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Fuzzy OverProbability for Competitiveness Evaluation of the Power Electronics Technology Industry with Multi-Criteria Decision-Making Method

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Abstract: The power electronics technology sector is essential to the advancement of industrial modernization and sustainable development as the demand for electrification and energy efficiency rises globally. A thorough competitiveness assessment model for the power electronics technology sector is presented in this study. Ten crucial criteria are developed using a multi-criteria decision-making (MCDM) framework, which considers the economic, technological, and innovation-based elements influencing industrial success. These criteria are used to evaluate ten major options that represent well-known businesses or areas. To improve industrial competitiveness in this high-impact industry, the study intends to assist academics, investors, and policymakers in identifying key strengths, weaknesses, and strategic orientations. We use the MULTIMOORA methodology to rank the alternatives. We use Fuzzy OverProbability to obtain the show the final probability between different interval values.

Keywords: Fuzzy OverProbability; Multi-Criteria Decision-Making; Power Electronics Technology Industry.

1. Introduction

Power electronics plays a key role in the transformation of electrical energy systems by facilitating effective power conversion and control in commercial, residential, and industrial settings. The industry includes embedded software, control systems, and semiconductor devices that work together to provide energy-saving solutions. To remain competitive, businesses in the power electronics industry need to quickly adjust to the rapidly changing technical landscape and expanding environmental laws. Assessing competitiveness becomes crucial for evaluating performance against international norms as well as for strategic decision-making[1], [2].

The multifaceted character of competitiveness in this industry is frequently overlooked by traditional evaluation methodologies. Therefore, a strong, criteria-based strategy is necessary. Innovation capacity, production efficiency, market performance, and other factors must all be taken into consideration in such a strategy. This study suggests a quantitative assessment method based on ten well-chosen criteria. These represent the most important elements influencing the development and prosperity of businesses in the power electronics technology sector[3], [4].

Industry studies, expert discussions, and literature evaluations serve as the foundation for the criteria selection process. To represent its relative significance in promoting competitiveness, each criterion is weighted and standardized. As evaluation alternatives, ten top businesses or local industrial clusters are selected. These options offer a fair foundation for comparison because they differ in terms of their operational structures, innovation focus, and market reach[5], [6].

To evaluate performance and produce useful rankings, the evaluation makes use of multi-criteria decision-making techniques. These techniques facilitate the integration of qualitative and quantitative data, guaranteeing thorough analysis. The results shed light on the criteria that have the biggest effects on competitiveness. The assessment also reveals differences between businesses, which could be the result of legal frameworks, investment trends, or strategy decisions[7], [8].

The study provides a forward-looking approach that considers the demands of modern industry by incorporating sustainability, technological innovation, and financial stability into the testing process. In the end, this paradigm supports scholarly discussion, policy creation, and strategic planning. It encourages long-term development and innovation in the field of power electronics technology by enabling stakeholders to make data-driven decisions[9], [10].

Compared to the recently developed intelligent knowledge-based systems, such as multi-criteria decision making (MCDM) for Competitiveness Evaluation of the Power Electronics Technology Industry, the scope of employing conventional methods and systems for Competitiveness Evaluation of the Power Electronics Technology Industry is comparatively limited. Nevertheless, there aren't many studies that have thoroughly examined MCDM in the power electronics industry.

One of the causes is that the standards used to choose power electronics vary slightly depending on the industry. For instance, the aerospace sector considers aspects like financial, production, technological, and environmental effect, while the cycling industry considers elements like supply chain.

The degree of flexibility in MCDM applications is another difficult component, since different sectors have different power electronics requirements, except for the choice of sustainable power electronics[11], [12]. The adoption and application of MCDM have been hampered by researchers. It is crucial to identify the power electronics used in the industry because the MCDM approaches support informed decisions in power electronics selection. These methods also consider environmental factors in addition to digital transformation factors[13], [14].

Through power electronics selection from a variety of MCDM accessible, MCDM approaches would assist power electronics scientists, architects, engineers, and construction managers in accelerating sustainability. To provide a smooth power electronics selection process, this study aims to satisfy the needs and aspirations of the stakeholders in the power electronics industry, especially power electronics engineers, and sustainability scientists[15], [16].

The report offers a comprehensive analysis of the status of disruptive approaches in a range of industries, including their advantages, disadvantages, and prospects. The study also concentrates on the fundamental methods of MCDM. To provide a thorough analysis and practical suggestions on the tried-and-true MCDM techniques of major importance, this study has been meticulously planned using a methodical methodology[17], [18].

Smarandache (2007) expanded the uncertain set to include uncertain OverSet (when some component is > 1) because he noted that, for instance, an employee who works overtime should have a degree of membership > 1, whereas an employee who works regular full-time and has a degree of membership = 1[19], [20]; uncertain UnderSet (when some neutrosophic component is < 0), because, for instance, an employee who causes more harm than good to his company should have a degree of membership < 0, whereas an employee who benefits the company and has a degree of membership > 0; and uncertain OffSet (when some neutrosophic components are off the interval [0, 1], i.e. some neutrosophic component > 1 and some neutrosophic component < 0)[21], [22], [23].

This was followed by the extension of the uncertain logic, measure, probability, statistics, etc. to the corresponding uncertain over-, under-, and off-logic, measure, probability, statistics, etc. All fuzzy and fuzzy-extensions (intuitionistic fuzzy, neutrosophic, spherical fuzzy, plithogenic, etc.) are considered "uncertain".

2. Fuzzy OverProbability

What is student's OverProbability of passing the test (including receiving an A+)?One more question: what is the OverProbability of an A+ (degree > 1) for a student?[20]

We can compute the Fuzzy OverProbability between [0.5,1.1] and [0,1.1]

$$F_{\text{OverProbability}} = \frac{1.1-0.5}{1.1-0} = 0.545 \tag{1}$$

We can compute the Fuzzy OverProbability between [0.25,1.1] and [0,1.1]

$$F_{\text{OverProbability}} = \frac{1.1-0.25}{1.1-0} = 0.77272 \tag{2}$$

We can compute the Fuzzy OverProbability between [0.3,1.1] and [0,1.1]

$$F_{\text{OverProbability}} = \frac{1.1-0.3}{1.1-0} = 0.7272 \quad (3)$$

We can compute the Fuzzy OverProbability between [0.6,1.1] and [0,1.1]

$$F_{\text{OverProbability}} = \frac{1.1-0.6}{1.1-0} = 0.4545 \quad (4)$$

We can compute the Fuzzy OverProbability between [0.7,1.1] and [0,1.1]

$$F_{\text{OverProbability}} = \frac{1.1-0.7}{1.1-0} = 0.3636 \quad (5)$$

We can compute the Fuzzy OverProbability between [0.8,1.1] and [0,1.1]

$$F_{\text{OverProbability}} = \frac{1.1-0.8}{1.1-0} = 0.2727 \quad (6)$$

We can compute the Fuzzy OverProbability between [0.1,1.1] and [0,1.1]

$$F_{\text{OverProbability}} = \frac{1.1-0.1}{1.1-0} = 0.9090 \quad (7)$$

We show the steps of the MULTIMOORA to rank the alternatives.

