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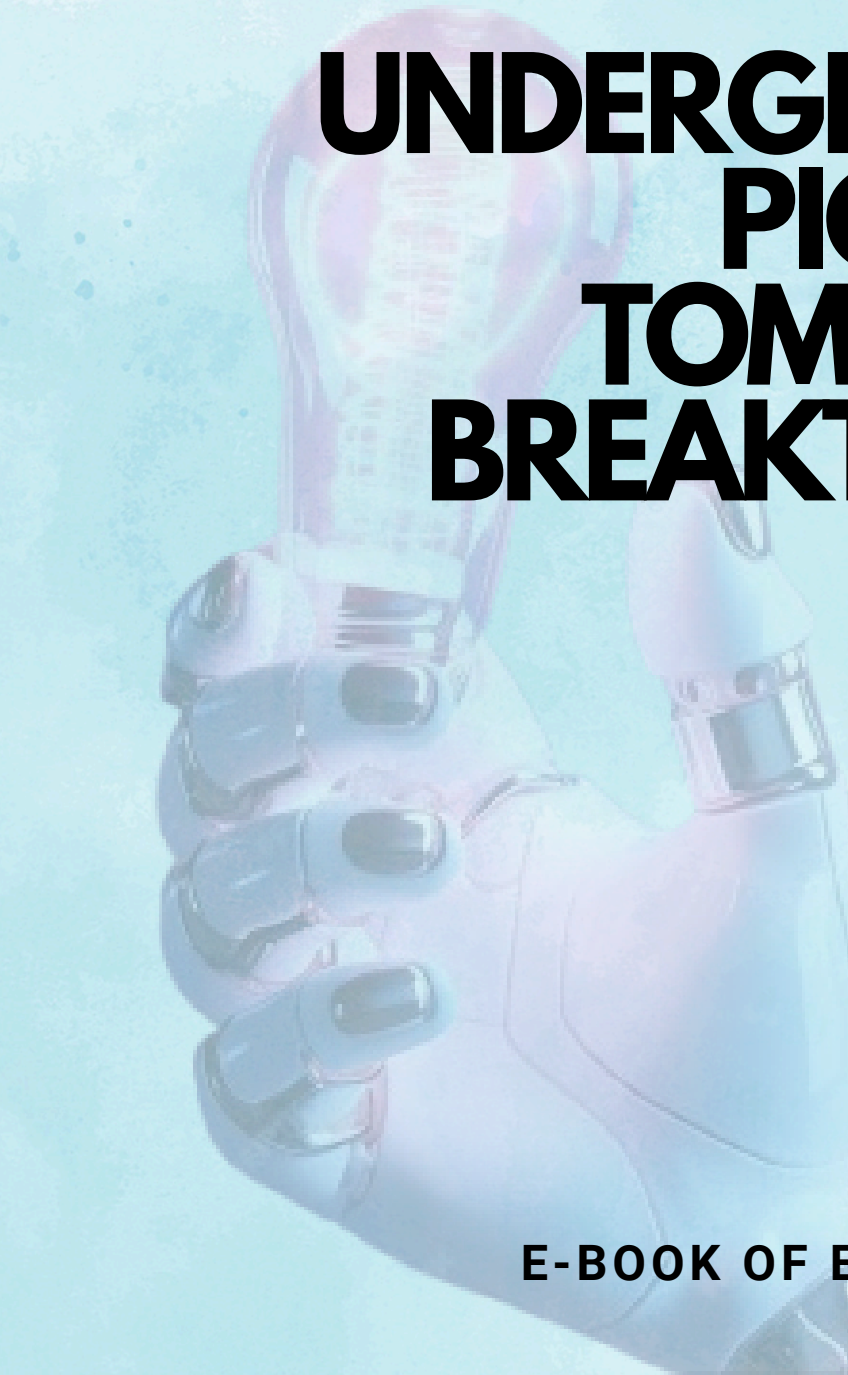

