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Combination of Rank Sum and Multi Attribute Utility Theory in Determining the Best Receptionist Performance

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Abstract−As the frontline of the service industry, a receptionist's performance not only reflects his professionalism, but also affects the first impression and overall customer experience. Problems in assessing the performance of a receptionist can include several things, namely difficulty measuring the quality of social interactions objectively, performance appraisals often focus more on administrative tasks, lack of understanding of the receptionist's role as a liaison between the company and customers, difficulty in assessing intangible aspects such as friendliness, patience, or the ability to respond to changing customer needs quickly and efficiently. The combination of rank sum weighting methods and Multi-Attribute Utility Theory (MAUT) can result in a more holistic and robust approach to decision making. In this approach, the rank sum weighting method can be used to get an initial picture of the relative preferences of various alternatives, while MAUT can be used to dig deeper into those preferences and account for complex factors such as attribute weights and utility values. By combining these two methods, decision makers can gain a deeper understanding of their preferences, while still maintaining openness to multiple perspectives and information. The results of the ranking of the best cashier performance the 1st best cashier with a value of 0.574 obtained by Zulaikah, the 2nd best cashier with a value of 0.473 obtained by Arini, and the 3rd best cashier with a value of 0.337 obtained by Lilik Karlina.

Keywords: Best Cashier; MAUT; Performance; Rank Sum; Weighting Method

1. INTRODUCTION

As the frontline of the service industry, a receptionist's performance not only reflects his professionalism, but also affects the first impression and overall customer experience. A qualified receptionist is one who has exceptional communication skills, is friendly, and can handle various situations well. They are able to manage phone calls, greet guests with a smile, and provide clear and accurate information. In addition, good multitasking and organizational skills are also very important in maintaining operational efficiency at the front desk. With this ability, a receptionist not only becomes the gatekeeper of the company, but also becomes an important link between the company and the customer, creating a positive and memorable relationship. They are also responsible for maintaining the security and confidentiality of information received from customers as well as maintaining professional manners and appearance. A high-performing receptionist also has the ability to handle difficult situations or conflicts calmly and diplomatically, creating satisfactory solutions for all parties involved. By understanding the importance of their role in creating a positive image of the company and providing quality service, a receptionist can be an invaluable asset to the organization, strengthen customer relationships, and ensure the continued success of the company. Problems in assessing the performance of a receptionist can include several things. First, it is difficult to objectively measure the quality of social interactions. Second, performance appraisals often focus more on administrative tasks than the ability to handle unexpected situations or conflicts. Third, a lack of understanding of the receptionist's role as a liaison between the company and the customer can lead to a lack of recognition of their contribution to the company's image and customer satisfaction. Fourth, difficulty in assessing intangible aspects such as friendliness, patience, or the ability to respond quickly and efficiently to changing customer needs. To address these issues, it is important to develop a more holistic assessment method that covers various aspects of receptionist performance, including interpersonal abilities, multitasking skills, problem solving, and contribution to the company's image[1].

Research related to the combination of the Multi-Attribute Utility Theory (MAUT) and Rank Sum methods was conducted by Williyandi (2024) The ranking results of the MAUT and Rank Sum methods were obtained 1st place with a final score of 0.5327 on behalf of student Nadia Kadhita Andriane as the best student[2]. Research from Fikri (2022) uses the Multi Attribute Utility Theory (MAUT) method in the performance assessment process of each teacher who teaches, the final results are sorted from the highest alternative value to the lowest alternative value and get the result of teacher 1 getting the highest score with a value of 0.84[3]. Research from Lubis (2022) the MAUT method used in determining the criteria for employees who are eligible to be disabled is A2 with a result of 0.9303 is a viable alternative to be disabled during a pandemic[4]. Khair's research (2022) Multi Attribute Utility Theory method was used to assess employee performance in this study as many as 20 samples. The results are able to support employee decisions using predetermined criteria. So that the highest value is found in the 6th alternative with a value of 1.8[5].

A decision support system (DSS) is a system designed to assist decision making in complex or ambiguous situations[6], [7]. By utilizing available technology and data, DSS can provide relevant information and in-depth analysis to assist users in evaluating various options. Thus, DSS can improve efficiency and accuracy in decision making, both on an individual scale and in an organizational context. The main advantage of DSS is its ability to simplify the decision-making process by utilizing proven algorithms and models, thus helping users make better and more timely decisions.

DSS can also be used to optimize resource allocation and formulate strategies that are more effective in achieving certain goals[8], [9]. By integrating data from multiple sources and applying sophisticated analytical methods, DSS becomes an invaluable tool for individuals and organizations in facing complex and dynamic decision-making challenges. In addition, DSS can also assist in risk management by providing more accurate risk analysis and assisting in informed decision making. Thus, the use of decision support systems not only provides a competitive advantage, but also allows companies to face market and environmental changes more adaptively and responsively. The combination of rank sum and Multi-Attribute Utility Theory (MAUT) aims to provide a relatively simple method for assigning weight to criteria and generating alternative rankings based on their relative assessments. The results of this combination are expected to provide more measurable and informed decisions, as well as improve understanding of how criteria can be weighted and integrated with stakeholder preferences effectively. By combining these two methods, the study aims to strike a balance between ease of implementation and the ability to overcome complexity in decision making. The reason for combining rank sum and Multi-Attribute Utility Theory (MAUT) is to combine the advantages of each approach to improve the quality of multi-criteria decision making.

