

Symmetric and Asymmetric Data in Solution Models

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Abstract: This Special Issue covers symmetric and asymmetric data that occur in real-life problems. We invited authors to submit their theoretical or experimental research to present engineering and economic problem solution models that deal with symmetry or asymmetry of different data types. The Special Issue gained interest in the research community and received many submissions. After rigorous scientific evaluation by editors and reviewers, seventeen papers were accepted and published. The authors proposed different solution models, mainly covering uncertain data in multi-criteria decision-making problems as complex tools to balance the symmetry between goals, risks, and constraints to cope with the complicated problems in engineering or management. Therefore, we invite researchers interested in the topics to read the papers provided in the Special Issue.

Keywords: symmetric data; asymmetric data; solution models; MCDM; fuzzy sets; neutrosophic sets



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1. Introduction

This Special Issue covers symmetric and asymmetric data that occur in real-life problems. The existence of data asymmetry causes difficulties when achieving an optimal solution. The authors submitted their theoretical and experimental research, presenting engineering and other problem-solving models dealing with symmetry and asymmetry of different data types.

Accurate balance in the real world is an exceptional case. Decision makers need information about a problem's objectives and the importance of many reasonable goals, guidelines and trade-offs [1]. The role of asymmetric information is more important and weightier. Therefore, solution models offer different integrated tools to balance the overall components of work [2], i.e., to find asymmetry axes concerning goals, risks, and constraints to cope with complicated problems. Policymakers need to find a balance between data objectivity and subjectivity.

Symmetrical and asymmetrical information play a decisive role in many problems. Decision makers address these information asymmetry problems in different ways.

Marwala and Hurwitz [3] noted decreased information asymmetry observed between two artificial intelligent agents, compared to two human agents. If these artificial intelligence agents are present in the financial markets, it reduces arbitrage opportunities and makes them more efficient. As the number of artificially intelligent agents in the market increases, the market's commercial volume will decrease because trade is the information asymmetry [4] in the valuation of goods and services. Information asymmetry is applied in various ways in management research, ranging from conceptualisations of information asymmetry to building resolutions to reduce it [5].

Schmidt and Keil's study show that private information's asymmetry affects a business's normal conduct. Firms with a better understanding of such resources can use this information to assess their own and competitors' advantages [6]. Although different team

members incorporate diverse, specialised knowledge, values, and perspectives into overall, strategic decision making, there is a lack of equal information sharing [7].

Since the publication of Shepard pioneering articles on multi-dimensional scaling (MDS) [8,9], the MDS methodology has received wide attention and application by researchers in the behavioural and administrative sciences. Over the last decade, researchers in marketing have applied numerous MDS methods of perceptions and preferences. Harshman [10–14] proposed a new family of models called DEDICOM (DEcomposition into DIrectional COMponents), analysing intrinsically asymmetric data matrices to fulfil a gap in the MDS methodology the lack of suitable models for analysing inherently asymmetric data relationships. Such information often has helpful marketing implications.

Arrow, the Nobel Prize winner in Economics in 1972, examined, among other things, uncertainty in the field of medicine. Arrow noted that a patient must defer to the doctor, and trust that they will use their knowledge to the patient's best advantage to provide the best care. According to Arrow, the doctor relies on trust's social obligation to sell their services to the public, even though the patients do not or cannot inspect the doctor's work quality. Last, he notes how this unique relationship demands that doctors attain high education and certification levels to maintain doctors' medical service quality.

High investment, more comprehensive implementation of plans and polished technologies characterise more recent projects [15]. Many decision-making problems stem from the fact that not all know the information necessary to create a reasonable solution. In one market, product developers have to have detailed information on product functions. It is necessary to understand the importance of asymmetric information [16], as the nobility, if this inefficiency were to cause concern, and the degree of asymmetry are essential, economically. Information asymmetry is the most important, usually in areas where information is complex to receive. Asymmetric information is typically for a problem where one party has more information than another. Thus, stakeholders also need to see an incentive for mechanisms that allow for imperfectly beneficial decisions for both parties.

The degree of asymmetry is different and gives the effect of the prevalence of asymmetric learning [17]. People practice various creative solutions [18]. Individuals make scientific and technological measurements of subjective elements [19] by selecting or collecting data to analyse or explain facts. They create an incentive for company employees [20] to gather information and exchange and collaborate with other companies, rather than through covert means [21].

In addition, they receive confirmation; suppose a company pays against a believer to show that it has the financial resources to repay the money. In that case, the believer has an incentive to pay the company a lower interest than was necessary if the company considered the believer to be a risky borrower [22].