Create the decision matrix by using the opinions of experts and decision makers. We use the fuzzy OverProbability to obtain crisp values. We combine the decision matrices into one.

Calculate the weights of factors.

The weights of factors are calculated using the average method.

Compute the normalization values.

$$Q_{ij}^{*} = \frac{x_{ij}}{\left(\sum_{i=1}^{m} x_{ij}^{2}\right)^{0.5}} \quad (8)$$

Compute the ratio system

$$R_i = \sum_{j=1}^{g} w_j Q_{ij}^{*} - \sum_{j=g+1}^{n} w_j Q_{ij}^{*} \quad (9)$$

Calculate the reference point

$$P_i = \max_{j} \left| w_j \max Q^{*}{}_{j} - w_j Q_{ij}^{*} \right| \quad (10)$$

Calculate the full multiplicative form

$$F_i = \frac{\prod_{j=1}^{g} \left(Q_{ij}^{*}\right)^{w_j}}{\prod_{j=g+1}^{n} \left(Q_{ij}^{*}\right)^{w_j}} \quad (11)$$

Rank the alternatives based on ratio system, reference point, and full multiplicative form. We apply the dominance theory to show the final ranks of the alternatives.

3. Application

We show results of this study by showing the ranking of the alternatives and criteria weights. We use ten criteria and ten alternatives. Three experts created the decision matrix. We use the fuzzy OverProbability to obtain crisp values.

Technological Innovation Capacity (C1) – Measures R&D investment, patent filings, and new product development frequency.

Market Share and Penetration (C2) – Represents the company's presence in domestic and global markets.

Production Efficiency (C3) – Reflects unit cost, automation, and throughput.

Supply Chain Integration (C4) – Evaluates resilience, sourcing strategy, and supplier relationships.

Product Quality and Reliability (C5) – Indicates conformance to standards and failure rates.

Energy Efficiency and Environmental Compliance (C6) – Assesses adherence to green standards and eco-certifications.

Financial Performance (C7) – Based on revenue growth, profitability, and capital turnover.

Human Capital and Technical Expertise (C8) – Reflects workforce skills, training investments, and retention.

Global Strategic Partnerships (C9) – Evaluates alliances, joint ventures, and research collaborations.

Digital Transformation and Smart Manufacturing (C10) – Examines use of AI, IoT, and data analytics in operations.

A1: Siemens Power Electronics Division, A2: Infineon Technologies, A3: ABB Power Converters and Inverters, A4: Mitsubishi Electric Power Devices, A5: GE Power Electronics, A6: Hitachi Energy Power Electronics Systems, A7: Huawei Digital Power, A8: Texas Instruments (Power Management Division), A9: Toshiba Electronic Devices & Storage, A10: Chinese National Power Electronics Industrial Park.

Table 1. The decision matrix.

	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}
A_1	([0.25,1.1],[0,1.1])	([0.3,1.1],[0,1.1])	([0.6,1.1],[0,1.1])	([0.7,1.1],[0,1.1])	([0.8,1.1],[0,1.1])	([0.10,1.1],[0,1.1])	([0.8,1.1],[0,1.1])	([0.8,1.1],[0,1.1])	([0.25,1.1],[0,1.1])	([0.8,1.1],[0,1.1])
A_2	([0.10,1.1],[0,1.1])	([0.5,1.1],[0,1.1])	([0.25,1.1],[0,1.1])	([0.3,1.1],[0,1.1])	([0.6,1.1],[0,1.1])	([0.7,1.1],[0,1.1])	([0.7,1.1],[0,1.1])	([0.25,1.1],[0,1.1])	([0.3,1.1],[0,1.1])	([0.7,1.1],[0,1.1])
A_3	([0.8,1.1],[0,1.1])	([0.5,1.1],[0,1.1])	([0.6,1.1],[0,1.1])	([0.7,1.1],[0,1.1])	([0.8,1.1],[0,1.1])	([0.8,1.1],[0,1.1])	([0.6,1.1],[0,1.1])	([0.5,1.1],[0,1.1])	([0.6,1.1],[0,1.1])	([0.6,1.1],[0,1.1])
A_4	([0.7,1.1],[0,1.1])	([0.25,1.1],[0,1.1])	([0.3,1.1],[0,1.1])	([0.25,1.1],[0,1.1])	([0.5,1.1],[0,1.1])	([0.25,1.1],[0,1.1])	([0.3,1.1],[0,1.1])	([0.7,1.1],[0,1.1])	([0.7,1.1],[0,1.1])	([0.3,1.1],[0,1.1])
A_5	([0.6,1.1],[0,1.1])	([0.5,1.1],[0,1.1])	([0.7,1.1],[0,1.1])	([0.8,1.1],[0,1.1])	([0.10,1.1],[0,1.1])	([0.8,1.1],[0,1.1])	([0.10,1.1],[0,1.1])	([0.6,1.1],[0,1.1])	([0.5,1.1],[0,1.1])	([0.10,1.1],[0,1.1])