Multi-Attribute Utility Theory (MAUT) is an analytical framework used in decision making to evaluate complex alternatives by considering several relevant attributes or criteria[10], [11]. In MAUT, each attribute is assigned a weight that reflects its relative importance to the desired goal, and each alternative is assessed based on how they meet those criteria. Using the concept of utility, MAUT allows decision makers to gauge their subjective preferences and choose alternatives that best suit those preferences. Thus, MAUT helps in dealing with uncertainty and complexity in decision making by providing a clear and measurable structure. MAUT is often used in a variety of contexts, including in decision-making in business, engineering, finance, and the environment. In practice, decision makers use MAUT to identify the best solution among the many options available, taking into account preferences, risks, and trade-offs between various attributes. In addition, MAUT also makes it possible to take into account the subjective preferences and judgments of individuals or groups, thus enabling a more inclusive and targeted decision-making process[12]. Thus, MAUT is a powerful tool in helping decision makers to achieve their goals in a more systematic and measurable way. Although Multi-Attribute Utility Theory (MAUT) has many advantages, such as its ability to handle the complexity of decision making and account for subjective preferences, this method also has some disadvantages that need to be noted[13]. One of the major drawbacks of MAUT is its reliance on subjective judgments of decision makers related to attribute weights and utility value. These judgments can be influenced by personal or group biases, allowing distortions in the final results. In addition, MAUT often requires the collection of complete and detailed data on preferences and preferences relative to various attributes, which can be time and resource consuming. In addition, the complexity of determining the proper weight of utility attributes and functions can also be challenging, especially when there are many alternatives to be evaluated. Therefore, it is important to use MAUT with caution and be aware of its limitations and underlying assumptions. One of the weighting methods is Rank Sum.

The rank sum weighting method is a technique used in decision making to assess different alternatives by taking into account the relative preferences of decision makers. In this method, each alternative is ranked by each decision maker, and the ratings are summed for each alternative[14]. Then, weight is given to each rank based on its position in the overall ranking. Using this approach, the rank sum weighting method makes it possible to take into account the subjective preferences and judgments of the various parties involved in decision making[15], [16]. One of the main advantages of the rank sum weighting method is its simplicity which allows it to be used easily without the need for complex analytical skills. This approach can also quickly provide a general idea of the relative preferences of decision makers towards the various alternatives evaluated. This method also considers all ratings assigned by each decision maker, thus accommodating various individual preferences in group decision making. In addition, because it does not require additional information such as attribute weights or utility values, the rank sum weighting method can be applied easily in situations where such information is difficult or unavailable. Therefore, the rank sum weighting method is often used as a fast and efficient tool in the decision-making process, especially in situations where time and resources are limited.

The combination of rank sum weighting methods and Multi-Attribute Utility Theory (MAUT) can result in a more holistic and robust approach to decision making. In this approach, the rank sum weighting method can be used to get an initial picture of the relative preferences of various alternatives, while MAUT can be used to dig deeper into those preferences and account for complex factors such as attribute weights and utility values. By combining these two methods, decision makers can gain a deeper understanding of their preferences, while still maintaining openness to multiple perspectives and information. Thus, the combination of rank sum and MAUT weighting methods allows for more informed and measurable decision making, which can lead to better and more informed decisions in a variety of contexts. In addition, the combination of rank sum and MAUT weighting methods also makes it possible to take advantage of the advantages of each approach. The rank sum weighting method provides a quick overview of relative preferences without requiring complex data collection, while MAUT provides a deeper analytical structure and takes into account more complex aspects of decision making. In this way, the use of a combination of these two methods can overcome some of the weaknesses that are owned individually, thus creating a more comprehensive and effective approach in dealing with complex and dynamic decision-making situations.

2. RESEARCH METHODOLOGY

2.1 Research Stages

Research stages are a series of steps carried out to design, implement, and analyze a study. These stages include the formulation of research problems, the development of theoretical frameworks, the design of research methodologies, data collection, data analysis, interpretation of results, and the preparation of reports or publications. These stages form a systematic and structured framework for conducting valid and quality research. The stages of research carried out are as shown in Figure 1.

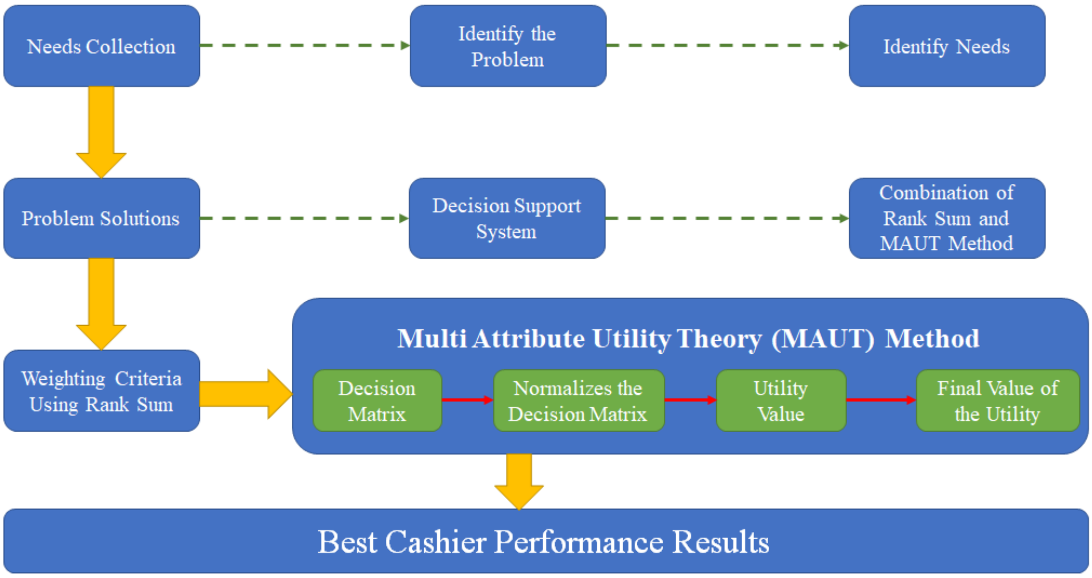

Figure 1. Research Concept Framework

The research concept in figure 1 is a research framework in assessing the best cashier performance, the first stage of collecting needs consists of the process of identifying problems in research and collecting criteria needs and performance data from cashiers. The next stage is the solution to the problem, namely by using a decision support system approach using a combination of rank sum weighting method and Multi Attribute Utility Theory method. The next stage is a combination of the rank sum method in determining the weight of criteria and the MAUT method for assessing cashier performance so that it will produce the best cashier performance appraisal.

