Research on Internet Technology and Operational Research Based on Interval Fuzzy Number to Realize Online Aided Decision-making System

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Abstract: In modern decision-making theory and practice, as a common psychological phenomenon and personality trait, indecision often makes decision-making individuals or organizations unable to make decisions in time, and then affects the smooth progress of the whole decision-making process. Based on the Internet technology and operations research of interval fuzzy numbers, this paper deeply discusses how to combine computer network, database, programming and other related technologies with operational research theory. Based on the possibility theory, a new method for ranking interval numbers is proposed. On the basis of consistency of interval number complementary judgment matrices, two new methods of sorting interval number complementary judgment matrices are proposed. Then, from the global consideration, the model with the shortest distance between the local optimal attribute value and the global attribute value of each scheme is established, and the comprehensive attribute value of the scheme is calculated. In this way, the computer-aided decision-making system is developed to provide scientific, convenient and fast auxiliary decision-making services for network users, so as to achieve work efficiency improvement and cost reduction.

1. Introduction

Decision support system is developed on the basis of management information system and operations research. In modern decision theory and practice, due to the increasingly complex political, economic and social environment in which decision makers live, the decision information they face often presents more and more uncertainties [1]. Decision-making problems can be divided into deterministic decision-making, risk-based decision-making, strict decision making under uncertainty, fuzzy decision-making and so on according to the completeness of information. In the study of single-objective decision-making problems, the single-objective decision-making problems are generally divided into risk-based decision-making problems and decision making under uncertainty problems according to the different natural states in which the decisions are made [2]. If the decision maker can give certain attribute values and attribute weights, the existing multi-attribute decision theory and method can be used to sort or select the scheme. The new decision support system architecture consisting of data warehouse, online analysis and data mining solves the inconsistency of data in the database [3]. Judging from the current conditions, both the data storage and the computing speed of the network server have such capabilities. Operational research applies single model to assist decision-making and multi-model combination to complete quantitative decision-making, while the expert system of knowledge reasoning mainly carries out qualitative analysis. By means of mathematical modeling, mechanism design and computer simulation, the behavior characteristics of complex large group decision-making are depicted, the evolution law of complex large group conflict is revealed, and the theory and method of complex multi-agent decision-making are explored.

2. Methodology

Complexity of decision-making issues is an important source of big data generation, such as environmental issues, transportation issues, resource utilization issues, etc. In many decision-making activities in real life, the decision-making information relied on by experts often

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contains different types of uncertainties, such as randomness, indiscernibility, incompleteness and fuzziness. Therefore, in order to obtain a reasonable decision result, we need to deal with these uncertainties well. In this case, decision makers can only give fuzzy judgments between things, and then convert the fuzzy judgments into fuzzy numbers according to the selected scales. When solving the probability interval decision-making problem, because the probability of occurrence of each natural state is not a definite number, but an interval number, we cannot calculate the definite value of the expected profit and loss value of each scheme [4]. For each scheme, there is an attribute weight vector that makes the local satisfaction of the scheme the best; for this scheme, it is best to have such a result, because the scheme is most likely to be adopted by the decision maker [5]. For example, descriptive knowledge about decision-making problems, procedural knowledge in decision-making process, reasoning knowledge of problem solving, and auxiliary decision-making system to help solve complex decision-making problems through logical reasoning. The combination of the two can provide unified service support. The infrastructure of the decision support platform should be based on this environment, build a new infrastructure and its service model, and provide rapid scientific support for decision-making.

Let U be a non-empty finite field, and a hesitant fuzzy set on U can be represented as a function h that returns a subset over the interval [0, 1]:

$$h : U \to P[0,1] \tag{1}$$

Let U be a non-empty finite field, M is a set of n membership functions, and the hesitation fuzzy set for M can be expressed as h_M, as defined below:

$$h_M : U \to P[0,1] \tag{2}$$

Let U be a non-empty finite universe, and a hesitant fuzzy set on U can be expressed as a function H, which returns a subset on [0, 1] interval when applied to universe U, and its mathematical symbol is expressed as:

$$\varepsilon = \left\{ \left\langle x, h_\varepsilon(x) \right\rangle \middle| x \in U \right\} \tag{3}$$