A_6	([0.3,1.1],[0,1.1])	([0.7,1.1],[0,1.1])	([0.6,1.1],[0,1.1])	([0.25,1.1],[0,1.1])	([0.10,1.1],[0,1.1])	([0.25,1.1],[0,1.1])	([0.8,1.1],[0,1.1])	([0.3,1.1],[0,1.1])	([0.25,1.1],[0,1.1])	([0.8,1.1],[0,1.1])
A_7	([0.10,1.1],[0,1.1])	([0.6,1.1],[0,1.1])	([0.7,1.1],[0,1.1])	([0.5,1.1],[0,1.1])	([0.3,1.1],[0,1.1])	([0.3,1.1],[0,1.1])	([0.10,1.1],[0,1.1])	([0.10,1.1],[0,1.1])	([0.5,1.1],[0,1.1])	([0.7,1.1],[0,1.1])
A_8	([0.5,1.1],[0,1.1])	([0.3,1.1],[0,1.1])	([0.5,1.1],[0,1.1])	([0.7,1.1],[0,1.1])	([0.6,1.1],[0,1.1])	([0.6,1.1],[0,1.1])	([0.3,1.1],[0,1.1])	([0.5,1.1],[0,1.1])	([0.25,1.1],[0,1.1])	([0.8,1.1],[0,1.1])
A_9	([0.25,1.1],[0,1.1])	([0.10,1.1],[0,1.1])	([0.10,1.1],[0,1.1])	([0.10,1.1],[0,1.1])	([0.7,1.1],[0,1.1])	([0.7,1.1],[0,1.1])	([0.6,1.1],[0,1.1])	([0.25,1.1],[0,1.1])	([0.3,1.1],[0,1.1])	([0.6,1.1],[0,1.1])
A_{10}	([0.8,1.1],[0,1.1])	([0.7,1.1],[0,1.1])	([0.6,1.1],[0,1.1])	([0.3,1.1],[0,1.1])	([0.10,1.1],[0,1.1])	([0.8,1.1],[0,1.1])	([0.7,1.1],[0,1.1])	([0.8,1.1],[0,1.1])	([0.6,1.1],[0,1.1])	([0.5,1.1],[0,1.1])
	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}
A_1	([0.5,1.1],[0,1.1])	([0.3,1.1],[0,1.1])	([0.6,1.1],[0,1.1])	([0.7,1.1],[0,1.1])	([0.8,1.1],[0,1.1])	([0.25,1.1],[0,1.1])	([0.8,1.1],[0,1.1])	([0.5,1.1],[0,1.1])	([0.10,1.1],[0,1.1])	([0.8,1.1],[0,1.1])
A_2	([0.25,1.1],[0,1.1])	([0.8,1.1],[0,1.1])	([0.25,1.1],[0,1.1])	([0.3,1.1],[0,1.1])	([0.6,1.1],[0,1.1])	([0.7,1.1],[0,1.1])	([0.7,1.1],[0,1.1])	([0.5,1.1],[0,1.1])	([0.3,1.1],[0,1.1])	([0.7,1.1],[0,1.1])
A_3	([0.3,1.1],[0,1.1])	([0.8,1.1],[0,1.1])	([0.6,1.1],[0,1.1])	([0.7,1.1],[0,1.1])	([0.8,1.1],[0,1.1])	([0.5,1.1],[0,1.1])	([0.7,1.1],[0,1.1])	([0.7,1.1],[0,1.1])	([0.6,1.1],[0,1.1])	([0.7,1.1],[0,1.1])
A_4	([0.6,1.1],[0,1.1])	([0.25,1.1],[0,1.1])	([0.3,1.1],[0,1.1])	([0.10,1.1],[0,1.1])	([0.5,1.1],[0,1.1])	([0.10,1.1],[0,1.1])	([0.3,1.1],[0,1.1])	([0.6,1.1],[0,1.1])	([0.7,1.1],[0,1.1])	([0.3,1.1],[0,1.1])
A_5	([0.7,1.1],[0,1.1])	([0.8,1.1],[0,1.1])	([0.7,1.1],[0,1.1])	([0.5,1.1],[0,1.1])	([0.25,1.1],[0,1.1])	([0.3,1.1],[0,1.1])	([0.10,1.1],[0,1.1])	([0.3,1.1],[0,1.1])	([0.5,1.1],[0,1.1])	([0.25,1.1],[0,1.1])
A_6	([0.3,1.1],[0,1.1])	([0.10,1.1],[0,1.1])	([0.5,1.1],[0,1.1])	([0.25,1.1],[0,1.1])	([0.3,1.1],[0,1.1])	([0.6,1.1],[0,1.1])	([0.8,1.1],[0,1.1])	([0.25,1.1],[0,1.1])	([0.25,1.1],[0,1.1])	([0.8,1.1],[0,1.1])
A_7	([0.10,1.1],[0,1.1])	([0.3,1.1],[0,1.1])	([0.25,1.1],[0,1.1])	([0.3,1.1],[0,1.1])	([0.6,1.1],[0,1.1])	([0.7,1.1],[0,1.1])	([0.3,1.1],[0,1.1])	([0.5,1.1],[0,1.1])	([0.5,1.1],[0,1.1])	([0.8,1.1],[0,1.1])
A_8	([0.5,1.1],[0,1.1])	([0.6,1.1],[0,1.1])	([0.3,1.1],[0,1.1])	([0.6,1.1],[0,1.1])	([0.7,1.1],[0,1.1])	([0.6,1.1],[0,1.1])	([0.6,1.1],[0,1.1])	([0.25,1.1],[0,1.1])	([0.25,1.1],[0,1.1])	([0.7,1.1],[0,1.1])
A_9	([0.25,1.1],[0,1.1])	([0.7,1.1],[0,1.1])	([0.6,1.1],[0,1.1])	([0.7,1.1],[0,1.1])	([0.7,1.1],[0,1.1])	([0.7,1.1],[0,1.1])	([0.7,1.1],[0,1.1])	([0.8,1.1],[0,1.1])	([0.3,1.1],[0,1.1])	([0.6,1.1],[0,1.1])
A_{10}	([0.8,1.1],[0,1.1])	([0.7,1.1],[0,1.1])	([0.7,1.1],[0,1.1])	([0.3,1.1],[0,1.1])	([0.25,1.1],[0,1.1])	([0.8,1.1],[0,1.1])	([0.8,1.1],[0,1.1])	([0.7,1.1],[0,1.1])	([0.6,1.1],[0,1.1])	([0.25,1.1],[0,1.1])
	C_1	C_2	C_3	C_4	C_5	C_6	C_7	C_8	C_9	C_{10}
A_1	([0.10,1.1],[0,1.1])	([0.3,1.1],[0,1.1])	([0.6,1.1],[0,1.1])	([0.7,1.1],[0,1.1])	([0.7,1.1],[0,1.1])	([0.25,1.1],[0,1.1])	([0.8,1.1],[0,1.1])	([0.8,1.1],[0,1.1])	([0.25,1.1],[0,1.1])	([0.5,1.1],[0,1.1])
A_2	([0.10,1.1],[0,1.1])	([0.7,1.1],[0,1.1])	([0.25,1.1],[0,1.1])	([0.3,1.1],[0,1.1])	([0.6,1.1],[0,1.1])	([0.7,1.1],[0,1.1])	([0.7,1.1],[0,1.1])	([0.25,1.1],[0,1.1])	([0.3,1.1],[0,1.1])	([0.7,1.1],[0,1.1])
A_3	([0.5,1.1],[0,1.1])	([0.6,1.1],[0,1.1])	([0.6,1.1],[0,1.1])	([0.7,1.1],[0,1.1])	([0.3,1.1],[0,1.1])	([0.6,1.1],[0,1.1])	([0.6,1.1],[0,1.1])	([0.8,1.1],[0,1.1])	([0.6,1.1],[0,1.1])	([0.6,1.1],[0,1.1])
A_4	([0.7,1.1],[0,1.1])	([0.3,1.1],[0,1.1])	([0.7,1.1],[0,1.1])	([0.25,1.1],[0,1.1])	([0.25,1.1],[0,1.1])	([0.3,1.1],[0,1.1])	([0.3,1.1],[0,1.1])	([0.7,1.1],[0,1.1])	([0.7,1.1],[0,1.1])	([0.3,1.1],[0,1.1])
A_5	([0.6,1.1],[0,1.1])	([0.10,1.1],[0,1.1])	([0.6,1.1],[0,1.1])	([0.7,1.1],[0,1.1])	([0.7,1.1],[0,1.1])	([0.25,1.1],[0,1.1])	([0.25,1.1],[0,1.1])	([0.6,1.1],[0,1.1])	([0.8,1.1],[0,1.1])	([0.25,1.1],[0,1.1])
A_6	([0.3,1.1],[0,1.1])	([0.7,1.1],[0,1.1])	([0.3,1.1],[0,1.1])	([0.6,1.1],[0,1.1])	([0.6,1.1],[0,1.1])	([0.7,1.1],[0,1.1])	([0.8,1.1],[0,1.1])	([0.3,1.1],[0,1.1])	([0.8,1.1],[0,1.1])	([0.8,1.1],[0,1.1])
A_7	([0.25,1.1],[0,1.1])	([0.6,1.1],[0,1.1])	([0.25,1.1],[0,1.1])	([0.3,1.1],[0,1.1])	([0.3,1.1],[0,1.1])	([0.6,1.1],[0,1.1])	([0.25,1.1],[0,1.1])	([0.25,1.1],[0,1.1])	([0.8,1.1],[0,1.1])	([0.7,1.1],[0,1.1])
A_8	([0.8,1.1],[0,1.1])	([0.3,1.1],[0,1.1])	([0.8,1.1],[0,1.1])	([0.10,1.1],[0,1.1])	([0.10,1.1],[0,1.1])	([0.3,1.1],[0,1.1])	([0.3,1.1],[0,1.1])	([0.8,1.1],[0,1.1])	([0.10,1.1],[0,1.1])	([0.8,1.1],[0,1.1])
A_9	([0.25,1.1],[0,1.1])	([0.25,1.1],[0,1.1])	([0.25,1.1],[0,1.1])	([0.25,1.1],[0,1.1])	([0.7,1.1],[0,1.1])	([0.25,1.1],[0,1.1])	([0.6,1.1],[0,1.1])	([0.25,1.1],[0,1.1])	([0.3,1.1],[0,1.1])	([0.6,1.1],[0,1.1])
A_{10}	([0.5,1.1],[0,1.1])	([0.7,1.1],[0,1.1])	([0.6,1.1],[0,1.1])	([0.3,1.1],[0,1.1])	([0.25,1.1],[0,1.1])	([0.8,1.1],[0,1.1])	([0.7,1.1],[0,1.1])	([0.8,1.1],[0,1.1])	([0.6,1.1],[0,1.1])	([0.3,1.1],[0,1.1])