2.2 Rank Sum Weighting

The weighting method using Rank Sum is a technique used in decision making to assess and compare alternatives based on the preferences given by the decision makers. In this method, each alternative is ranked by each decision maker based on their preferences[17]. These rankings are then summed for each alternative, and the total rankings are used to determine the order of preference of those alternatives. Then, weight is given to each rank based on its relative position in the overall ranking. Such weights can be given in different ways, by giving higher weights to ranks higher in the overall ranking[18]. This method allows decision makers to combine their subjective preferences in a systematic and measurable way, thus facilitating more informed and data-driven decision making. The rank sum weighting equation is as follows.

$$W_j = \frac{n - r_j + 1}{\sum_{k=1}^{n} n - r_k + 1} \qquad (1)$$

Where n is the number of criteria, while RJ is the priority level of each criterion.

2.3 Multi-Attribute Utility Theory (MAUT) Method

Multi-Attribute Utility Theory (MAUT) is a conceptual framework used in complex decision making. MAUT allows decision makers to consider many diverse factors or attributes in the decision-making process, and then measure preferences relative to combinations of those attribute values[19], [20]. Using techniques such as preference analysis and utility measurement, MAUT assists decision makers in assessing possible options in a systematic manner. This approach makes it possible to take into account the uncertainty, subjective preferences and complexity that may be involved in complex decisions. MAUT has been applied in a variety of contexts, from business planning to natural resource management, helping decision makers to make decisions that are more informed and fit for their goals[21]. The first stage is to make a decision matrix using the decision matrix equation (X) as follows.

$$X = \begin{bmatrix} x_{i1} & \cdots & x_{in} \\ \vdots & \ddots & \vdots \\ x_{m1} & \cdots & x_{mn} \end{bmatrix} \qquad (2)$$

The next stage normalizes the decision matrix that has been made so that it will produce a normalization matrix, a formula for normalizing as in the following equation.

$$r_{ij}^{*} = \frac{X_{ij} - min(X_{ij})}{max(X_{ij}) - min(X_{ij})} \quad (3)$$

$$r_{ij}^{*} = 1 + \frac{min(X_{ij}) - (X_{ij})}{max(X_{ij}) - min(X_{ij})} \quad (4)$$

The equation above has 2 types of equations for the type of benefit criteria calculated using equation (3), and the type of cost criterion is calculated using equation (4). The next stage in the MAUT method is to calculate the utility value with the following equation.

$$u_{ij} = \frac{e\left(r_{ij}^{*}\right)^{2} - 1}{1,71} \quad (5)$$

The next stage calculates the final value of the utility with the following equation.

$$u_{(x)} = \sum_{j=1}^{n} u_{ij} . W_j \quad (6)$$

3. RESULT AND DISCUSSION

The combination of the Rank Sum weighting method and the Multi-Attribute Utility Theory (MAUT) provides a holistic approach in determining the best performance of a receptionist. In this context, the Rank Sum weighting method allows raters to assign weights or values relative to various attributes considered crucial in receptionist performance evaluation, such as responsiveness, communication skills, friendliness, and efficiency. Meanwhile, MAUT makes it possible to assess subjective preferences and integrate the individual preferences of the raters against the combination of values of those attributes. By combining these two methods, receptionist performance appraisals become more detailed and structured, allowing the selection of the best candidates who meet the various needs and preferences desired by the organization or assessment team.

The combination of the Rank Sum weighting method and the Multi-Attribute Utility Theory (MAUT) also allows for flexibility in adjusting the different preferences and interests of the various parties involved in the assessment process. By using Rank Sum, raters can assign different levels of importance to each attribute, according to the specific priorities and goals possessed by the organization or assessment team. While MAUT helps measure the relative utility of the combination of values of those attributes, it reflects the subjective preferences of each rater. Thus, the combination of these two methods allows for more accurate and targeted decision making, and ensures that the best receptionist performance is selected taking into account various aspects that are critical to the success of the organization.

3.1 Criteria Weighting Method Using Rank Sum

The method of weighting criteria using Rank Sum is an analytical technique used to evaluate options or candidates based on a number of relevant criteria. In this process, each criterion is weighted by its importance, and the relative value of each option for each criterion is sorted from best to worst. Then, for each option, the rating values of each criterion are summed, and the option with the lowest rating total is considered the best. The Rank Sum method allows decision makers to give priority to certain criteria that are considered crucial, while systematically considering the preferences and relative importance of each criterion in the decision-making process. The criteria used in this study are based on data collection obtained from ABC companies in determining the best cashier performance as in Table 1.

Table 1. Criteria Data

Criteria Name	Criteria Type	Priority Criteria
Expertise in Financial Transactions	Benefit	1
Communication Skills	Benefit	2
Accuracy	Benefit	3
Work Ethics and Integrity	Benefit	4
Adaptability	Benefit	5

Table 1 data is data based on input from the company in determining the selection of the best cashier. After the criteria data is obtained, then calculate the weight of each criterion using equation (1), the results of the calculation of the weight of the criteria are as follows.

$$W_1 = \frac{5 - 1 + 1}{5 + 4 + 3 + 2 + 1} = \frac{5}{15} = 0.333$$

$$W_2 = \frac{5 - 2 + 1}{5 + 4 + 3 + 2 + 1} = \frac{4}{15} = 0.267$$

$$W_3 = \frac{5 - 3 + 1}{5 + 4 + 3 + 2 + 1} = \frac{3}{15} = 0.2$$

$$W_4 = \frac{5-4+1}{5+4+3+2+1} = \frac{2}{15} = 0.133$$
$$W_5 = \frac{5-5+1}{5+4+3+2+1} = \frac{1}{15} = 0.067$$

The results of visualization of the weight of each criterion based on calculations using the rank sum weighting method as shown in Figure 2.

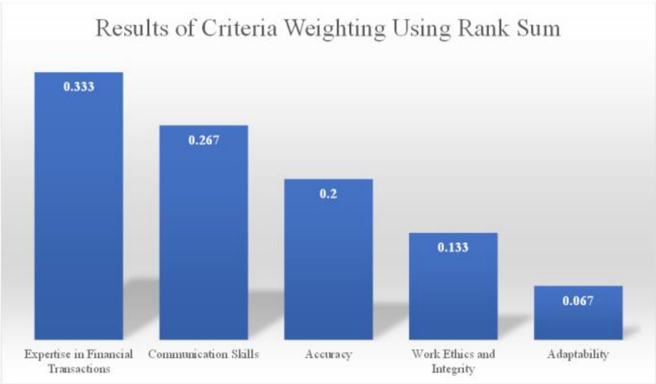

Figure 2. Results of Criteria Weighting Using Rank Sum

The results of rank sum weighting in Figure 2 will be used in the MAUT method in calculating the utility value of each existing alternative.

