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SELECTING E-HAILING DELIVERY SERVICES AMONG UNDERGRADUATE STUDENTS: A FUZZY TOPSIS APPROACH

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Abstract:

This research evaluates students' preferences regarding e-hailing food delivery services at Universiti Teknologi Mara (UiTM) Perlis. Despite the growing reliance on online food delivery, there is a lack of studies addressing student preferences in smaller campuses like Perlis, as well as a limited use of Multi-Criteria Decision-Making (MCDM) methods to provide structured rankings rather than simple descriptive statistics. Using the Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) method, the research aims to rank the criteria that influence students' choices. Factors such as delivery time, price, food delivery services, customer experience, and rider professionalism are examined to understand their impact on decision-making. This research employs quantitative methods, including surveys with 83 students, to gather data and provide insights into improving e-hailing food delivery services. The study is important as it will improve their operational effectiveness and support the continuing development of food e-hailing services. It was revealed that GrabFood was the most frequently used delivery service, followed by Foodpanda, Restaurant Delivery, and Shopee. In future research, this study may employ Multi-Criteria Decision-Making (MCDM) MCDM techniques such as Decision-Making Trial and Evaluation Laboratory (DEMATEL), Multi-Attribute

Utility Theory (MAUT), Fuzzy Analytical Hierarchy Process (Fuzzy AHP), and Preferences Ranking Method for Enrichment of Evaluations (Fuzzy PROMETHEE). To improve the review process, additional criteria and a wider range of alternatives might be considered.

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Keyword:

Decision-Making, Effectiveness, Food Delivery, Fuzzy TOPSIS, Services.



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Introduction

E-hailing services are considered on-demand services that affect food delivery efficiency (Yusoff et al., 2023). Nowadays, the introduction of e-hailing or ridesharing has provided a fast and effective way for people to move between places. Local e-hailing food delivery services are operated using motor vehicles. Additionally, due to COVID-19, people increasingly used Online Food Delivery Services (OFDS) due to various restrictions and new no-contact norms. It became one of the most used e-hailing services during the peak of the COVID-19 outbreak (Halim & Mohi, 2021). There were many e-hailing services focused on food delivery, including Foodpanda and GrabFood (Hazimi & Termida, 2023).

Prior to the emergence of e-hailing services, food operators sold food directly to customers through face-to-face interactions, dine-in services, take-out, or drive-thru options. In this era of technology, customers can order food directly through food delivery applications, wherever and whenever they want (Halim & Mohi, 2021; Mohd Yusof et al., 2021). Online delivery services also offer a variety of payment methods. Credit card or online banking options allow customers and riders to engage in contactless delivery, making delivery easier and faster (Hazimi & Termida, 2023).

Service quality is always the most significant factor for gaining customer insights, since e-hailing food delivery services rely on their users. Furthermore, several factors influence customers' decisions to use OFDS, including menu variety, ease of use, quick and easy delivery, and meal convenience. OFDS also helps those who are not keen on cooking by delivering food to their doorstep in less than an hour (Halim & Mohi, 2021). OFDS is an app that customers use to quickly place an order from a restaurant, and the online menu can be set up in the app. Orders could also be easily tracked through the application. The menu included food images in the application, making it convenient for customers to choose and place orders (Halim & Mohi,

2021). The Fuzzy Technique for Order Preference by Similarity to Ideal Solution (TOPSIS) method was used in this study, based on the concept that the chosen alternative should have the shortest distance from the positive-ideal solution and the longest distance from the negative-ideal solution.

Customers often find it hard to decide when ordering food from the OFDS application due to the many choices and the availability or lack of doorstep delivery at their location (Sharma, 2023). Next, the manual practice of purchasing directly from their local food dealers has become obsolete and time-consuming. The introduction of e-hailing meal delivery services has sparked significant interest among a wide range of people. However, these services had received both negative and positive feedback. Sometimes the application did not indicate whether a restaurant was open or closed, even though the website did. Late deliveries could lead to user frustration with e-hailing food delivery services, thereby reducing repeat orders. The quality of products was also a primary concern, as customers sometimes identified that the products they received differed from what companies had described in their application software (Macias et al., 2023). Currently, there is a notable lack of studies focusing on student preferences in smaller campuses such as Perlis. Furthermore, existing literature often relies on descriptive statistics, highlighting a need for structured ranking using MCDM methods like TOPSIS in food e-hailing preference studies. Thus, this study aims to systematically rank the criteria and alternatives influencing e-hailing food delivery service selection among UiTM Perlis students using a Fuzzy TOPSIS approach.