Symmetry examines symmetric phenomena concerning mathematics, physics, interdisciplinary fields and others. According to the results, the following topics can be looked at in the future [23]:

1. Processing complex and varied raw data and examining new operators;
2. Examining symmetry phenomena in artificial intelligence;
3. Identifying symmetry in conforming problems aimed at solving social management problems;
4. Predicting trends in possible changes in time and its weight in dynamic issues;
5. Studying intelligent algorithms and encouraging their stability and reliability.

The evolution of humans' creativity highlights the advantages of symmetry principles [24]. Symmetry is an essential element of design that reflects the balance between a product and its factors [25]. It affects such product conditions as structural efficiency, attractive forms, economic production, and functional or aesthetic requirements [26]. Geometric symmetry means symmetry in space. The ideal shape is the most straightforward: round. Simple symmetrical geometry shapes are safer, more efficient, and more predictable than asymmetrical ones [27]. In industry, more material is needed to make asymmetrical items [28]; therefore, designers prefer symmetrical shapes to asymmetrical ones. There are

subjective decisions in every objective measurement. Planners first decide which goals and objectives are essential [29].

Information asymmetry is usually most significant in areas where information is complex, challenging to obtain or both. Asymmetric information is typical of a problem where one party has more information than another does. Insufficient info makes market problems more difficult. The degree of asymmetry is different, yielding testable implications for the prevalence of asymmetric learning. Decision makers should acknowledge a critical parameter corresponding to the degree to which the information is asymmetric. Humans necessarily fill scientific and technology measurements with subjective elements by selecting or collecting, analysing, or interpreting data [30].

Many decision-making problems arise from imperfect information. In a market where customers reach balance and product developers need detailed information about product features, it is necessary to understand the importance of asymmetric information so that nobility, should this inefficiency cause concern, and the degree of asymmetry are economically essential. For this reason, decision makers can use interval type-2 fuzzy sets. The project environment is particularly vulnerable during conflict [31].

The perfect symbol of Yin–Yang is a sign of balance, harmony and moderation. There is symmetrical balance when all parts of an object are well balanced. It is about finding unity in the middle of duality. Human balanced product conditions include structural efficiency, attractiveness, and financial, functional, or aesthetic requirements. It includes compliance with standardisation requirements, production of repetitive elements and mass production, which reduce production costs. In many particular situations, using the balance of the Yin–Yang manufacturing theory and product organisation helps decision makers [32].

Modern decision makers (both scientists and experienced users), when stakes are very high, are critical in defining a problem and multiple conflicting criteria properly, and explicitly evaluating multiple criteria instead of making decisions based on only the intuition of one's own experience. Proper systemic analysis of complex problems leads to more informed and better decisions. The beginning of the 21st century led to the development of both new and much more advanced MCDM (Multi-Criteria Decision-Making) tools. The notion of sustainable development, which is increasingly omnipresent in all activity fields, is part of the knowledge that researchers in management have to acquire [33]. The basic premise is rationality. Often, different MCDM methods do not give the same results [34]. The most popular hybrid MCDM methods show benefits over traditional solutions to complex problems, including stakeholder preferences, interrelated or conflicting criteria, and an unsafe environment [35]. The objectivity, balance and symmetry of decision making highlight paradoxes in the envelope on groups and results.

Correct, logical and rational projects are reliable and sound products that meet critical quality and design requirements of safety, price, and influence; they are expected to have a lower, long-term impact on the environment [36].

The lack of information in the multi-criteria analysis stems from two following sources:

6. Imprecise definition of alternatives, assessment criteria and preferences (or preference scenarios);
7. Inaccurate measurement of the impact of other options on the assessment criteria and preferential weights.

Modern decision makers (scientists and expert users) define problems with many conflicting criteria rather than adopting decisions based solely on intuition. As a result, researchers need to research with a wide range of knowledge. Exogenous asymmetric information is the basis of many traditional models of contract theory [37,38]. Thus, some authors have examined theoretical processing models, where asymmetric information appears endogenous if agents decide to collect information. Nowadays, the supply chains' environmental and economic factors have come to the fore due to more critical competition conditions [39].

Environmental restoration, revival and recovery are vital principles for sustainable development and human well-being. There is balance when all the objects' features are symmetrically well balanced [40]. Using interval type-2 fuzzy sets helps decision makers deal more effectively with the uncertainty of experts or decision makers' opinions, judgements and preferences [41].