3.2 Multi Attribute Utility Theory in Determining the Best Receptionist Performance

Multi Attribute Utility (MAUT) theory is a decision analysis framework used to evaluate alternatives based on various relevant attributes or criteria. In the context of determining the best receptionist performance, MAUT allows managers to consider a variety of factors. Each attribute is given relative weight according to its importance in the context of the organization. MAUT then allows subjective assessment of each receptionist based on their performance in each attribute, which can then be calculated mathematically to determine the best choice according to managerial preferences. Using this approach, organizations can make more informed and data-driven decisions in choosing the most suitable receptionist to meet their customer service needs. Assessment data from cashier performance as in table 2.

Table 2. Cashier Performance Appraisal Data

Cashier Name	W_1	W_2	W_3	W_4	W_5
Susanti	95	93	96	98	95
Arini	94	95	95	99	95
Lilik Karlina	96	94	96	97	96
Yuni Arianti	97	93	94	96	93
Fatimah	95	92	93	98	96
Zulaikah	98	93	97	97	94
Tuti	93	95	95	96	92
Ririn	94	93	96	97	93

The cashier performance appraisal data in table 2 is obtained based on the company's assessment based on the performance of existing cashiers, the data will be used in assessing the selection of the best cashier performance.

The first stage is to make a decision matrix using the decision matrix equation (X) based on cashier performance appraisal data using equation (2), the results of the decision matrix are as follows.

$$X = \begin{bmatrix} x_{11} & x_{21} & x_{31} & x_{41} & x_{51} \\ x_{12} & x_{22} & x_{32} & x_{42} & x_{52} \\ x_{13} & x_{23} & x_{33} & x_{43} & x_{53} \\ x_{14} & x_{24} & x_{34} & x_{44} & x_{54} \\ x_{15} & x_{25} & x_{35} & x_{45} & x_{55} \\ x_{16} & x_{26} & x_{36} & x_{46} & x_{56} \\ x_{17} & x_{27} & x_{37} & x_{47} & x_{57} \\ x_{18} & x_{28} & x_{38} & x_{48} & x_{58} \end{bmatrix} \Rightarrow X = \begin{bmatrix} 95 & 93 & 96 & 98 & 95 \\ 94 & 95 & 95 & 99 & 95 \\ 96 & 94 & 96 & 97 & 96 \\ 97 & 93 & 94 & 96 & 93 \\ 95 & 92 & 93 & 98 & 96 \\ 98 & 93 & 97 & 97 & 94 \\ 93 & 95 & 95 & 96 & 92 \\ 94 & 93 & 96 & 97 & 93 \end{bmatrix}$$

The next stage is calculating matrix normalization using equation (3) because all criteria are types of benefits, the results of the matrix normalization calculation are as follows.

$$r_{11}^{*}=\frac{X_{11}-min(X_{11;18})}{max(X_{11;18})-min(X_{11;18})}=\frac{95-93}{98-93}=\frac{2}{5}=0.4$$
$$r_{12}^{*}=\frac{X_{12}-min(X_{11;18})}{max(X_{11;18})-min(X_{11;18})}=\frac{94-93}{98-93}=\frac{1}{5}=0.2$$
$$r_{13}^{*}=\frac{X_{13}-min(X_{11;18})}{max(X_{11;18})-min(X_{11;18})}=\frac{96-93}{98-93}=\frac{3}{5}=0.6$$
$$r_{14}^{*}=\frac{X_{14}-min(X_{11;18})}{max(X_{11;18})-min(X_{11;18})}=\frac{97-93}{98-93}=\frac{4}{5}=0.8$$
$$r_{15}^{*}=\frac{X_{15}-min(X_{11;18})}{max(X_{11;18})-min(X_{11;18})}=\frac{95-93}{98-93}=\frac{2}{5}=0.4$$
$$r_{16}^{*}=\frac{X_{16}-min(X_{11;18})}{max(X_{11;18})-min(X_{11;18})}=\frac{98-93}{98-93}=\frac{5}{5}=1$$
$$r_{17}^{*}=\frac{X_{17}-min(X_{11;18})}{max(X_{11;18})-min(X_{11;18})}=\frac{93-93}{98-93}=\frac{0}{5}=0$$
$$r_{18}^{*}=\frac{X_{18}-min(X_{11;18})}{max(X_{11;18})-min(X_{11;18})}=\frac{94-93}{98-93}=\frac{1}{5}=0.2$$
$$r_{21}^{*}=\frac{X_{21}-min(X_{21;28})}{max(X_{21;28})-min(X_{21;28})}=\frac{93-92}{95-92}=\frac{1}{3}=0.333$$
$$r_{22}^{*}=\frac{X_{22}-min(X_{21;28})}{max(X_{21;28})-min(X_{21;28})}=\frac{95-92}{95-92}=\frac{3}{3}=13$$
$$r_{23}^{*}=\frac{X_{23}-min(X_{21;28})}{max(X_{21;28})-min(X_{21;28})}=\frac{94-92}{95-92}=\frac{2}{3}=0.667$$
$$r_{24}^{*}=\frac{X_{24}-min(X_{21;28})}{max(X_{21;28})-min(X_{21;28})}=\frac{93-92}{95-92}=\frac{1}{3}=0.333$$
$$r_{25}^{*}=\frac{X_{25}-min(X_{21;28})}{max(X_{21;28})-min(X_{21;28})}=\frac{92-92}{95-92}=\frac{0}{3}=0$$
$$r_{26}^{*}=\frac{X_{26}-min(X_{21;28})}{max(X_{21;28})-min(X_{21;28})}=\frac{93-92}{95-92}=\frac{1}{3}=0.333$$
$$r_{27}^{*}=\frac{X_{27}-min(X_{21;28})}{max(X_{21;28})-min(X_{21;28})}=\frac{95-92}{95-92}=\frac{3}{3}=1$$
$$r_{28}^{*}=\frac{X_{28}-min(X_{21;28})}{max(X_{21;28})-min(X_{21;28})}=\frac{93-92}{95-92}=\frac{1}{3}=0.333$$
$$r_{31}^{*}=\frac{X_{31}-min(X_{31;38})}{max(X_{31;38})-min(X_{31;38})}=\frac{96-93}{97-93}=\frac{3}{4}=0.75$$
$$r_{32}^{*}=\frac{X_{32}-min(X_{31;38})}{max(X_{31;38})-min(X_{31;38})}=\frac{95-93}{97-93}=\frac{2}{4}=0.5$$
$$r_{33}^{*}=\frac{X_{33}-min(X_{31;38})}{max(X_{31;38})-min(X_{31;38})}=\frac{96-93}{97-93}=\frac{3}{4}=0.75$$
$$r_{34}^{*}=\frac{X_{34}-min(X_{31;38})}{max(X_{31;38})-min(X_{31;38})}=\frac{94-93}{97-93}=\frac{1}{4}=0.25$$
$$r_{35}^{*}=\frac{X_{35}-min(X_{31;38})}{max(X_{31;38})-min(X_{31;38})}=\frac{93-93}{97-93}=\frac{0}{4}=0$$
$$r_{36}^{*}=\frac{X_{36}-min(X_{31;38})}{max(X_{31;38})-min(X_{31;38})}=\frac{97-93}{97-93}=\frac{4}{4}=1$$
$$r_{37}^{*}=\frac{X_{37}-min(X_{31;38})}{max(X_{31;38})-min(X_{31;38})}=\frac{95-93}{97-93}=\frac{2}{4}=0.5$$
$$r_{38}^{*}=\frac{X_{38}-min(X_{31;38})}{max(X_{31;38})-min(X_{31;38})}=\frac{96-93}{97-93}=\frac{3}{4}=0.75$$