As an important generalization of classical fuzzy sets, hesitation fuzzy sets allow membership to be composed of multiple possible values when describing the membership degree of elements belonging to the set, which can better describe the hesitation degree of experts in providing decision opinions in the actual decision-making process, thus avoiding information loss to some extent [6]. In the decision-making process, due to the complexity and uncertainty of practical problems in social production and life, as well as the limitations of people's thinking ability and knowledge structure, it is very difficult for people to give a clear judgment on the importance of evaluation objects or alternative schemes. Therefore, it is often given in the form of interval numbers. According to the ranking method of interval number, the priority of each scheme can be determined by ranking the expected profit and loss intervals of each scheme. However, there is only one comprehensive attribute weight vector in the whole multi-attribute decision-making problem, and the competition among the schemes is fair. Therefore, considering the shortest distance between the global and local satisfaction of each scheme under the comprehensive attribute weight, an optimization model is established. These tools make it easy and efficient for users to analyze large amounts of complex data, and can make correct judgments quickly. By exploring the multi-agent decision-making game relationship and equilibrium conditions, and using game theory to explore the solution of the conflict of interests between multi-agent, a new complex multi-agent decision-making coordination mechanism can be formed.

Let U be a non-empty finite field, with hesitation fuzzy set ε_1, $\varepsilon_2 \in$ HF (U), then: (1) The complement of ε_1 is denoted by ε_1^c, and for any x $\in$ U, then:

$$h_{\varepsilon_1^c}(x) = \square\, h_{\varepsilon_1}(x) = \left\{ 1-\gamma \middle| \forall_\gamma \in h_{\varepsilon_1}(x) \right\} \tag{4}$$

Let $h_\varepsilon(x)$ be a hesitant fuzzy element and define the scoring function based on $h_\varepsilon(x)$ as follows:

$$s(h_\varepsilon(x)) = \frac{1}{l(h_\varepsilon(x))} \sum_{\gamma \in h_\varepsilon(x)} \gamma \tag{5}$$

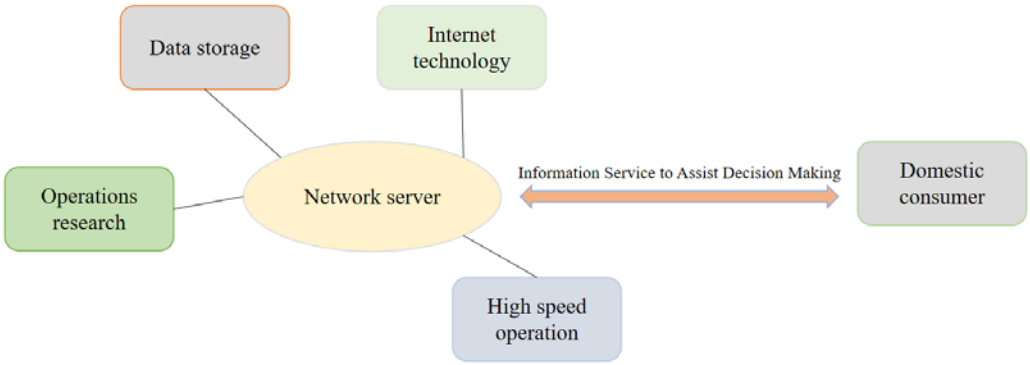

Fig.1. Internet-based assistant decision system model

For multi-attribute decision making with incomplete information, the essence is to find the attribute weight vector. The data of star structure reflects the multi-dimensional cube of space. This highly centralized data provides a useful analytical basis for various decision-making needs. When a user submits a request service on the client side, the server can receive the request through the network, make use of its high-speed program execution and data computing capabilities, and quickly calculate, and send the result to the client through the network (see Figure 1). Data warehouse is different from the data of two-dimensional plane structure database. Data organization expands to multi-dimensional structure of space. Therefore, hesitation fuzzy set model can be regarded as a powerful tool to deal with hesitation and fuzziness in data analysis. When all the experts give a scheme with the same importance under a certain attribute, it is generally believed that what is given at this time is the comprehensive importance of the scheme under this attribute. If the judgment information given by an expert differs greatly from that of other experts, it indicates that the expert has a large deviation in this judgment. The emergence of these new features requires the design and construction of corresponding management decision analysis models and methods, the effective combination of decision science, information science and practical application, and the collaborative innovation of decision mechanism based on big data analysis.