Literature Review

Criteria of E-Hailing Food Delivery Service

The food delivery services provided by e-hailing companies enabled users to place orders via an online food ordering system (R et al., 2017). The quality of service and goods depends on customers' perceptions. Customers evaluate food delivery services based on whether they meet their expectations. Additionally, the restaurant-to-consumer delivery technique was the main focus of the meal delivery system. Customers could place direct orders from the restaurant via e-hailing services such as GrabFood, Foodpanda, Domino's, McDonald's, KFC, and Pizza Hut. Delivery time, cost, customer satisfaction, food delivery services, and the professionalism of the rider were the elements that affected e-hailing food services (Hazimi & Termida, 2023).

Price

The costs and benefits customers are willing to pay for certain goods or services are determined by their perceptions of those goods or services. Price range was a highly essential factor in choosing e-hailing food services. A highly suitable price can sustain consumer loyalty after meeting the ideal level of customer need, prompting them to trust and make a good purchase (Sudari et al., 2019). Price is a critical factor in customer loyalty since customers can assess whether they get value for their money when they spend on food. Md Rahim and Mohd Yunus (2021) concluded that price did not guarantee customer satisfaction.

Delivery Time

Time is an essential factor for customers. They could become hyperaware of waiting times due to service performance variability. Furthermore, delivery time delays would affect customer experience and service quality. They may lead to customer frustration, fewer repeat orders, and negative reviews (Mohd Yusof et al., 2021).

Customer Experience

Customer experience involved a broad perspective on more emotionally appealing connections between users and products, applications, systems, or services (Mohd Yusof et al., 2021). Online food delivery services helped customers manage their time wisely. If a waiting period is extended longer than expected, it has been observed that the novelty of their experience diminishes. In this study's context, customer experience refers to how customers perceive their purchase of a particular service or product from a food delivery service. It can also be defined as a customer's perception of the degree to which customer requirements have been fulfilled, based on the gap between expectations and actual performance. Therefore, service quality in food delivery could be influenced by the customers' experience.

Food Delivery Services

A rising demand for food delivery systems was observed, including mobile ordering with home delivery and pickup. Nowadays, the conditions of the food delivery industry are completely different due to the platforms themselves and the economy. According to Kumar and Shah (2021), online food delivery services were provided through restaurants' self-owned platforms, such as Domino's, McDonald's, KFC, and Pizza Hut, or through third-party intermediary platforms such as GrabFood and Foodpanda. Li et al. (2020) distinguished between the gig economy and professional food delivery platforms. Customers who used these food delivery service platforms could place their orders directly with their preferred restaurant. Restaurants could prepare the orders once they were ready, and couriers or riders would deliver the food to the customers.

Rider Professionalism

Professionalism during delivery services was another significant aspect of the rider-user relationship (Mohi, 2012). Although some riders believed their employer could be stern about job performance, others felt their employer turned a blind eye to their misbehavior at times. Furthermore, some riders claimed there was no reason to be friendly towards customers, since there were no rewards or extra cash linked to their performance ratings. In e-hailing food delivery services, human resources was responsible for instructing riders to maintain professionalism during deliveries to ensure top-notch service quality (Gaikwad & Herczeg, 2020). Many companies enhance professionalism through various discipline programs to maximize service quality (Adams & Baum, 1984). Some riders often saw a positive customer experience as a reward and felt appreciated for providing efficiency, which could lead to good ratings for the company and the rider. Riders with low customer ratings can improve their ratings by being affable and making a good impression. Politeness and good customer service went a long way toward increasing a rider's rating and establishing rapport with customers (Gaikwad & Herczeg, 2020).