We compute the criteria weights by the average method.

C1 (0.1107): This criterion receives the highest weight, emphasizing the strategic importance of R&D, patent portfolios, and innovative product development in maintaining a competitive edge in a technology-driven industry.

C2 (0.1022): Slightly lower in weight, this reflects the value of expansive market presence and customer reach, essential for economies of scale and brand strength.

C3 (0.1003): A nearly equal weight underlines the role of cost-effective, lean manufacturing practices that improve throughput and lower waste without compromising quality.

C4 (0.1082): High importance is placed on the ability to coordinate sourcing, logistics, and supplier collaboration—key for resilience and timely delivery in competitive markets.

C5 (0.1008): This weight indicates the necessity of consistent product performance, low failure rates, and adherence to international quality standards, especially in mission-critical applications.

C6 (0.0970): Reflects growing pressures from regulators and consumers to adopt green practices, ensuring long-term operational and reputational sustainability.

C7 (0.0926): Though slightly lower in weight, this criterion measures the company's liquidity, growth potential, and ability to fund expansion or R&D without compromising fiscal responsibility.

C8 (0.0962): Highlights the contribution of skilled engineers, training programs, and talent retention to ongoing innovation and operational excellence.

C9 (0.1063): Emphasizes the value of collaborations with universities, research labs, or other corporations for joint ventures, technological exchange, and global market access.

C10 (0.0858): Although the lowest in weight, it captures the transformative role of Industry 4.0 tools (e.g., AI, IoT, robotics) in enhancing responsiveness, customization, and productivity.

We compute normalization values using eq. (8) as shown in Fig 1. Fig 2 shows the weighted decision matrix.

We compute the ratio system using eq. (9) as shown in Fig 3.

We calculate the reference point using eq. (10) as shown in Fig 4. Fig 5 shows the reference point values.

We calculate the full multiplicative form using eq. (11) as shown in Fig 6. Fig 7 shows the full multiplicative form values.

