Research Article

Using the Neutrosophic DEMATEL Method to Determine the Effect of Internet Finance and Big Data Risk Control Monitoring

Lin Tian¹ and Hongmei Gu²

¹College of Accounting and Finance, Xi’an Peihua University, Xi’an, 710000 Shaanxi, China
²Information Technology and Cultural Management Institute, Hebei Institute of Communications, Shijiazhuang, Hebei, China

Correspondence should be addressed to Hongmei Gu; guhm@hebic.edu.cn

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Internet financial (IF) is an exchanged of goods and pays money over the Internet. The IF plays a critical role in financial fields. The IF is an innovation in the market and financial. The IF is better than the traditional financial. The IF has many criteria and subcriteria. Because there are so many different types of Internet-related financial risks, it is important for the institutions that deal with them to have effective risk prevention, control, monitoring, and management systems in place and to alert the public to any new threats. The goal of this paper is to determine the impacts of IF and big data risk control monitoring. The concept of multicriteria decision-making proposed in this paper deals with four main criteria and seventeen subcriteria. This paper proposed a Decision-Making Trial and Evaluation Laboratory (DEMATEL) method for computing the influence of the IF. The DEMATAL method is integrated with neutrosophic sets for overcoming incomplete and vague information. The applications are proposed to show the outcomes of the proposed methodology.

1. Introduction

Internet financial plays an essential role in the market and growth of countries. The IF presents a significant role in the development of countries. The IF hybrid has many technologies like big data, information technology (IT), and cloud computing. The IF includes many functions and transactions over the Internet, like paying and buying goods online. The IF can reduce financial risks by integrating with many technologies such as IT. The IF can improve the efficiency of resources. The IF can be built in the market-based system using credits. The IF is better than traditional financial. There are many papers in this field [1–9].

Since natural resources are depleting at an alarming rate, the need for energy efficiency in this period has never been greater. A variety of economic factors are significantly influenced by increased energy efficiency as well. Operations research has a subfield known as multicriteria decision-making (MCDM) (OR). Although MCDM could improve engineering decision-making throughout the entire process of design and manufacture, it is particularly beneficial in high Internet financials where product differentiation and competitive advantage are often achieved by just a few millimeters of improvement in the performance of a given material. When it comes to solving complicated material selection challenges, MCDM approaches have the capacity to examine material, process, and form simultaneously. MCDM approaches must thus be used for a wide range of engineering applications, and the expertise gained should be used to enhance the selection of materials. When selecting and designing materials, it is important to be able to manipulate data ranges effectively in order to make better use of MCDM. If there is ambiguity or compromise, this must be done.

There are two ways to categorize MCDM, based on the weighting mechanism used for each choice. Firstly, a compensatory choice is a judgement that takes into account all of the criteria, including the criteria’s strengths as well as
their weaknesses, so that the strong aspects of each criteria may compensate for the weak parts. If you are looking for an example of a compensating decision-making tool, look no further than the analytical hierarchy process (AHP). It is used to compare difficult-to-quantify factors. Secondly, an outranking decision-making strategy analyses criteria in couples to decide, based on the comparisons, which criterion ranks higher than the other criteria. Elimination and choice expressing reality (ELECTRE) is an example of an outranking decision-making approach, which is used to choose, rank, and sort options to solve a problem.

The IF can contain many criteria and subcriteria. So, the MCDM methods are proposed to deal with various and conflict criteria. The MCDM is used in problems of decision-making. This paper introduces the DEMATEL method to present the effects of IF in many criteria. The DEMATEL method is an MCDM method. The DEMATEL was used to present the importance of main and subcriteria [10–16].

This paper proposes the DEMATEL method with the neutrosophic sets to overcome incomplete information and uncertainty. The neutrosophic set is a better tool to deal with uncertainty. Neutrosophic sets are better than the fuzzy system. Because the fuzzy system cannot consider the indeterminacy value in its calculations, neutrosophic sets do it. This paper used the single-valued neutrosophic sets (SVNSs), which contain three values: truth, indeterminacy, and falsity values [17–20].

The main contribution in this paper is the first time we introduce the DEMATEL method to determine the effects of Internet financial and big data risk control monitoring under neutrosophic sets to overcome the uncertainty information. The rest of this paper is presented as follows: Section 2 presents the neutrosophic DEMATEL method, and Section 3 presents the proposed method’s application and results. Section 4 presents the conclusions and future work.