Fuzzy TOPSIS

This study used the Fuzzy TOPSIS method to evaluate the most preferred e-hailing food delivery service among UiTM Perlis students and to rank the selected criteria accordingly. TOPSIS is a fuzzy technique for order preference by similarity to the ideal solution and by remoteness from the negative ideal solution. The method selects the alternative with the maximum similarity to the positive ideal solution (Wang & Chang, 2007). It was often challenging for a decision-maker to assign a precise performance rating to an alternative for attributes under consideration. This method was particularly suitable for solving the group decision-making problem in a fuzzy environment, an essential concept in situations where accuracy is not achievable.

TOPSIS was also closely linked to Multicriteria Decision-Making (MCDM) across various fields. Hwang and Yoon (1981) proposed the TOPSIS method to solve MCDM problems and select the best alternative by measuring the shortest distance to the positive ideal solution and the farthest distance from the negative ideal solution. MCDM was a branch of operations research that identified optimal solutions by explicitly evaluating feasible alternatives under multiple, conflicting criteria. Among other MCDM techniques, the TOPSIS method was among the most effective and worthwhile for decision-making.

Previous Study in E-Hailing Food Services

Several studies on e-hailing food services have been conducted to provide a better approach for ranking the criteria. Based on this study by Hazimi and Termida (2023), factors affecting e-hailing food services can be categorized into two groups: direct and indirect. Direct factors included delivery time, service quality, pricing, and the condition of the food provided. Meanwhile, indirect factors include restaurant variety and quantity, menu, delivery tracking service, and the delivery person's attitude. The growth of internet providers and rising smartphone penetration has fuelled the development of various food delivery applications, such as Foodpanda, GrabFood, Uber Eats, Domino's, Pizza Hut, McDonald's, and Halo (Ray et al., 2019). The relationships between the e-hailing food delivery service quality dimensions (i.e., Responsiveness, App Reliability, Product Expectation, Rider's Professionalism, and Waiting Time) and user experience were examined. The results demonstrated that there was a positive relationship between the independent variables, which are the e-hailing food delivery service quality dimensions, and the dependent variables of user experiences (Mohd Yusof et al., 2021). Yusoff et al. (2023) stated that e-hailing services are considered on-demand vehicles that affect the efficiency of food delivery. This service could improve the process of quickly collecting and sending customer orders. In addition, customers prefer using OFDS for various reasons. Food delivery services allowed customers to save time by not having to prepare or buy food. Customers would then receive their orders at their doorstep within the estimated time frame. Moreover, Md Nor et al. (2021) emphasized that customer loyalty was vital for e-hailing's specialist organizations. This could investigate the roles of safety and security, price, convenience, and accessibility, and whether they affect e-hailing service satisfaction.

Additionally, according to Hazimi and Termida (2023), online food delivery services were among the most popular e-hailing services in this era, further boosted by the COVID-19 pandemic and the subsequent Movement Control Order (MCO). The service's online platforms could improve the food and beverage industry by promoting e-hailing services that deliver meals to customers via dedicated mobile applications. Some delivery services were

restaurant/franchise-owned by the food and beverage company, such as Domino's and Pizza Hut. As for OFDS providers, aside from Foodpanda, there were many other food delivery services available in Malaysia, such as GrabFood, Uber Eats, Honestbee, DeliverEat, and RunningMan Delivery. The rising demand for OFDS created new opportunities for restaurants to reach new markets and increase revenue while providing customers with the convenience of home delivery (Poon & Tung, 2022).

Previous Research in Fuzzy TOPSIS

A few years ago, several Fuzzy TOPSIS methods were developed in various applied works and subsequently validated using the TOPSIS method. The Analytic Hierarchy Process (AHP) was used in Singh and Dubey (2017) to determine the best diet plan for anaemia patients. Diet recommendations for anaemia patients using AHP were relatively new, making this work unique. It involved expert doctors and hematologists, who provided the feedback required to validate the proposed work. The diet plan for an anaemia patient was based on a few critical factors, including iron, vitamin B12, vitamin C, and folic acid. The final ranking of the alternatives was based on the closeness coefficient, which measured each alternative's closeness to the positive ideal solution. This approach was better than conventional approaches for a diet recommendation. Lin and Sun (2009) adopted the Fuzzy TOPSIS as the analytical tool to determine the weights of each criterion in their research on solving MCDM problems related to online shopping websites. Security and trust were the most important factors that could improve the competitive advantages of shopping websites. This was to evaluate the criteria and rank the alternatives among four shopping websites: Taiwan Yahoo, PC Home, Unimall, and eBay. The TOPSIS method was also developed for other areas, such as order selection and manufacturer (supplier) pricing on a make-to-order basis when orders exceeded production capacity. This research includes evaluating criteria such as efficiency, practicality, ease of use, timesaving, communication, confidence, security, trust, familiarity, experience, proficiency, and knowledgeability.