$$r_{41}^{*} = \frac{X_{41} - min(X_{41;48})}{max(X_{41;48}) - min(X_{41;48})} = \frac{98-96}{99-96} = \frac{2}{3} = 0.667$$
$$r_{42}^{*} = \frac{X_{42} - min(X_{41;48})}{max(X_{41;48}) - min(X_{41;48})} = \frac{99-96}{99-96} = \frac{3}{3} = 1$$
$$r_{43}^{*} = \frac{X_{43} - min(X_{41;48})}{max(X_{41;48}) - min(X_{41;48})} = \frac{97-96}{99-96} = \frac{1}{3} = 0.333$$
$$r_{44}^{*} = \frac{X_{44} - min(X_{41;48})}{max(X_{41;48}) - min(X_{41;48})} = \frac{96-96}{99-96} = \frac{0}{3} = 0$$
$$r_{45}^{*} = \frac{X_{45} - min(X_{41;48})}{max(X_{41;48}) - min(X_{41;48})} = \frac{98-96}{99-96} = \frac{2}{3} = 0.667$$
$$r_{46}^{*} = \frac{X_{46} - min(X_{41;48})}{max(X_{41;48}) - min(X_{41;48})} = \frac{97-96}{99-96} = \frac{1}{3} = 0.333$$
$$r_{47}^{*} = \frac{X_{47} - min(X_{41;48})}{max(X_{41;48}) - min(X_{41;48})} = \frac{96-96}{99-96} = \frac{0}{3} = 0$$
$$r_{48}^{*} = \frac{X_{48} - min(X_{41;48})}{max(X_{41;48}) - min(X_{41;48})} = \frac{97-96}{99-96} = \frac{1}{3} = 0.333$$
$$r_{51}^{*} = \frac{X_{51} - min(X_{51;58})}{max(X_{51;58}) - min(X_{51;58})} = \frac{95-92}{96-92} = \frac{3}{4} = 0.75$$
$$r_{52}^{*} = \frac{X_{52} - min(X_{51;58})}{max(X_{51;58}) - min(X_{51;58})} = \frac{95-92}{96-92} = \frac{3}{4} = 0.75$$
$$r_{53}^{*} = \frac{X_{53} - min(X_{51;58})}{max(X_{51;58}) - min(X_{51;58})} = \frac{96-92}{96-92} = \frac{4}{4} = 1$$
$$r_{54}^{*} = \frac{X_{54} - min(X_{51;58})}{max(X_{51;58}) - min(X_{51;58})} = \frac{93-92}{96-92} = \frac{1}{4} = 0.25$$
$$r_{55}^{*} = \frac{X_{55} - min(X_{51;58})}{max(X_{51;58}) - min(X_{51;58})} = \frac{96-92}{96-92} = \frac{4}{4} = 1$$
$$r_{56}^{*} = \frac{X_{56} - min(X_{51;58})}{max(X_{51;58}) - min(X_{51;58})} = \frac{94-92}{96-92} = \frac{2}{4} = 0.5$$
$$r_{57}^{*} = \frac{X_{57} - min(X_{51;58})}{max(X_{51;58}) - min(X_{51;58})} = \frac{92-92}{96-92} = \frac{0}{4} = 0$$
$$r_{58}^{*} = \frac{X_{58} - min(X_{51;58})}{max(X_{51;58}) - min(X_{51;58})} = \frac{93-92}{96-92} = \frac{1}{4} = 0.25$$

The next stage in the MAUT method is to calculate the utility value using equation (5), the result of the utility value of each criterion from each alternative as follows.