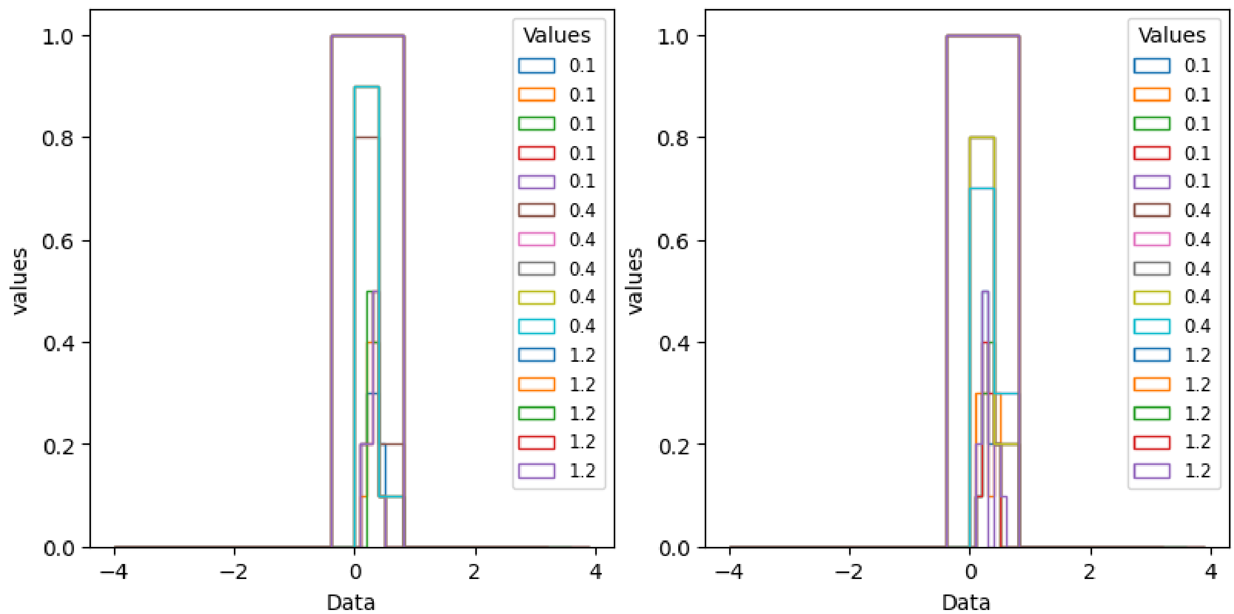

Fig 1. The normalization numbers.

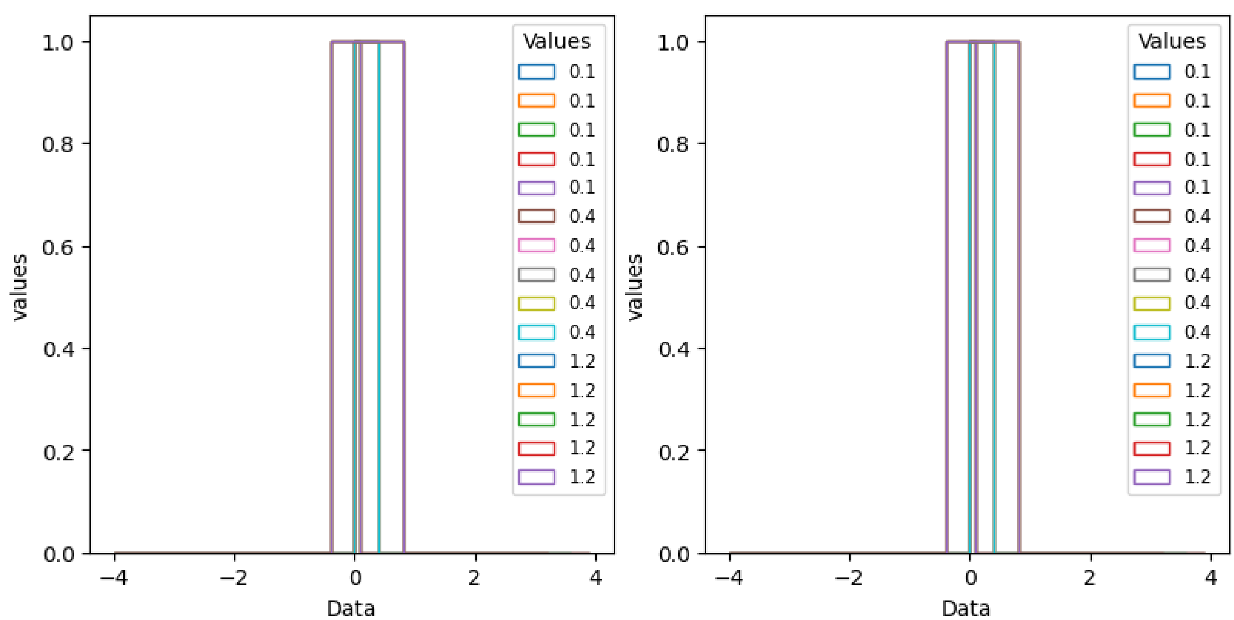

Fig 2. The weighted matrix.

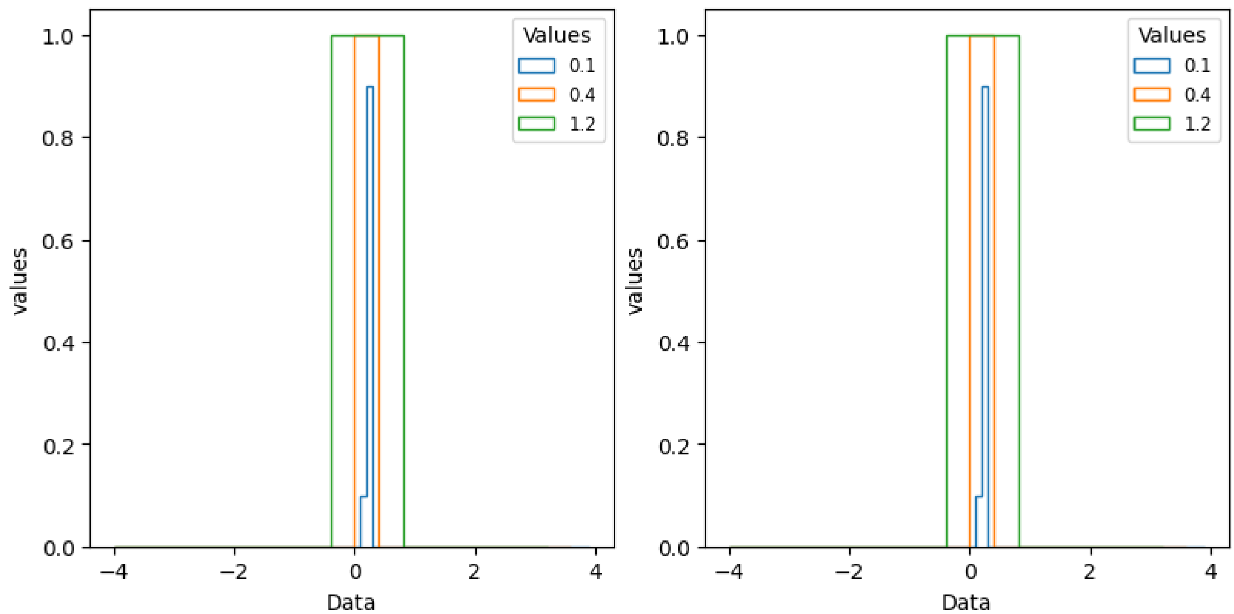

Fig 3. The ratio system values.