3. Result Analysis and Discussion

In the process of complex group decision-making, because participants come from different research fields, knowledge structure, practical experience and personal preferences are quite different, there will be conflicts within groups or organizations when opinions are gathered, so it is necessary to establish an appropriate coordination mechanism to reach a comprehensive agreement on group opinions [7]. Data warehouse cleans up, extracts and converts a large amount of traditional database data used for transaction processing, and reorganizes them according to the needs of decision-making topics. Using the data of basic data, historical data, comprehensive data and metadata contained in the data warehouse, it is reorganized according to the decision subject to provide auxiliary decision information such as comprehensive information and time trend analysis information [8]. In the classical set, the hierarchical method is embodied by the inclusion relation between sets. In classical fuzzy sets, the hierarchical method is embodied by comparing the size of membership functions. The matrix contains the possibility degree information of comparing all schemes, so the ranking of interval numbers is transformed into the ranking vector of solving the possibility degree matrix. Give weight to different elements given by experts, different elements have different weights, which reduces the interval length which is too large when the judgment error of individual experts is large. Through the comparative analysis of the geometric relationship of relevant statistical data in each period of the development and change system, the factors

influencing the development of the system are determined, and then the importance of each factor is obtained.

Modern decision science is the process of researching a certain goal, applying scientific theories and methods, systematically analyzing subjective and objective conditions, proposing various feasible solutions, and choosing an optimal solution to achieve a specific goal. It extracts comprehensive data and information from the data warehouse that is sufficient to reflect the intrinsic nature of large amounts of data. In the representation process of group decision information, expanding the multi-granularity rough set to the dual domain can not only effectively express decision information, but also integrate decision information under different granularities. It can be seen as an effective multi-source information analysis and fusion. Method [9]. The research on the ordering problem of fuzzy numbers is mainly the study of the ordering method of fuzzy numbers with common parts. For the ranking of fuzzy numbers without common parts, we can easily get it. For interval intuitionistic fuzzy multi-attribute decision making with preference of decision makers, the similarity between objective preference and subjective preference of each alternative should be maximized [10]. Data mining is based on a large number of data in data warehouse and multi-dimensional database. It automatically discovers potential patterns in data and makes prediction based on these patterns. With the increasing complexity of decision-making problems, decision-making is changing to multi-agent group and complex large group decision-making. It is extremely difficult to form a high consistency optimal decision-making scheme, which implies a large number of basic scientific problems. The design of its storage structure and the efficiency of data query and extraction are very important, and the management system is more complex.

The closer the objective preference value and subjective preference value are, the more in line with the wishes of decision makers. However, the dual universe multi-granularity rough set model can only deal with data sets whose attributes are symbolic values, and can not meet the needs of decision analysis in complex decision environment. But the ranking of fuzzy numbers is not only related to itself, but also to its corresponding membership function. Therefore, the ranking of fuzzy numbers must also take into account the influence of their membership functions. The knowledge maintenance of static knowledge system needs manual intervention, and the behavior of the system is determined before the solution process begins, while the dynamic system can automatically gain experience from the decision-making process. A scalable Cloud Architecture between the diverse needs of the Internet of Things and the conflict between user needs; Service-oriented panoramic information integration platform with data layer, middle layer and application layer; through the realization of multiple comprehensive data capabilities of data warehouse, it provides highly integrated data for decision-making information. Compared with the decision-making method based on hesitant fuzzy multi-granularity rough set model, the decision-making method based on hesitant fuzzy integration operator is a relatively single information fusion strategy. For the ordering of fuzzy numbers, the difficulty lies in the ordering of fuzzy numbers with common parts, and the ordering between fuzzy numbers without common parts is easy to obtain. Data mining shows that knowledge is hidden in the large amount of data accumulated daily. And only by complex algorithms and reasoning can not find knowledge, data is the real source of knowledge.

4. Conclusion

Based on the interdisciplinary fuzzy number-based Internet technology and operational research ideas, from the local considerations, each scheme achieves the optimal scheme under the local attribute weight, and establishes a multi-objective programming model. Then, from the global consideration, under the comprehensive attribute weight, the comprehensive attributes of each scheme The distance between the value and the local optimal attribute value is the shortest, and a single-objective programming model is established. From the perspective of technical feasibility, it is fully achievable to make full use of computer network, database, programming and other related technologies combined with operational research theory to develop an auxiliary decision-making system for ordinary users. The theoretical results of hesitate fuzzy multi-granularity rough set are

enriched from the perspective of properties and uncertainty measurement. The fusion of multi-granularity rough set and hesitation fuzzy set theory is completed, and the application range of multi-granularity rough set is expanded from classical information system to hesitation fuzzy information system. From the above analysis, it can be seen that the conditions for the realization of an auxiliary decision-making system based on Internet technology and oriented to ordinary users are already met and have a very good market prospect. Although there are many problems that need extensive and in-depth research, online decision support system is still the development direction of decision support system. With the progress of technology, it will certainly be realized in the near future.

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