$$u_{11} = \frac{e(r_{11}^{*})^2-1}{1{,}71} = \frac{e(0.4)^2-1}{1{,}71} = 0.101$$
$$u_{12} = \frac{e(r_{12}^{*})^2-1}{1{,}71} = \frac{e(0.2)^2-1}{1{,}71} = 0.024$$
$$u_{13} = \frac{e(r_{13}^{*})^2-1}{1{,}71} = \frac{e(0.6)^2-1}{1{,}71} = 0.253$$
$$u_{14} = \frac{e(r_{14}^{*})^2-1}{1{,}71} = \frac{e(0.8)^2-1}{1{,}71} = 0.524$$
$$u_{15} = \frac{e(r_{15}^{*})^2-1}{1{,}71} = \frac{e(0.4)^2-1}{1{,}71} = 0.101$$
$$u_{16} = \frac{e(r_{16}^{*})^2-1}{1{,}71} = \frac{e(1)^2-1}{1{,}71} = 1.005$$
$$u_{17} = \frac{e(r_{17}^{*})^2-1}{1{,}71} = \frac{e(0)^2-1}{1{,}71} = 0$$
$$u_{18} = \frac{e(r_{18}^{*})^2-1}{1{,}71} = \frac{e(0.2)^2-1}{1{,}71} = 0.024$$
$$u_{21} = \frac{e(r_{21}^{*})^2-1}{1{,}71} = \frac{e(0.333)^2-1}{1{,}71} = 0.024$$
$$u_{22} = \frac{e(r_{22}^{*})^2-1}{1{,}71} = \frac{e(1)^2-1}{1{,}71} = 0.069$$
$$u_{23} = \frac{e(r_{23}^{*})^2-1}{1{,}71} = \frac{e(0.667)^2-1}{1{,}71} = 1.005$$
$$u_{24} = \frac{e(r_{24}^{*})^2-1}{1{,}71} = \frac{e(0.333)^2-1}{1{,}71} = 0.327$$
$$u_{25} = \frac{e(r_{25}^{*})^2-1}{1{,}71} = \frac{e(0)^2-1}{1{,}71} = 0.069$$
$$u_{26} = \frac{e(r_{26}^{*})^2-1}{1{,}71} = \frac{e(0.333)^2-1}{1{,}71} = 0$$
$$u_{27} = \frac{e(r_{27}^{*})^2-1}{1{,}71} = \frac{e(1)^2-1}{1{,}71} = 1.005$$
$$u_{28} = \frac{e(r_{28}^{*})^2-1}{1{,}71} = \frac{e(0.333)^2-1}{1{,}71} = 0.069$$
$$u_{31} = \frac{e(r_{31}^{*})^2-1}{1{,}71} = \frac{e(0.75)^2-1}{1{,}71} = 0.442$$
$$u_{32} = \frac{e(r_{32}^{*})^2-1}{1{,}71} = \frac{e(0.5)^2-1}{1{,}71} = 0.166$$
$$u_{33} = \frac{e(r_{33}^{*})^2-1}{1{,}71} = \frac{e(0.75)^2-1}{1{,}71} = 0.442$$
$$u_{34} = \frac{e(r_{34}^{*})^2-1}{1{,}71} = \frac{e(0.25)^2-1}{1{,}71} = 0.038$$
$$u_{35} = \frac{e(r_{35}^{*})^2-1}{1{,}71} = \frac{e(0)^2-1}{1{,}71} = 0$$
$$u_{36} = \frac{e(r_{36}^{*})^2-1}{1{,}71} = \frac{e(1)^2-1}{1{,}71} = 1.005$$

$u_{37} = \frac{e(r_{37}^*)^2-1}{1,71} = \frac{e(0.5)^2-1}{1,71} = 0.166$
$u_{38} = \frac{e(r_{38}^*)^2-1}{1,71} = \frac{e(0.75)^2-1}{1,71} = 0.442$
$u_{41} = \frac{e(r_{41}^*)^2-1}{1,71} = \frac{e(0.667)^2-1}{1,71} = 0.327$
$u_{42} = \frac{e(r_{42}^*)^2-1}{1,71} = \frac{e(1)^2-1}{1,71} = 1.005$
$u_{43} = \frac{e(r_{43}^*)^2-1}{1,71} = \frac{e(0.333)^2-1}{1,71} = 0.069$
$u_{44} = \frac{e(r_{44}^*)^2-1}{1,71} = \frac{e(0)^2-1}{1,71} = 0$
$u_{45} = \frac{e(r_{45}^*)^2-1}{1,71} = \frac{e(0.667)^2-1}{1,71} = 0.327$
$u_{46} = \frac{e(r_{46}^*)^2-1}{1,71} = \frac{e(0.333)^2-1}{1,71} = 0.069$
$u_{47} = \frac{e(r_{47}^*)^2-1}{1,71} = \frac{e(0)^2-1}{1,71} = 0$
$u_{48} = \frac{e(r_{48}^*)^2-1}{1,71} = \frac{e(0.333)^2-1}{1,71} = 0.069$
$u_{51} = \frac{e(r_{51}^*)^2-1}{1,71} = \frac{e(0.75)^2-1}{1,71} = 0.442$
$u_{52} = \frac{e(r_{52}^*)^2-1}{1,71} = \frac{e(0.75)^2-1}{1,71} = 0.442$
$u_{53} = \frac{e(r_{53}^*)^2-1}{1,71} = \frac{e(1)^2-1}{1,71} = 1.005$
$u_{54} = \frac{e(r_{54}^*)^2-1}{1,71} = \frac{e(0.25)^2-1}{1,71} = 0.038$
$u_{55} = \frac{e(r_{55}^*)^2-1}{1,71} = \frac{e(1)^2-1}{1,71} = 1.005$
$u_{56} = \frac{e(r_{56}^*)^2-1}{1,71} = \frac{e(0.5)^2-1}{1,71} = 0.166$
$u_{57} = \frac{e(r_{57}^*)^2-1}{1,71} = \frac{e(0)^2-1}{1,71} = 0$
$u_{58} = \frac{e(r_{58}^*)^2-1}{1,71} = \frac{e(0.25)^2-1}{1,71} = 0.038$

The next stage calculates the final value of the utility using equation (6), the result of calculating the final value of each utility alternative as follows.