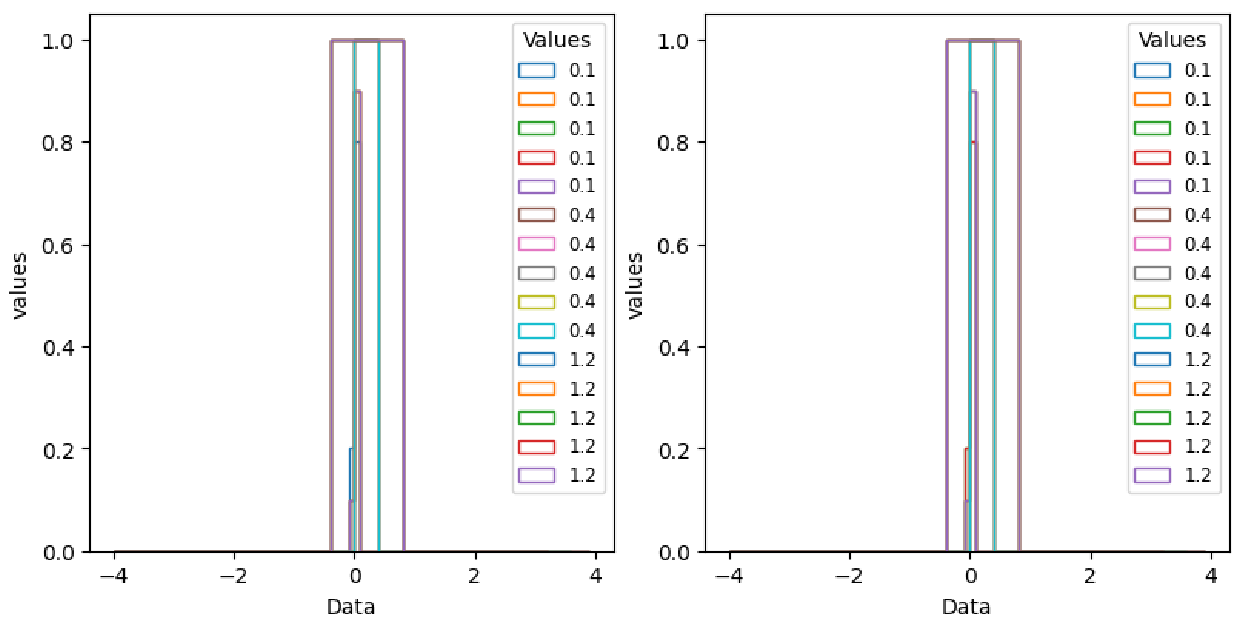

Fig 4. The reference point matrix.

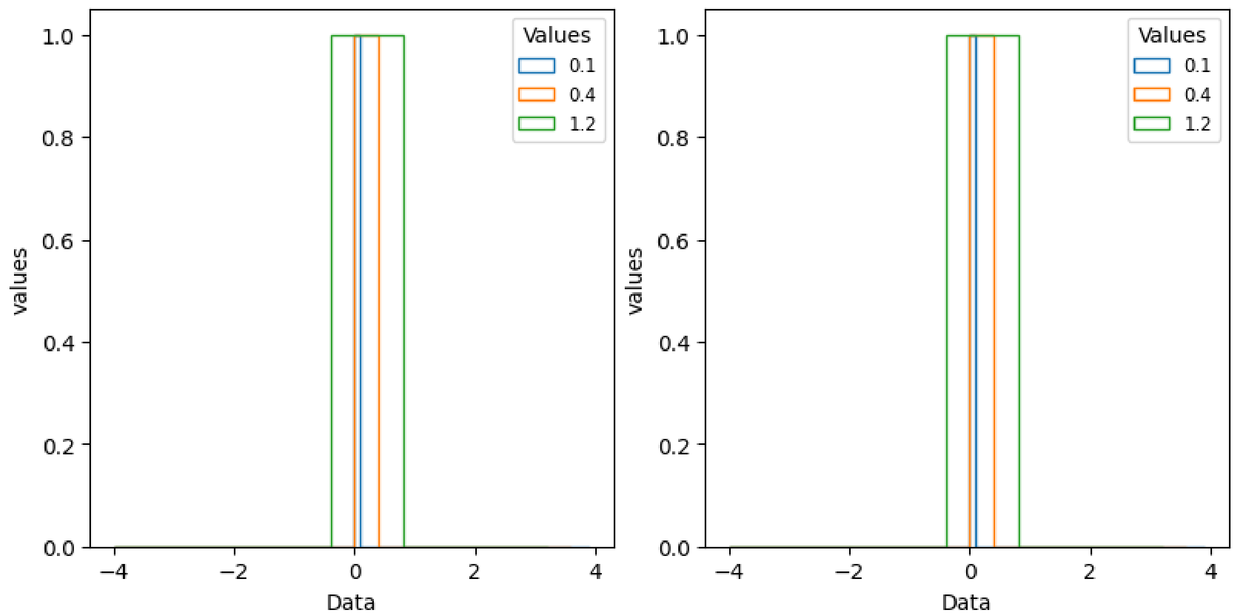

Fig 5. The reference point values.