| Table 1: The opinion of the first decision-makers. |
|--------------------------------------------------|
|          | GBC   | IC       | IFP      | MB         |
| GBC      | 1     | 0.9      | 0.8167   | 0.283      |
| IC       | 1.111111 | 1        | 0.283    | 0.9        |
| IFP      | 1.22444 | 3.53569  | 1        | 0.8167     |
| MB       | 1.111111 | 1.22444  | 3.53569  | 1          |

| Table 2: The opinion of the second decision-makers. |
|--------------------------------------------------|
|          | GBC   | IC       | IFP      | MB         |
| GBC      | 1     | 0.8167   | 0.383    | 0.9        |
| IC       | 1.22444 | 1        | 0.383    | 0.8167     |
| IFP      | 2.610966 | 2.610966 | 1        | 0.9        |
| MB       | 1.22444 | 2.610966 | 1.111111 | 1          |

| Table 3: The opinion of the second decision-makers. |
|--------------------------------------------------|
|          | GBC   | IC       | IFP      | MB         |
| GBC      | 1     | 0.383    | 0.283    | 0.8167     |
| IC       | 2.610966 | 1        | 0.8167   | 0.383      |
| IFP      | 3.53569 | 1.22444  | 1        | 0.283      |
| MB       | 2.610966 | 3.53569  | 1.22444  | 1          |

| Table 4: The combined opinion of the decision-makers. |
|--------------------------------------------------|
|          | GBC   | IC       | IFP      | MB         |
| GBC      | 1     | 0.6999   | 0.494233 | 0.666567   |
| IC       | 1.648839 | 1        | 0.494233 | 0.6999     |
| IFP      | 2.456325 | 2.456325 | 1        | 0.666567   |
| MB       | 1.648839 | 2.456325 | 1.956373 | 1          |

| Table 5: The normalized opinion of the decision-makers. |
|--------------------------------------------------|
|          | GBC   | IC       | IFP      | MB         |
| GBC      | 0.141612 | 0.099114 | 0.069989 | 0.094394   |
| IC       | 0.233496 | 0.141612 | 0.069989 | 0.099114   |
| IFP      | 0.347846 | 0.347846 | 0.141612 | 0.094394   |
| MB       | 0.233496 | 0.347846 | 0.277046 | 0.141612   |

| Table 6: The total relation matrix. |
|-----------------------------------|
|          | GBC   | IC       | IFP      | MB         |
| GBC      | 0.052029 | 0.013863 | 0.017078 | 0.051229   |
| IC       | 0.119876 | 0.039593 | 0.006365 | 0.042396   |
| IFP      | 0.146066 | 0.182016 | 0.046716 | 0.000348   |
| MB       | -0.01023 | 0.129815 | 0.157892 | 0.03889    |

| Table 7: The criteria’s weights. |
|---------------------------------|
|          | Weights |
| GBC      | -0.17355  |
| IC       | -0.15706  |
| IFP      | 0.147095  |
| MB       | 0.183509  |
2. The Neutrosophic DEMATEL Method

In this section, the MCDM DEMATEL method is proposed to determine the importance of the criteria and subcriteria. Figure 1 provides schematic diagram for DEMATEL in neutrosophic environment. The following steps of DEMATEL method are the following:

Step 1. Define the goal from this study.

Step 2. Collect a group of decision-makers and criteria.

Step 3. Evaluate the criteria by opinions of decision-makers.

Step 4. Combine the opinions of experts into one matrix.

Step 5. Normalize the opinions of decision-makers.

Step 6. Use the MATLAB software for obtaining the total relation matrix.

3. The Application and Outcomes

This section presents the outcome of the proposed method. First, the goal of this paper is to determine the importance
and effects of IF and big data risk control monitoring. The three experts were collected to evaluate the criteria and sub-criteria. This paper used the four main criteria and seventeen subcriteria as GBC: government-based credit (GBC1: outline planning, GBC2: licensee issue, and GBC3: commercial institution), IC: individual credit (IC1: transaction, IC2: business condition, IC3: record payment, and IC4: investment), IFP: Internet financial platform (IFP1: cost of platform, IFP2: creditworthiness of customer, IFP3: index of credit, IFP4: risk management, and IFP5: supply chain), and MB: market-based credit system (MB1: cost market system, MB2: customer verifying, MB3: information about market, MB4: big data process, and MB5: security). First, decision-makers evaluated the four criteria in Tables 1–3. Then, Table 4 presents their combined opinions. Then,

![Weights](image)

**Figure 3: The criteria’s weights for GBC.**

| Table 15: The opinion of the first decision-makers for GBC. |
|------------------|------------------|------------------|------------------|
| IC1 | IC2 | IC3 | IC4 |
| IC1 | 1 | 0.8167 | 0.9 | 0.383 |
| IC2 | 1.22444 | 1 | 0.8167 | 0.283 |
| IC3 | 1.111111 | 1.22444 | 1 | 0.9 |
| IC4 | 2.610966 | 3.533569 | 1.111111 | 1 |

| Table 16: The opinion of the second decision-makers. |
|------------------|------------------|------------------|------------------|
| IC1 | IC2 | IC3 | IC4 |
| IC1 | 1 | 0.9 | 0.8167 | 0.283 |
| IC2 | 1.111111 | 1 | 0.383 | 0.9 |
| IC3 | 1.22444 | 2.610966 | 1 | 0.8167 |
| IC4 | 3.533569 | 1.111111 | 1.22444 | 1 |