$u_{(1)} = \sum_{j=1}^{n} u_{ij}.W_j = (u_{11} * w_1) + (u_{21} * w_2) + (u_{31} * w_3) + (u_{41} * w_4) + (u_{51} * w_5)$
$u_{(1)} = (0.101 * 0.333) + (0.069 * 0.267) + (0.442 * 0.2) + (0.327 * 0.133) + (0.442 * 0.067)$
$u_{(1)} = (0.034) + (0.018) + (0.088) + (0.044) + (0.030)$
$u_{(1)} = 0.214$
$u_{(2)} = \sum_{j=1}^{n} u_{ij}.W_j = (u_{12} * w_1) + (u_{22} * w_2) + (u_{32} * w_3) + (u_{42} * w_4) + (u_{52} * w_5)$
$u_{(2)} = (0.024 * 0.333) + (1.005 * 0.267) + (0.166 * 0.2) + (1.005 * 0.133) + (0.442 * 0.067)$
$u_{(2)} = (0.008) + (0.268) + (0.033) + (0.134) + (0.030)$
$u_{(2)} = 0.473$
$u_{(3)} = \sum_{j=1}^{n} u_{ij}.W_j = (u_{13} * w_1) + (u_{23} * w_2) + (u_{33} * w_3) + (u_{43} * w_4) + (u_{53} * w_5)$
$u_{(3)} = (0.253 * 0.333) + (0.327 * 0.267) + (0.442 * 0.2) + (0.069 * 0.133) + (1.005 * 0.067)$
$u_{(3)} = (0.084) + (0.087) + (0.088) + (0.009) + (0.067)$
$u_{(3)} = 0.337$
$u_{(4)} = \sum_{j=1}^{n} u_{ij}.W_j = (u_{14} * w_1) + (u_{24} * w_2) + (u_{34} * w_3) + (u_{44} * w_4) + (u_{54} * w_5)$
$u_{(4)} = (0.524 * 0.333) + (0.069 * 0.267) + (0.038 * 0.2) + (0 * 0.133) + (0.038 * 0.067)$
$u_{(4)} = (0.175) + (0.018) + (0.008) + (0) + (0.003)$
$u_{(4)} = 0.203$
$u_{(5)} = \sum_{j=1}^{n} u_{ij}.W_j = (u_{15} * w_1) + (u_{25} * w_2) + (u_{35} * w_3) + (u_{45} * w_4) + (u_{55} * w_5)$
$u_{(5)} = (0.101 * 0.333) + (0 * 0.267) + (0 * 0.2) + (0.327 * 0.133) + (1.005 * 0.067)$
$u_{(5)} = (0.034) + (0) + (0) + (0.044) + (0.067)$
$u_{(5)} = 0.145$
$u_{(6)} = \sum_{j=1}^{n} u_{ij}.W_j = (u_{16} * w_1) + (u_{26} * w_2) + (u_{36} * w_3) + (u_{46} * w_4) + (u_{56} * w_5)$
$u_{(6)} = (0.101 * 0.333) + (0 * 0.267) + (0 * 0.2) + (0.327 * 0.133) + (1.005 * 0.067)$
$u_{(6)} = (1.005) + (0.069) + (1.005) + (0.069) + (0.166)$
$u_{(6)} = 0.574$
$u_{(7)} = \sum_{j=1}^{n} u_{ij}.W_j = (u_{17} * w_1) + (u_{27} * w_2) + (u_{37} * w_3) + (u_{47} * w_4) + (u_{57} * w_5)$
$u_{(7)} = (0 * 0.333) + (1.005 * 0.267) + (0.166 * 0.2) + (0 * 0.133) + (0 * 0.067)$
$u_{(7)} = (0) + (0.268) + (0.033) + (0) + (0)$
$u_{(7)} = 0.302$
$u_{(8)} = \sum_{j=1}^{n} u_{ij}.W_j = (u_{187} * w_1) + (u_{28} * w_2) + (u_{38} * w_3) + (u_{48} * w_4) + (u_{58} * w_5)$
$u_{(8)} = (0.024 * 0.333) + (0.069 * 0.267) + (0.442 * 0.2) + (0.069 * 0.133) + (0.038 * 0.067)$
$u_{(8)} = (0.008) + (0.018) + (0.088) + (0.009) + (0.003)$
$u_{(8)} = 0.126$

The results of the calculation of the final value of the utility of each alternative are the final results of calculations using the MAUT method and rank sum weighting in assessing cashier performance.

3.3 Best Cashier Performance Results

The best cashier performance results reflect superior service quality and operational efficiency in a retail or customer service environment. A cashier who achieves the best performance results usually stands out in several aspects, including speed in processing transactions, accuracy in calculating money and giving change, expertise in interacting with customers in a friendly and professional manner, and the ability to manage challenging situations well, such as resolving complaints or payment issues. High performance results from a cashier not only increase customer satisfaction, but can also contribute to operational efficiency and a positive reputation for the company. Cashiers who achieve the best performance results also tend to have a good understanding of the products or services offered by the company, so they can provide additional information to customers or provide relevant recommendations. In addition, the ability to work in a team, maintain order in the cashier area, and have integrity in carrying out financial tasks are also important factors in achieving the best performance results. Thus, the best cashier performance results are not only about efficiency in transactions, but also involve interpersonal skills, product knowledge, and integrity in carrying out financial responsibility. The best cashier performance ranking results as shown in Figure 3.

Figure 3. The Best Cashier Performance Ranking Results

The results of the ranking of the best cashier performance in figure 3 show the 1st best cashier with a value of 0.574 obtained by Zulaikah, the 2nd best cashier with a value of 0.473 obtained by Arini, and the 3rd best cashier with a value of 0.337 obtained by Lilik Karlina.

4. CONCLUSION

The combination of rank sum weighting methods and Multi-Attribute Utility Theory (MAUT) can result in a more holistic and robust approach to decision making. In this approach, the rank sum weighting method can be used to get an initial picture of the relative preferences of various alternatives, while MAUT can be used to dig deeper into those preferences and account for complex factors such as attribute weights and utility values. By combining these two methods, decision makers can gain a deeper understanding of their preferences, while still maintaining openness to multiple perspectives and information. The rank sum weighting method provides a quick overview of relative preferences without requiring complex data collection, while MAUT provides a deeper analytical structure and takes into account more complex aspects of decision making. The results of the ranking of the best cashier performance in figure 3 show the 1st best cashier with a value of 0.574 obtained by Zulaikah, the 2nd best cashier with a value of 0.473 obtained by Arini, and the 3rd best cashier with a value of 0.337 obtained by Lilik Karlina.

REFERENCES

[1] T. Suwarto, C. Pforr, and M. Volgger, “Front-desk workforce cultural diversity and its implications for service quality in the accommodation sector: a case from Australia,” *Tour. Rev.*, vol. 79, no. 1, pp. 234–249, 2024.