E-BOOK OF EXTENDED ABSTRACTS

SELECTING RENTAL HOUSES AMONG YOUNG ADULTS USING INTEGRATED ENTROPY FUZZY VIKOR MODEL

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ABSTRACT

The demand for rental houses is increasing since property prices continue to rise. Hence, it is difficult to become an owner of a house, especially for young adults. In Malaysia, numerous young adults face financial difficulties, which often lead them to rent a house. Identifying the crucial criteria that influenced their rental decisions is important. Hence, the decisions they make will correspond with their preferences and requirements. In this study, criteria such as price, location, accessibility, security, and amenities were the inputs that were used to establish a framework for determining rental decisions. By applying the Integrated Entropy Fuzzy-VIKOR Model, it tackled the issue of selection for rental house preferences among young adults and provided a significant impact on decision-making. The entropy method was used to avoid subjectivity in the selection process. Then, the Fuzzy-VIKOR method was applied to determine the rank of rental house alternatives, which were the apartment, double-story house, terrace, and bungalow, according to these weighted criteria. The findings of this study showed that security received the highest prioritised criteria by implementing the entropy method, and apartment was the most preferred alternative among young adults using the Fuzzy-VIKOR model.

Keywords: Rental House, Young Adults, Fuzzy-VIKOR, Entropy

INTRODUCTION

In Malaysia, young adults face challenges when choosing a preferred rental house despite the availability of various housing options. Understanding their preferences and decisions on rentals is essential to understanding their needs when selecting a rental house. Since there are many criteria involved, younger adults often face difficulties in making rental decisions. Hence, Multi-Criteria Decision-Making (MCDM) is the relevant method to be used in determining a suitable house for rent.

MCDM is one of the decision-making methods that was designed to structure and address decision and planning challenges that involve the consideration of multiple criteria simultaneously (Aruldoos et al., 2013). The VIseKriterijumska Optimizacija I Kompromisno Resenje (VIKOR) method, also known as the Fuzzy VIKOR method, is one of the MCDM methods that has been implemented in numerous areas to solve complex decision problems. This model is crucial in identifying a compromise solution that is farthest from the Negative Ideal Solution (NIS) and closest to the Positive Ideal Solution (PIS) with the ability to rank preferential decision alternatives (Khan et al., 2020).

In addition to that, the entropy weight method introduced by Shannon is significant for decision-making as it measures the level of uncertainty and amount of information related to decision criteria (Deng et al., 2020). Shannon incorporated entropy into information theory to measure uncertainties in information sources, making the entropy weight method a reliable tool for measuring uncertain information (Siew et al., 2021). The objective of this study is to identify the critical criteria rental housing preferences. With that, this study aims to implement the MCDM model, specifically the Integrated Entropy-Fuzzy VIKOR model, to analyse and rank the most preferred rental housing option among young adults.

METHODOLOGY

The fuzzy rating for ith alternative for jth criterion based on kth decision maker is set as $\tilde{x}_{ijk} = \left(x_{ijk1}, x_{ijk2}, x_{ijk3}, x_{ijk4}\right)$. The importance of weight is set as $\tilde{w}^s_{jk} = \left(w^s_{jk1}, w^s_{jk2}, w^s_{jk3}, w^s_{jk4}\right)$. Then, the fuzzy rating was aggregated. The importance of weight for each jth criterion based on kth decision maker also was aggregated as Equations (1) and (2), where $i = 1,2,\cdots,m$, $j = 1,2,\cdots,n$ and $k = 1,2,\cdots,t$.

$$\text{Aggregated importance of weight for each criterion} = \begin{cases} w^s_{j1} = \min\limits_k \left\{w^s_{jk1}\right\} \\ w^s_{j2} = \dfrac{1}{k}\sum\limits_{k=1}^{k} w^s_{jk2} \\ w^s_{j3} = \dfrac{1}{k}\sum\limits_{k=1}^{k} w^s_{jk3} \\ w^s_{j4} = \max\limits_k \left\{w^s_{jk4}\right\} \end{cases} \tag{1}$$

$$\text{Aggregated importance of weight for each criterion} = \begin{cases} x_{ij1} = \min\limits_k \left\{x_{ijk1}\right\} \\ x_{ij2} = \dfrac{1}{k}\sum\limits_{k=1}^{k} x_{ij2} \\ x_{ij3} = \dfrac{1}{k}\sum\limits_{k=1}^{k} x_{ij3} \\ x_{ij4} = \max\limits_k \left\{x_{ij4}\right\} \end{cases} \tag{2}$$

Based on Equations (1) and (2), the decision matrix $\tilde{D}$ and the subjective matrix, $\tilde{W}^s$ can be expressed as $\tilde{D} = \begin{bmatrix} x_{11} & \cdots & x_{1n} \\ \vdots & \ddots & \vdots \\ x_{m1} & \cdots & x_{mn} \end{bmatrix}$ and $\tilde{W}^s = \begin{bmatrix} \tilde{w}^s_1 & \tilde{w}^s_2 & \cdots & \tilde{w}^s_n \end{bmatrix}$. Defuzzification of the $\tilde{D}$ and $\tilde{W}^s$ was calculated using Equation (3) where a is minimum value, b is value in the centre but less than c, and d is the maximum value.