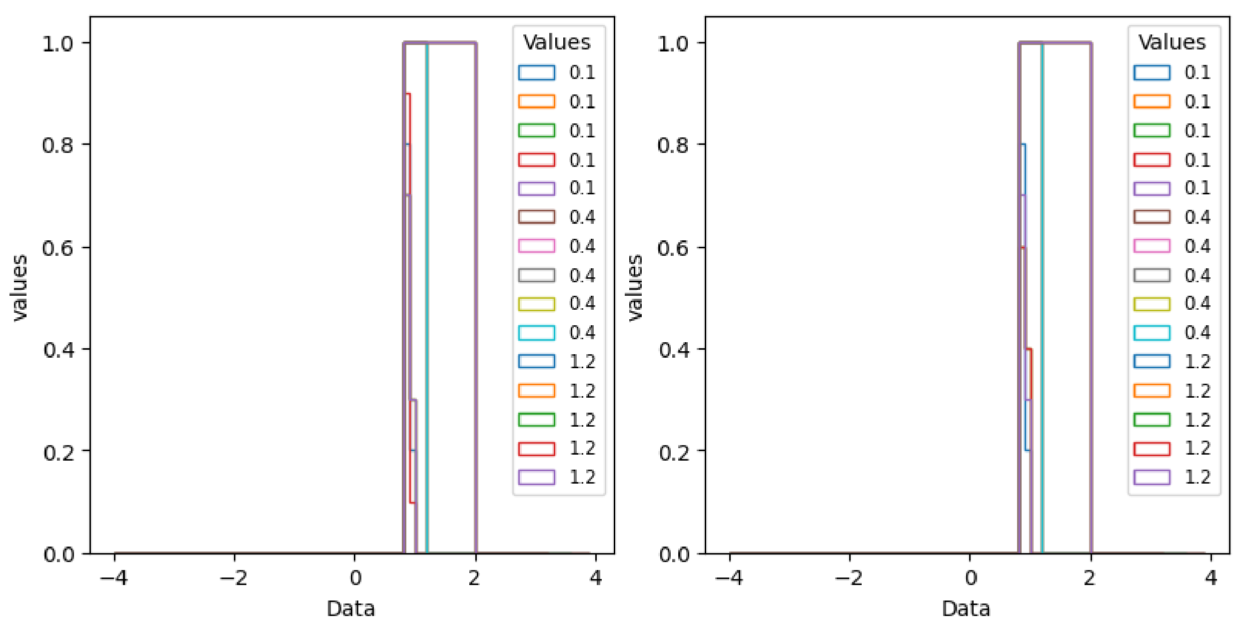

Fig 6. The multiplicative form matrix.

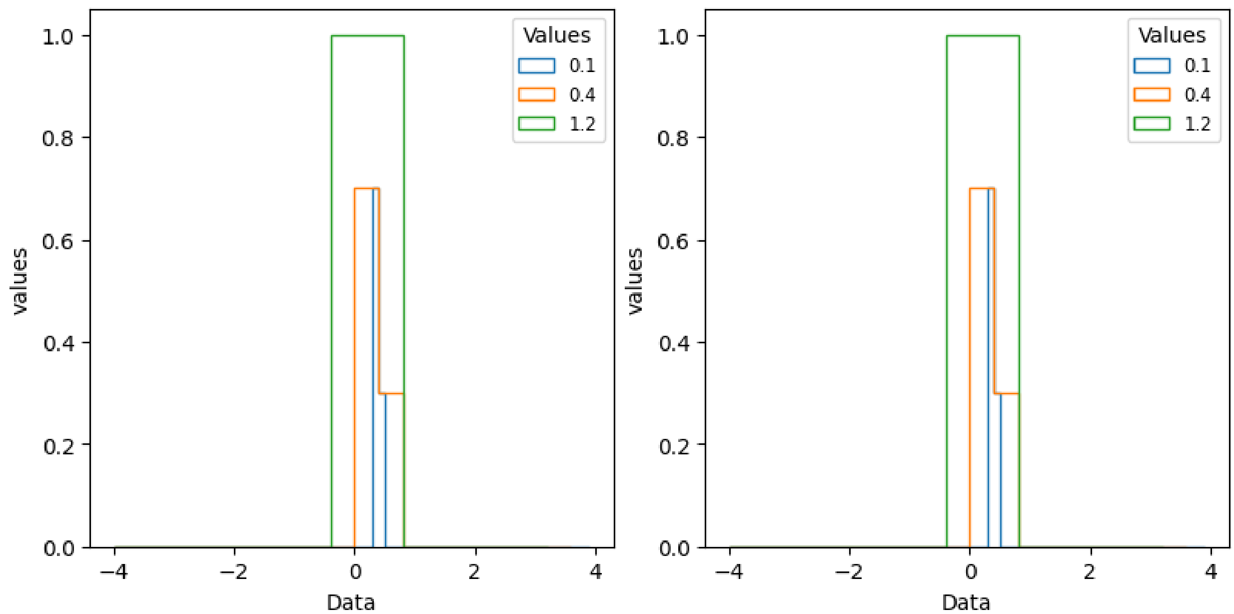

Fig 7. The multiplicative form values.

4. Analysis

This section shows the ranks of each three strategies such as ratio system, reference point, and full multiplicative form. Then we show the final ranks by the dominancy strategy as shown in Fig 9.

Ratio System Method

A1 – Rank 4: A1 performs well, showing stability in core metrics, though it doesn't lead in any specific domain.

A2 – Rank 3: A strong candidate with a balanced competitive edge, outperforming most but just shy of leadership.

A3 – Rank 1: A top-ranked performer in efficiency and overall value, setting the benchmark for others.

A4 – Rank 10: The lowest in this method, A4 likely faces challenges in productivity or strategic alignment.

A5 – Rank 9: Struggles to gain a foothold competitively; possibly lagging in innovation or market adaptability.

A6 – Rank 5: Holds the middle ground, reflecting moderate strengths with potential for further development.

A7 – Rank 8: Below average, perhaps hindered by inefficiencies or lower operational scalability.

A8 – Rank 7: A standard outcome, indicating reliability but limited advancement.

A9 – Rank 6: Close to the median, suggesting steady but unexceptional performance.

A10 – Rank 2: Near the top; demonstrates impressive consistency and sound strategy.

Reference Point Method

A1 – Rank 1: Excels when benchmarked against ideal values, showing minimal deviation from target metrics.

A2 – Rank 5: A solid performance with a few weak areas, staying competitive overall.

A3 – Rank 8: Unexpectedly low in this method, possibly due to sensitivity to certain variable targets.

A4 – Rank 7: Below average, potentially affected by poor alignment with optimal benchmarks.

A5 – Rank 10: The furthest from ideal values; may need significant recalibration of strategic focus.

A6 – Rank 1: Matches A1 in hitting precise targets, reinforcing its operational accuracy.

A7 – Rank 6: Adequate performance with slight inefficiencies in key comparison areas.

A8 – Rank 4: Performs better than average, with some proximity to ideal target points.

A9 – Rank 9: Falls short in several benchmark criteria, highlighting areas for improvement.

A10 – Rank 3: Aligns well with optimal standards, showing solid strategic execution.

Full Multiplicative Form Method

A1 – Rank 3: Maintains robust performance through cumulative factor strength, indicating well-rounded capability.