Samaie et al. (2020) stated that the Fuzzy TOPSIS method was effective due to its simplicity and ability to consider an unlimited number of alternatives and criteria in the decision-making process. The sustainability of Electric Vehicle (EV) development in Tehran was evaluated using the closeness coefficient for each policy scenario, calculated via Fuzzy TOPSIS. Various policies affecting the development of EVs in Tehran were ranked.

Yadav et al. (2023) applied the TOPSIS approach to rank international markets in a study on food safety concerns. Food safety standards were arguably the most contentious topic in exports, as they affect international trade. This paper ranked international markets based on the stringency of selected Food Safety Measures (FSMs). Markets were ranked based on the effort firms made to comply with food safety requirements.

According to Awasthi and Chauhan (2012), sustainability was an important subject for modern transportation decision-makers. The challenge faced by decision-makers was how to evaluate and select a sustainable transportation system. This paper presented a multicriteria decision-making approach for selecting a sustainable transportation system under partial or incomplete information (uncertainty). The proposed approach comprises three steps. Step 1 involved identifying the criteria for the transportation sustainability assessment. Step 2 involved the experts providing linguistic ratings for the potential alternatives against the selected criteria. A Fuzzy TOPSIS method was used to generate aggregate scores for sustainability assessment and

to select the best alternatives. In step 3, a sensitivity analysis was conducted to assess the influence of the criteria weights on the decision-making process. Examples of sustainable transportation include energy-efficient vehicles, clean-fuel vehicles like biodiesel and electric vehicles, carsharing, and public transit. Meanwhile, the criteria for the sustainability evaluation of transportation systems included cost, safety, security, air pollution, noise, and the use of fossil fuels.

Lastly, according to Palczewski and Sałabun (2019), Multicriteria Decision Analysis (MCDA) methods have been widely applied by researchers across various fields of study. One of the numerous MCDA methods, the Fuzzy TOPSIS method, has been applied to many real-life problems, ranging from green supply chain management to logistics and engineering and manufacturing systems. Reviewing the TOPSIS method in a fuzzy environment was an important step for identifying the problem.

Methodology

The study aimed to determine the selection criteria and alternatives for e-hailing food delivery services among UiTM Perlis students. This study employed a structured questionnaire as its primary data collection method. A structured questionnaire was distributed to 83 respondents using Google Forms. This sample size is justified as it is sufficient to form a knowledgeable expert decision-making committee required for evaluating Multiple Attribute Decision-Making (MADM) problems. Furthermore, the linguistic variables gathered from Part C of the surveys were directly transformed into triangular fuzzy numbers to compute the aggregated fuzzy ratings for the TOPSIS decision matrix. The questionnaire was divided into three parts: Part A, Part B, and Part C. Part A required respondents to provide their demographic information, such as gender, age, monthly allowance for food delivery services, and faculty. Next, Part B asked about their preferences for e-hailing food delivery applications. Lastly, Part C required respondents to rank the criteria and alternatives using linguistic variables.