$$Z^* = \frac{\left(c^2 + d^2 + cd\right) - \left(a^2 + b^2 + ab\right)}{3\left[(c+d) - (b+a)\right]} \tag{3}$$

The decision matrix should be normalized for each criterion $C_j\left(j = 1,2,\cdots,n\right)$ by using the calculation of the projection value of each criterion called P_{ij} of the index value of alternative m under criterion n.

$$P_{ij} = \frac{x_{ij}}{\sum\limits_{i=1}^{m} x_{ij}} \tag{4}$$

The entropy value e_j for each criterion. The k constant, $k = \dfrac{1}{\ln(m)}$, is calculated to ensure that the entropy values lies between 0 and 1 as Equation (5).

$$e_j = -k \sum_{i=1}^{m} p_{ij} \cdot \ln\left(p_{ij}\right) \tag{5}$$

Next, the calculation of weights, w_j^s as Equation (6).

$$w_j^s = \frac{1 - e_j}{\sum_{j=1}^{n}\left(1 - e_j\right)} \tag{6}$$

The normalisation of decision matrix ensures that each criterion is limited between 0 and 1, allowing for comparability among the criteria. The cost criteria, $x_{ij4}^{-} = \max\left\{x_{ij4}\right\}, C_j \in B$ represent the disadvantage criteria, while benefit criteria, $x_{ij4}^{+} = \max\left\{x_{ij4}\right\}, C_j \in B$, relate to criteria that has significant when selecting the rental houses, where u_{ij} is the new fuzz number for alternatives under criteria C_j, B is the benefit criteria and C is cost criteria as Equation (7).

$$u_{ij} = \left(\frac{x_{ij1}}{x_{ij4}^{+}}, \frac{x_{ij2}}{x_{ij4}^{+}}, \frac{x_{ij3}}{x_{ij4}^{+}}, \frac{x_{ij4}}{x_{ij4}^{+}}\right), C_j \in B \quad u_{ij} = \left(\frac{x_{ij1}}{x_{ij4}^{-}}, \frac{x_{ij2}}{x_{ij4}^{-}}, \frac{x_{ij3}}{x_{ij4}^{-}}, \frac{x_{ij4}}{x_{ij4}^{-}}\right), C_j \in C \quad u_{ij} = \frac{x_j^{+} - x_{ij}}{x_j^{+} - x_j^{-}} \tag{7}$$

The x_j^{+} is the best values and x_j^{+} is the worst value. Calculation of overall performance evaluation using Equation (8).

$$u_{ij} \times w_j^s \tag{8}$$

Defuzzification of the Decision Matrix Criterion with Respect to Alternatives. The formula of defuzzification is the same as in Equation (3). The best f_j^{+} and worst f_j^{-} values for each criterion are determined (Siew et al., 2021). Next two key indices are calculated for each bank which are the utility $\left(S_i\right)$ using Equation (9),

$$S_i = \sum_{j=1}^{n} \frac{w_j^s\left(f_j^{+} - f_{ij}\right)}{f_j^{+} - f_j^{-}} \tag{9}$$

and Regret $\left(R_i\right)$ using Equation (10),

$$R_i = \max\left(\frac{w_j^s\left(f_j^{+} - f_{ij}\right)}{f_j^{+} - f_j^{-}}\right) \tag{10}$$

which S_i represents the maximum group utility and R_i indicates the individual regret. Finally, the VIKOR index $\left(Q_i\right)$ is computed. This index represents a compromise and is used to rank the banks from best to worst, where v denotes the strategy of maximum group utility weight, while $1 - v$ signifies the individual regret weight using $v = 0.5$ following Lam et al., (2021). The Q_i is as Equation (11), where $S^{+} = \min\left(S_i\right)$, $S^{-} = \max\left(S_i\right)$, $\mathrm{R}^{+} = \min\left(R_i\right)$ and $R^{-} = \max\left(R_i\right)$.

$$Q_i = v\left(\frac{S_i - S^+}{S^- - S^+}\right) + (1-v)\left(\frac{R_i - R^+}{R^- - R^+}\right) \tag{11}$$

RESULT AND DISCUSSION

In this study, a literature was conducted to identify the most suitable criteria for rental house and found that amenities, security, price, location and accessibility as the important criteria. The Integrated Entropy-Fuzzy VIKOR model was implemented for identifying rental housing options. Figure 1 shows the weight of the importance assigned to each criterion using the entropy method.