A2 – Rank 4: Slightly behind A1, suggesting dependable execution but less synergy across metrics.

A3 – Rank 1: Dominates this method due to high combined effectiveness of contributing variables.

A6 – Rank 5: Reasonably competitive, with areas of strength and a few minor limitations.

A7 – Rank 10: Weakest cumulative performance; factors may be misaligned or under-optimized.

A8 – Rank 7: Average output; likely lacking in a few critical areas despite overall consistency.

A9 – Rank 6: Modestly effective, though not standing out in high-impact contributions.

A10 – Rank 2: Shows nearly top-tier synergy across elements, just behind the leader.

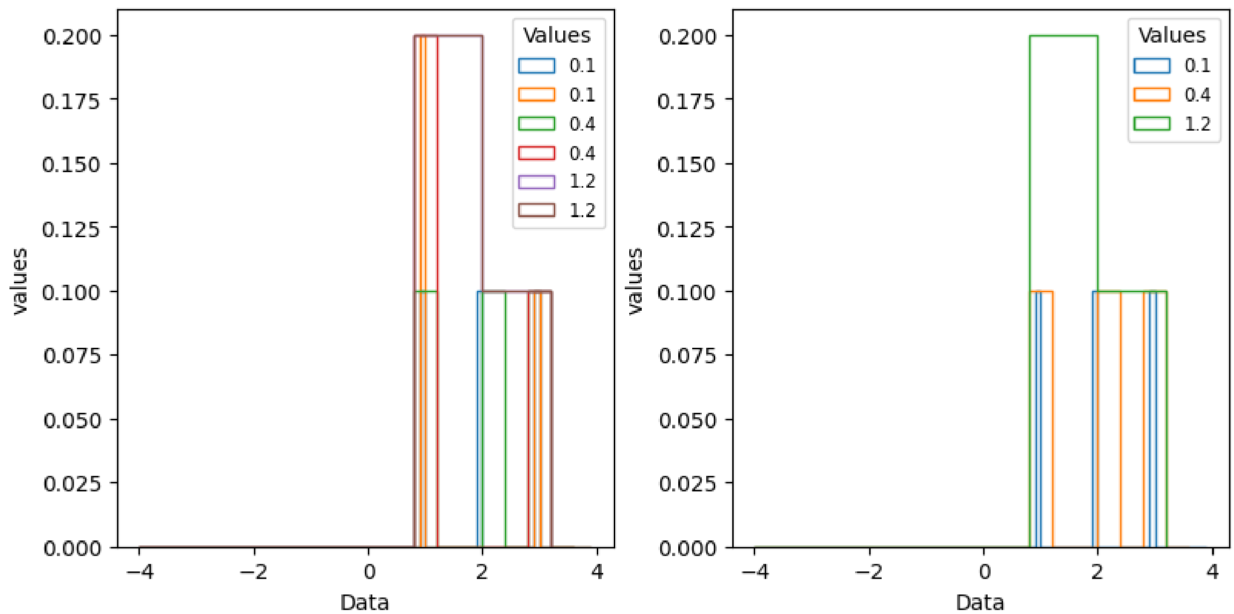

Fig 8. The ranks of three strategies.

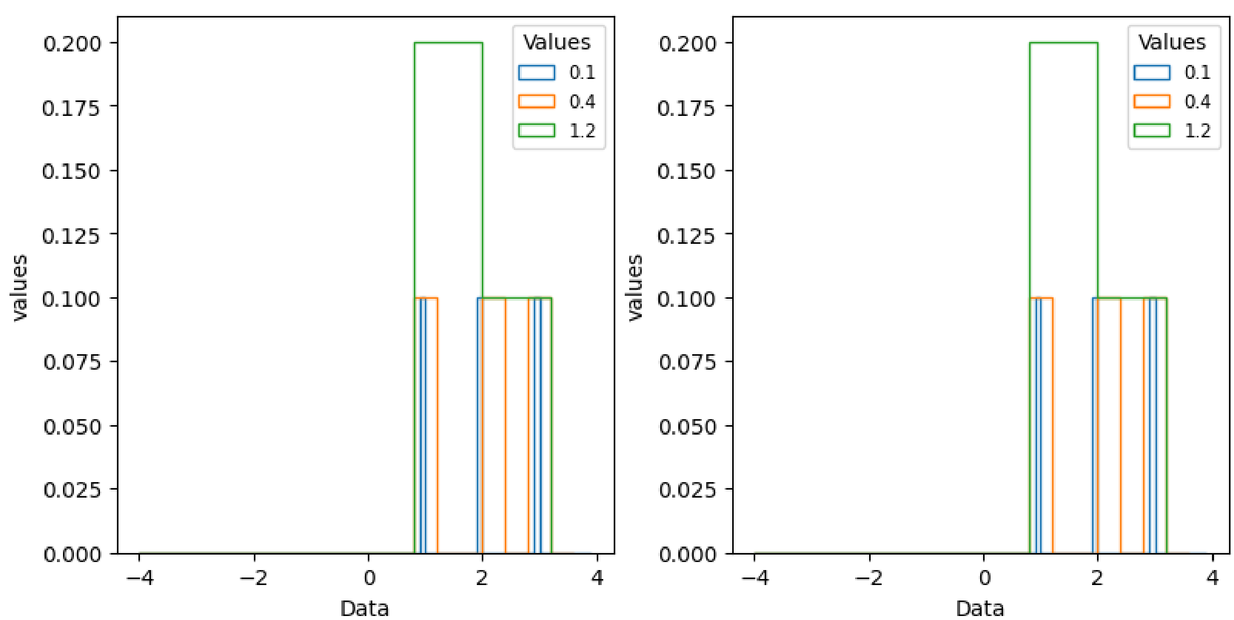

Fig 9. The final ranks.

5. Conclusions

The thorough instrument for evaluating and comparing competitiveness in the power electronics technology sector is this assessment methodology. The model emphasizes the importance of technological innovation, sustainability, financial performance, and digitization in determining industry success by using multi-dimensional factors. By using this paradigm, legislators can create legislation that will help, guide future investments, and encourage strategic improvements.

We used the MULTIMOORA methodology to rank the alternatives. The MCDM approach is used under Fuzzy OverProbability to obtain crisp values. Ten criteria and ten alternatives are used to show the application of the proposed approach. The alternatives are ranked based on three factors on the MULTIMOORA method. In the end, the ability to innovate sustainably while preserving operational excellence in a world that is becoming more digitally and globally integrated determines competitiveness in this sector.

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