Civil design and engineering are central to the axes of a multi-disciplinary (multi-dimensional) world, linked to many disciplines, which are, therefore, interrelated. Symmetry and structural regularity are essential concepts in many natural and manufactured objects and play an essential role in the world's design, construction, and development [42]. A project and plan's success depends mainly on balancing needs (symmetry) and its satisfaction on correctly defining many success indicators [43]. Sustainable and efficient development is one of the most significant challenges of modern society if we want to save the world for future generations [44]. In discrete, multi-criteria decision-making processes, the weights of criteria are the essential components on which decision makers make their final decisions. Designers that design products use several different subjective and objective requirements to select materiality and structural solutions, considering impacts on environmental aspects [45]. The Vague Kit is a methodological concept of knowledge that allows people, worldwide, to explore possible examples of medium-sized individual alternatives with a perfect decision-making tool [46].

Market participants avoid investment in new and successful technologies since such decisions are linked to personal training, higher start-up costs, and uncertainties about possible profits [47]. The choice of efficient technological industry systems is a complex task with several criteria. Many decision makers reject innovations that face similar difficulties [48]. Therefore, the most excellent valuation methods try to make, as decision makers, the most economical decisions and, above all, these decisions are only for economic objectives [49].

Over the last 40 years, despite many new and progressive technologies for applied industry projects, the sectors' efficiency has remained relatively low. Older researchers propose that digital technologies allow for fast, flexible forms of project organisation [50]. Technological and social growth shape social preferences to stop non-renewable sources and energy consumption and pollutant emissions into the environment as much as possible. It requires the development of systems and technologies for waste disposal, storage and regulatory enforcement. Old residential buildings consume a considerable amount of European energy [51]. The choice of an excellent site to implement projects is of great importance since the practice collaborates independently in the knowledge-rich and multi-functional working environments. The success of the choice of sites is an abstract concept. It decides, to the greatest extent, whether a project is a success or a failure. Decision theory usually analyses a player's perspective, while game theory emphasises its analysis of many players' interactions [52].

Therefore, it is necessary to retrofit them. There is a mass financial gap between the excellent post armament and its modernisation. The industrial sector uses the most significant parts of natural resources and generates increasing waste. In countries with the most significant growing populations, well-being, and urbanisation, the municipalities' significant challenges are to collect waste to be recycled and disposed of [53].

2. Contributions

After careful evaluation, seventeen papers were accepted and are published in the Special Issue.

The Special Issue raised the interest of researchers from different scientific schools in Europa, Asia and South America. Sixty-seven researchers from sixteen different countries contributed to the published papers (Figure 1). The most significant number of researchers were from Lithuania. Ten authors contributed from Serbia and China. From the other remaining countries, one to four authors participated.

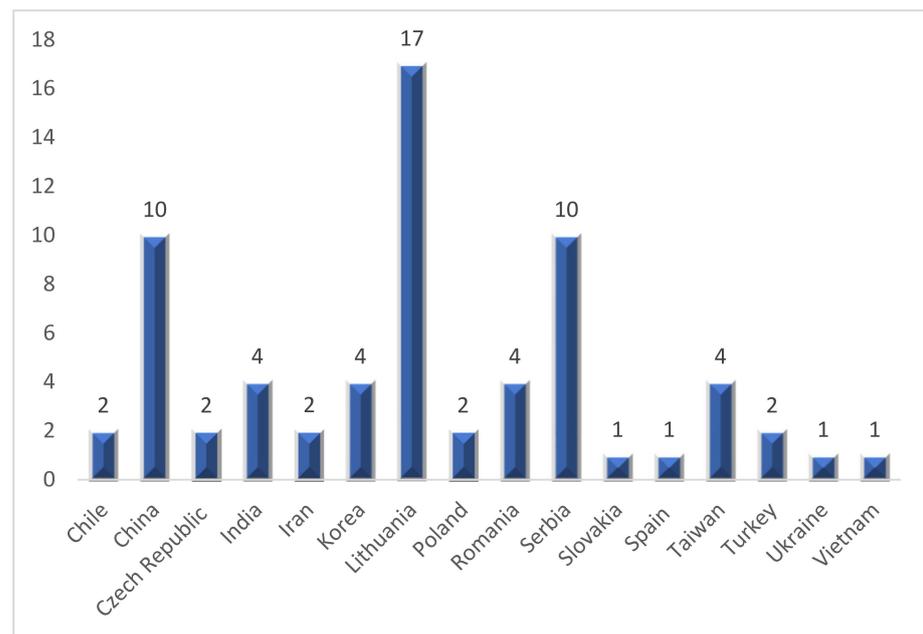


Figure 1. The number of authors from different countries.