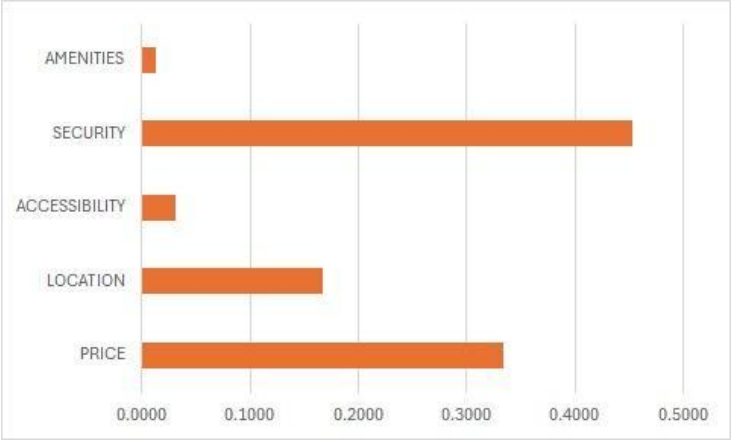

Figure 1: The Weightage of the Importance of Criteria

The analysis showed that security had the highest weight at 0.4530, making it the most important factor in a young adult's choice of a rental house. Price was the next most important at 0.3341, followed by location at 0.1678. In contrast, accessibility and amenities had the lowest weights at 0.0317 and 0.0133 respectively. These findings indicate that young adults prioritise safe living conditions. Table 1 shows the Fuzzy VIKOR method result.

Table 1. Rank and Q_i Value for each Alternative

Houses	Q_i	Rank
Two-storey	1.0000	4
Bungalow	0.5230	2
Terrace	0.8690	3
Apartment	0.0000	1

Based on Table 1, the Apartment is the most preferred rental house with a Q_i value of 0.0000. It represents the optimal compromise across all criteria. The second most preferred option is the bungalow with Q_i value of 0.5230. The terrace and two-storey house ranked lower with Q_i values of 0.8690 and 1.0000. The final ranking shows that the apartment is the most preferred choice for young adults likely due to its security, amenities and accessibility.

CONCLUSION

This study successfully met its objectives by proposing an Integrated Entropy Fuzzy VIKOR model for evaluating rental housing preferences among young adults. The study's two-stage approach proven to be

valid tool for making complex decisions. In the first stage, the entropy method was used to objectively determine the weights of each criterion, avoiding any personal bias. The analysis showed that security was the most important factor in a young adult's choice of a rental house while amenities were the least important. In the second stage, the Fuzzy VIKOR model was used to rank the rental housing options based on the previously determined weights. The findings revealed that the apartment received the lowest Q_i index indicating it was the most preferred options. It was followed by the bungalow, terrace and two-storey house.

REFERENCES

Aruldoss, M., Lakshmi, T. M., & Prasanna Venkatesan, V. (2013). A Survey on Multi Criteria Decision Making Methods and Its Applications. *American Journal of Information Systems, 1*(1), 31–43. Https://Doi.Org/10.12691/Ajis-1-1-5

Deng, F., Fang, Y., Xu, L., & Li, Z. (2020). Tourism, Transportation and Low-Carbon City System Coupling Coordination Degree: A Case Study In Chongqing Municipality, China. *International Journal of Environmental Research and Public Health, 17*(3). https://Doi.Org/10.3390/Ijerph17030792

Khan, M. J., Kumam, P., Alreshidi, N. A., Shaheen, N., Kumam, W., Shah, Z., & Thounthong, P. (2020). The Renewable Energy Source Selection By Remoteness Index-Based VIKOR Method For Generalized Intuitionistic Fuzzy Soft Sets. *Symmetry, 12*(6). https://Doi.Org/10.3390/SYM12060977

Siew, L. W., Fai, L. K., & Hoe, L. W. (2021). Performance Evaluation of Construction Companies in Malaysia with Entropy-Vikor Model. *Engineering Journal, 25*(1), 297–305. https://Doi.Org/10.4186/Ej.2021.25.1.297