligence systems ? both from foundations and applications points-of-view.
Volume 2