| Table 17: The opinion of the second decision-makers. |
|------------------|------------------|------------------|------------------|
| IC1 | IC2 | IC3 | IC4 |
| IC1 | 1 | 0.383 | 0.283 | 0.8167 |
| IC2 | 2.610966 | 1 | 0.9 | 0.383 |
| IC3 | 3.533569 | 1.111111 | 1 | 0.283 |
| IC4 | 1.22444 | 2.610966 | 3.533569 | 1 |

| Table 18: The combined opinion of the decision-makers. |
|------------------|------------------|------------------|------------------|
| IC1 | IC2 | IC3 | IC4 |
| IC1 | 1 | 0.6999 | 0.666567 | 0.494233 |
| IC2 | 1.648839 | 1 | 0.6999 | 0.522 |
| IC3 | 1.956373 | 1.648839 | 1 | 0.666567 |
| IC4 | 2.456325 | 2.418549 | 1.956373 | 1 |

| Table 19: The normalized opinion of the decision-makers. |
|------------------|------------------|------------------|------------------|
| IC1 | IC2 | IC3 | IC4 |
| IC1 | 0.127694 | 0.089373 | 0.085116 | 0.06311 |
| IC2 | 0.210546 | 0.127694 | 0.089373 | 0.06656 |
| IC3 | 0.249816 | 0.210546 | 0.127694 | 0.085116 |
| IC4 | 0.313657 | 0.308833 | 0.249816 | 0.127694 |

| Table 20: The total relation matrix. |
|------------------|------------------|------------------|------------------|
| IC1 | IC2 | IC3 | IC4 |
| IC1 | 0.051512 | 0.029137 | 0.039625 | 0.033791 |
| IC2 | 0.113541 | 0.053168 | 0.031975 | 0.028738 |
| IC3 | 0.114989 | 0.108162 | 0.050044 | 0.033578 |
| IC4 | 0.106121 | 0.149331 | 0.131718 | 0.049744 |

| Table 21: The criteria’s weights. |
|------------------|------------------|
| IC1 | IC2 | IC3 | IC4 |
| IC1 | -0.2321 | -0.11237 | 0.053411 | 0.291062 |
Table 5 presents the normalization matrix. Then, the total relation matrix is in Table 6. The criteria’s weights are in Table 7. In this step, each criterion’s objective weight is obtained by the removal effects ($E_j$). In what follows, $w_j$ refers to the weight of the $j$th criterion. The following equation is utilized for generating $w_j$:

$$w_j = \frac{E_j}{\sum_k E_k}. \quad (1)$$

Figure 2 presents the criteria’s weights. MB is the highest importance, and GBC is the lowest importance in the IF.
Then, determine the subcriteria’s weights for GBC. First, decision-makers’ criteria are in Tables 8–10. Then, Table 11 presents their combined opinions. Then, Table 12 presents the normalization matrix. Then, the total relation matrix is in Table 13. The criteria’s weights are in Table 14. Figure 3 presents the criteria’s weights. GBC3 is the highest importance, and GBC1 is the lowest importance in the IF.

Then, determine the subcriteria’s weights for IC. First, decision-makers’ criteria are in Tables 15–17. Then, Table 18 presents their combined opinions. Then, Table 19 presents the normalization matrix. Then, the total relation matrix is in Table 20. The criteria’s weights are in Table 21. Figure 4 presents the criteria’s weights. IC4 is the highest importance, and IC1 is the lowest importance in the IF.

In the IFP, IFP5 is of the highest importance, and IFP1 is of the lowest importance in the IF. In the MB, MB5 is the highest importance, and MB1 is the lowest importance in the IF. Figure 5 presents the weights of IFP. Figure 6 presents the weights of MB.

4. Conclusions

When it comes to making decisions, there is a growing corpus of study in the subject of “many criteria decision analysis” (MCDA), also known as “multiple criteria decision-making,” which analyses the benefits and drawbacks of different possibilities in diverse settings. It is a decision-making tool that is used in a broad variety of industries. It is possible to analyze the suitability of each criterion in terms of how well it fits within the context of the application. For the decision-maker to arrive at an educated judgement on the optimal course of action, this criterion is compared to all other available criterion options. These factors can be examined in a variety of ways.

In this paper, we introduce a new hybrid methodology from the DEMATEL method and neutrosophic sets to determine the effects the Internet financial and big data risk control monitoring. The DMATEL method is used to show the importance and weights of criteria. The four main criteria and seventeen subcriteria are used in this paper. We used the SVNS scale to present the numbers of neutro-

Data Availability

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

Conflicts of Interest

The authors state that this article has no conflict of interest.

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