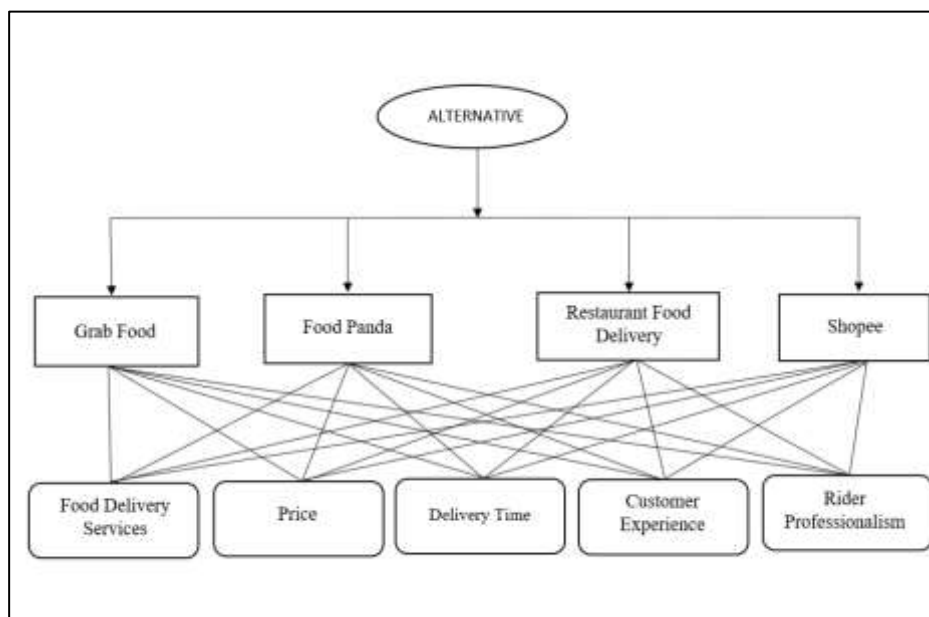


Figure 1: Hierarchy Structure For E-Hailing Food Delivery Services

This study used the TOPSIS method to evaluate the performance of alternative e-hailing food services and rank them accordingly. TOPSIS views a Multiple Attribute Decision-Making (MADM) problem with m alternatives as a geometric system consisting of m points in an n -dimensional space. The method is based on the concept that the chosen alternative should have the shortest distance from the positive-ideal solution and the longest distance from the negative-ideal solution. TOPSIS defines two indices: similarity to the positive-ideal solution and remoteness from the negative-ideal solution. The method then selects the alternative with the greatest similarity to the positive-ideal solution (Wang & Chang, 2007). It is often difficult for decision-makers to assign precise performance ratings to alternatives for the attributes under consideration. The merit of using a fuzzy approach is that it assigns attribute importance as fuzzy numbers rather than precise numbers. Sarwar et al. (2018) further extended TOPSIS to operate within a fuzzy environment. This method is particularly suitable for solving group decision-making problems in a fuzzy environment. It can be applied using any number of criteria, including both positive and negative ones, as well as qualitative and quantitative ones. The next section describes the steps of the Fuzzy TOPSIS method. Table 1 presents the linguistic terms of alternative ratings based on criteria.

Table 1: Linguistic Variable for The Alternatives Based on Criteria

Linguistic variables	Ratings value	Triangular Fuzzy Number
Very poor	1	(1,1,3)
Poor	2	(1,3,5)
Fair	3	(3,5,7)
Good	4	(5,7,9)
Very good	5	(7,9,9)

Fuzzy TOPSIS Steps

Step 1: Assignment of ratings to the criteria and the alternatives.

Assume there were J possible candidates called $A = \{A_1, A_2, \dots, A_j\}$ which are to be evaluated against n criteria $C = \{C_1, C_2, \dots, C_i\}$. The criteria weights were denoted by $W_i (i = 1, 2, \dots, m)$.

The performance ratings of each decision-maker $D_k (k = 1, 2, \dots, k)$ for each alternative $A_j (j = 1, 2, \dots, n)$ with respect to the criteria $C_i (i = 1, 2, \dots, m)$ are denoted by $R_k = X_{ij} (i = 1, 2, \dots, m; j = 1, 2, \dots, n, k = 1, 2, \dots, K)$, with a membership function $\mu_{R_k} (x)$.

Step 2: Compute aggregate fuzzy ratings for the criteria and the alternatives.

Fuzzy ratings of all decision makers are described as triangular fuzzy numbers, $R_k = (a_k, b_k, c_k), k = 1, 2, \dots, K$, then the aggregated fuzzy rating is given by $R = (a, b, c), k = 1, 2, \dots, K$, where:

$$a = \min \{a_k\}, b = \frac{1}{k} \sum_{k=1}^K b_k, c = \max \{c_k\}. \quad (1)$$