[2] W. Saputra, S. A. Wardana, H. Wahyuda, and D. A. Megawaty, “Penerapan Kombinasi Metode Multi-Attribute Utility Theory (MAUT) dan Rank Sum Dalam Pemilihan Siswa Terbaik,” *J. Inf. Technol. Softw. Eng. Comput. Sci.*, vol. 2, no. 1, pp. 12–21, 2024.

[3] M. I. Fikri, E. Haerani, I. Afrianty, and S. Ramadhani, “Sistem Pendukung Keputusan Penilaian Kinerja Guru Menggunakan Metode Multi Attribute Utility Theory (MAUT),” *JURIKOM (Jurnal Ris. Komputer)*, vol. 9, no. 5, pp. 1271–1280, 2022.

[4] J. H. Lubis, S. Esabella, M. Mesran, D. Desyanti, and D. M. Simanjuntak, “Penerapan Metode Multi Attribute Utility Theory (MAUT) Dalam Pemilihan Karyawan yang di Non-Aktifkan di Masa Pandemi,” *J. Media Inform. Budidarma*, vol. 6, no. 2, pp. 969–978, 2022.

[5] F. El Khair, S. Defit, and Y. Yuhandri, “Sistem Keputusan dengan Metode Multi Attribute Utility Theory dalam Penilaian Kinerja Pegawai,” *J. Inf. dan Teknol.*, pp. 215–220, 2021.

[6] M. Kayacık, H. Dinçer, and S. Yüksel, “Using quantum spherical fuzzy decision support system as a novel sustainability index approach for analyzing industries listed in the stock exchange,” *Borsa Istanbul Rev.*, vol. 22, no. 6, pp. 1145–1157, 2022.

[7] N. Panigrahi, I. Ayus, and O. P. Jena, “An expert system-based clinical decision support system for Hepatitis-B prediction &

diagnosis," *Mach. Learn. Healthc. Appl.*, pp. 57–75, 2021.

[8] H. Sulistiani, Setiawansyah, P. Palupiningsih, F. Hamidy, P. L. Sari, and Y. Khairunnisa, "Employee Performance Evaluation Using Multi-Attribute Utility Theory (MAUT) with PIPRECIA-S Weighting: A Case Study in Education Institution," in *2023 International Conference on Informatics, Multimedia, Cyber and Informations System (ICIMCIS)*, 2023, pp. 369–373. doi: 10.1109/ICIMCIS60089.2023.10349017.

[9] Setiawansyah, A. A. Aldino, P. Palupiningsih, G. F. Laxmi, E. D. Mega, and I. Septiana, "Determining Best Graduates Using TOPSIS with Surrogate Weighting Procedures Approach," in *2023 International Conference on Networking, Electrical Engineering, Computer Science, and Technology (IConNECT)*, 2023, pp. 60–64. doi: 10.1109/IConNECT56593.2023.10327119.

[10] Z. M. Arini, D. J. Sitanggang, M. Ali, and S. Aripin, "Sistem Pendukung Keputusan Penentuan Facial Wash Terbaik yang digunakan pada kulit berminyak dengan menggunakan Metode Multi Attribute Utility Theory (MAUT) dan Pembobotan Rank Order Centroid (ROC)," in *Prosiding Seminar Nasional Sosial, Humaniora, dan Teknologi*, 2022, pp. 317–324.

[11] A. A. Kusuma, Z. M. Arini, U. Hasanah, M. Mesran, and M. Kom, "Analisa Penerapan Metode Multi Attribute Utility Theory (MAUT) dengan Pembobotan Rank Order Centroid (ROC) Dalam Pemilihan Lokasi Strategis Coffeshop Milenial di Era New Normal," *J. Sist. Komput. dan Inform.*, vol. 3, no. 2, pp. 51–59, 2021.

[12] V. R. Campos and D. J. S. Moreira, "Risk assessment with multi-attribute utility theory for building projects," *J. Build. Pathol. Rehabil.*, vol. 7, no. 1, p. 98, 2022.

[13] H. Jaafaru and B. Agbelie, "Bridge maintenance planning framework using machine learning, multi-attribute utility theory and evolutionary optimization models," *Autom. Constr.*, vol. 141, p. 104460, 2022.

[14] A. F. O. Pasaribu, "Decision Support System for Best Supplier Selection Using Simple Additive Weighting and Rank Sum Weighting," *Chain J. Comput. Technol. Comput. Eng. Informatics*, vol. 1, no. 3, pp. 106–112, 2023.

[15] P. J. Krishna, V. P. Meena, V. P. Singh, and B. Khan, "Rank-sum-weight method based systematic determination of weights for controller tuning for automatic generation control," *IEEE Access*, vol. 10, pp. 68161–68174, 2022.

[16] S. Sintaro, "Sistem Pendukung Keputusan Penentuan Barista Terbaik Menggunakan Rank Sum dan Additive Ratio Assessment (ARAS)," *J. Ilm. Comput. Sci.*, vol. 2, no. 1, pp. 39–49, 2023, doi: 10.58602/jics.v2i1.15.

[17] I. M. Hezam, A. K. Mishra, D. Pamucar, P. Rani, and A. R. Mishra, "Standard deviation and rank sum-based MARCOS model under intuitionistic fuzzy information for hospital site selection," *Kybernetes*, 2023.

[18] Z. Wang, J. Wang, D. Yu, and K. Chen, "The potential evaluation of groundwater by integrating rank sum ratio (RSR) and machine learning algorithms in the Qaidam Basin," *Environ. Sci. Pollut. Res.*, vol. 30, no. 23, pp. 63991–64005, 2023.

[19] V. Pradhan, J. Dhar, and A. Kumar, "Software reliability models and multi-attribute utility function based strategic decision for release time optimization," in *Predictive Analytics in System Reliability*, Springer, 2022, pp. 175–190.

[20] F. A. AlFaraidy, K. S. Teegala, and G. Dwivedi, "Selection of a Sustainable Structural Floor System for an Office Building Using the Analytic Hierarchy Process and the Multi-Attribute Utility Theory," *Sustainability*, vol. 15, no. 17, p. 13087, 2023.

[21] C. Campos Valverde, "Adding value to a mining corporation through project portfolio management: Combined approaches of portfolio theory and multi-attribute utility theory," 2023.