Publications were evenly distributed according to whether authors produced them from one country or by international collectives: authors prepared nine papers from one country and the other eight were from international collectives (Table 1). Leading countries by the number of publications are Lithuania (three national collectives and four international collectives) and the Czech Republic (two papers).

Table 1. Publications by countries.

Countries	Number of Papers
Lithuania	3
Czech Republic	2
Poland	1
Romania	1
Taiwan	1
Korea	1
Iran–Lithuania	1
China–Lithuania	1
Ukraine–Slovakia–Lithuania	1
Serbia–Turkey–Lithuania	1
Serbia–Vietnam	1
Korea–India	1
China–India	1
Chile–Spain–Turkey	1

The authors proposed different solution models, mainly covering uncertain data in multi-criteria decision-making problems, as complex tools to deal with complicated problems in engineering or management (Table 2).

Table 2. Publications by solution methods and application areas.

References	Applied/Developed Solution Methods	Type of Data Uncertainty	Application Areas
[54]	AHP, FAHP	Fuzzy sets	Numerical examples, no real case study
[55]	Neutrosophic WASPAS	Single-valued neutrosophic sets	Evaluate the quality of the aerial image
[56]	Global sensitivity analysis of quantiles	Uncertain model inputs as random variables	Resistance of a steel member under compression
[57]	ANN	Crisp data	Construction project management
[58]	Fuzzy inference model	Fuzzy sets	Construction project management
[59]	Quantile-oriented sensitivity analysis	The variance of the input variable	Engineering tasks
[60]	A pattern recognition (PR) algorithm	Neural information	Development of intelligent prosthetic/rehabilitation devices
[61]	ENTROPY, WASPAS-SVNS, VASMA	Single-valued neutrosophic set	The choice of the kindergarten institution
[62]	Wilson's formulation	Varying parameters of the model	Supply chain management
[63]	Pulley-cable transmission and Bowden cable transmission	Geometrical and behavioural parameters of the biological hand	Medical robotics: motor rehabilitation treatment
[64]	DANP, Entropy, VIKOR, DANP-mV	Subjective and objective weights	Supply chain in electronic manufacturing
[23]	Bibliometric analysis	Certain data	Bibliometric analysis of the Journal
[65]	Extended TOPSIS	Single-valued neutrosophic sets	Ranking e-commerce development strategies
[66]	QSVBNS	Quadripartitioned single-valued and bipolar neutrosophic sets (QSVNS and BNS)	Green supplier selection
[67]	PIPRECIA, Interval-valued triangular fuzzy ARAS	Interval-valued triangular fuzzy sets	Evaluation of e-learning courses
[68]	CRITIC, CoCoSo-G	Grey values	Location selection of a temporary hospital during COVID-19 pandemic
[69]	Big data analysis, text mining, correlation analysis	Structured, unstructured and semi-structured data	Real estate market

More than half of the papers proposed different, multiple-criteria decision-making models, mainly dealing with uncertain data. Fuzzy sets [54,57,67] or single-valued neutrosophic sets [55,61,65,66] were the most often applied for modelling uncertain data.

The application fields of the proposed solution models rather often involved different engineering problems. Much attention was given to civil engineering in terms of construction project management [56,58] and the analysis of building structures [59,61]. Three papers analysed the optimisation of supply chains [62,64,66]. Two papers aimed to optimise e-activities, namely, to rank e-commerce development strategies [65] and to evaluate e-learning courses [67]. Two papers solved mechanical medical problems in rehabilitation [60,63]. An up-to-date medical-area problem was solved in [68], namely, location selection of a temporary hospital during the COVID-19 pandemic. It is worth mentioning the excellent article published in the current Special Issue, which is the bibliometric analysis of publications in the *Symmetry* journal from 2009 to 2019 [23], which helps readers to

understand past and current research scopes of the journal as well as future trends of its development.

3. Conclusions

The Special Issue raised the interest of researchers from different scientific schools in Europa, Asia and South America. Researchers from sixteen different countries, including eight international collectives, contributed to the papers published in the issue.

As regards solution models, more than half of the papers proposed multiple-criteria decision-making models. These models mostly covered partly uncertain or entirely uncertain data, integrating crisp MCDM methods with interval-valued fuzzy or neutrosophic sets theory. Therefore, we can conclude that the suggested hybrid decision-making techniques are well applicable to symmetric/asymmetric data modelling.

The application fields of the proposed solution models involved both problems of engineering and management sciences. Supply chain management, construction project management or other civil engineering problems, e-activities, and even problems in the medical field can be marked as application areas that received the most attention.

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