The fuzzy rating and importance weight of the k^{th} decision maker were $X_{ijk} = (a_{ijk}, b_{ijk}, c_{ijk})$ and $W_{ijk} = (w_{ijk}, w_{ijk}, w_{ijk}), i = 1, 2, \dots, m, j = 1, 2, \dots, n$, respectively, then the aggregated fuzzy ratings X_{ij} of alternatives with respect to each criterion are given by $X_{ij} = (a_{ij}, b_{ij}, c_{ij})$, where:

$$a_{ij} = \min \{a_{ijk}\}, b_{ij} = \frac{1}{k} \sum_{k=1}^K b_{ijk}, c_{ij} = \max \{c_{ijk}\}. \quad (2)$$

The aggregate fuzzy weights W_{ij} of each of the criteria were calculated as $W_j = (w_{j1}, w_{j2}, w_{ja})$, expressed as:

$$W_{j1} = \min \{a_{jk1}\}, W_{j2} = \frac{1}{k} \sum_{k=1}^K w_{jk2}, w_{ja} = \max \{c_{jka}\}. \quad (3)$$

Step 3: Compute the fuzzy decision matrix. The fuzzy decision matrix.

The fuzzy decision matrix. The fuzzy decision matrix for alternatives D and the criteria W was constructed as follows:

$$\bar{D} = \begin{matrix} & C_1 & C_2 & \dots & C_n \\ A_1 & \bar{x}_{11} & \bar{x}_{12} & \dots & \bar{x}_{1n} \\ A_2 & \bar{x}_{21} & \bar{x}_{22} & \dots & \bar{x}_{2n} \\ A_3 & \dots & \dots & \dots & \dots \\ A_m & \bar{x}_{m1} & \bar{x}_{m2} & \dots & \bar{x}_{mn} \end{matrix}, i = 1, 2, \dots, m; j = 1, 2, \dots, n$$

$$\bar{W} = (\bar{w}_1, \bar{w}_2, \dots, \bar{w}_n) \quad (4)$$

Step 4: Normalize the fuzzy decision matrix.

The raw data were normalized using a linear transformation to align the various criteria scales. The normalized fuzzy decision matrix R was given by:

$$R = [\tilde{r}_{ij}]_{m \times n}, i = 1, 2, \dots, m; j = 1, 2, \dots, n, \quad (5)$$

where,

$$\tilde{r}_{ij} = \left(\frac{a_{ij}}{c_j}, \frac{b_{ij}}{c_j}, \frac{c_{ij}}{c_j} \right), c_j = \max c_{ij} \text{ (benefit criteria),}$$

$$\tilde{r}_{ij} = \left(\frac{a_j}{c_{ij}}, \frac{a_j}{c_{ij}}, \frac{a_j}{c_{ij}} \right), a_j = \min a_{ij} \text{ (cost criteria).}$$

Step 5: Compute the weighted normalized matrix

The weighted normalized matrix V for the criteria is computed by multiplying the evaluation criterion weights, w_j , by the normalized fuzzy decision matrix \tilde{r}_{ij} , defined as:

$$V = [\tilde{v}_{ij}]_{m \times n}, i = 1, 2, \dots, m, j = 1, 2, \dots, n, \text{ where } V_{ij} = \tilde{r}_{ij} (\cdot) W_j \quad (6)$$

Step 6: Compute the Fuzzy Positive Ideal Solution (FPIS) and Fuzzy Negative Ideal Solution (FNIS)

The FPIS and FNIS of the alternatives were computed as follows:

$$A^* = (V_1^*, V_2^*, \dots, V_n^*), \quad V_j^* = \max_i \{V_{ij3}\}, i = 1, 2, 3, \dots, m, j = 1, 2, 3, \dots, n, \quad (7)$$

$$A^- = (V_1^-, V_2^-, \dots, V_n^-), \quad V_j^- = \min_i \{V_{ij1}\}, i = 1, 2, 3, \dots, m, j = 1, 2, 3, \dots, n. \quad (8)$$

Step 7: Compute the distance of each alternative from FPIS and FNIS.

The distance (d_i^*, d_i^-) of each weighted alternative $i = 1, 2, 3, \dots, m$ from the FPIS and FNIS was computed as follows:

$$d_i^* = \sum_{j=1}^n d_v(\tilde{v}_{ij}, \tilde{v}_j^*), \quad (9)$$

$$d_i^- = \sum_{j=1}^n d_v(\tilde{v}_{ij}, \tilde{v}_j^-), \quad (10)$$

where $d_v(a, \tilde{b})$ is the distance measurement between two fuzzy numbers a and \tilde{b} .

Step 8: Compute the closeness coefficient CC_i , which represents the distances to the fuzzy positive ideal solution A^* and the fuzzy negative ideal solution A^- simultaneously. The closeness coefficient for each alternative is calculated as follows.

$$CC_i = \frac{d_i^-}{d_i^- + d_i^*}, i = 1, 2, \dots, m. \quad (11)$$

Step 9: Rank the alternatives.

The closeness coefficient ranked different alternatives CC_i in decreasing order. The best alternatives are closest to the FPIS and the farthest from the FNIS.

Results and Discussions

Among UiTM Perlis students, 83 knowledgeable respondents were selected to form a decision-making committee. The process began with linguistic ratings of each alternative on a scale from "Very Poor" to "Very Good," which were then converted to numerical values using triangular fuzzy numbers during decision-making. Then, these fuzzy numbers were aggregated across all decision-makers to compute the individual preference weights for each criterion and alternative. After normalization across criteria, weighted normalized values were calculated.

The study further determined the FPIS and FNIS, representing the optimal and least-optimal ratings, respectively.

The last phase of the Fuzzy TOPSIS method was to determine the Euclidean distances for each option based on the final FPIS and FNIS. Next, a closeness coefficient was calculated to rank alternatives in order of preference. The higher the coefficient, the more preferable the alternative. Table 2 depicts that GrabFood ranked as the most preferred option among students, demonstrating strong performance across most criteria, particularly in Food Delivery Services and Customer Experience. The findings indicate that the Fuzzy TOPSIS method was effective in solving MCDA problems in the context of e-hailing food delivery services. These results provide insights into students' decision-making preferences and highlight that a food delivery service provider should prioritize enhancing service delivery for university students.

Table 2: The Closeness Coefficient for Five Alternatives

Alternatives	d_x^+	d_x^-	CC_i	Rank
GrabFood	3.6477	13.8794	4.6477	1
Foodpanda	3.1388	9.5813	4.1388	2
Restaurant Delivery	1.3354	3.4608	2.3354	3
Shopee	0.8509	1.7181	1.8509	4

Conclusion

Fuzzy TOPSIS, a technique for order of preference by similarity to the ideal solution, was employed in the decision-making process for evaluating e-hailing food delivery services among undergraduate students at UiTM Perlis. Analysis considered several decision levels, such as order price, delivery time, food delivery services, customer experience, and rider professionalism, using linguistic terms. Initially, linguistic assessments were obtained for each alternative, and triangular fuzzy numbers were then used to convert them into numerical values. Aggregating these values from several respondents yielded global preference weights for each criterion. To obtain comparable values across different measurement scales, normalization was conducted, and weighted normalization was calculated. Thus, the distinction between the most and least favourable alternatives was made using the Fuzzy Positive Ideal Solution (FPIS) and Fuzzy Negative Ideal Solution (FNIS). The Euclidean distance from each alternative to these ideal solutions was computed to obtain a closeness coefficient, which, in turn, enabled ranking the available services. Based on the calculated closeness coefficients, the analytical results demonstrated that GrabFood ranked as the optimal alternative (Closeness Coefficient = 3.6477), driven by its strong performance in food delivery and service quality. Shopee was ranked the least preferred option due to lower delivery speed scores and a generally poor image of food delivery services. The current study provides empirical evidence for the application of Fuzzy TOPSIS in the multicriteria decision-making (MCDM) process for selecting a food delivery service, offering students insights into the key factors shaping their preferences. The paper sheds light on important determinants that service providers could use as references to improve their operational strategies and service delivery to meet the needs of university students.

Future research should extend the application of advanced MCDM methods to better address causality, uncertainty, and fuzziness in consumer decision-making. Furthermore, the researcher could add additional criteria and a larger list of choices to the evaluation framework for improvement. This could strengthen the findings of this study by expanding the demographic scope to include students from other academic programs at UiTM Perlis, thereby improving specificity and accuracy. Finally, the research can be extended to other sites, for example, different campuses or even geographical locations, to gain broader insight. This would also improve data robustness and enrich the findings, thereby maintaining a balance between closeness and distance in the voting system.

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