Analytical Hierarchical Process (AHP): statistical index and factors that influence the housing price in Kuala Lumpur

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Abstract. The housing affordability issue has seriously occurred in Kuala Lumpur recently as the property price increased significantly from time to time. Several factors may influence the decision making of the buyers. The factors were the interesting topic for this study which can assist the consumers to purchase a suitable residence in Kuala Lumpur. The Analytical Hierarchical Process (AHP) was used to determine the best alternative for the housing selection. The priority weight for seven factors were determined and the AHP structure simultaneously. As the result showed, the best alternative is the medium property price where the consumer should purchase a residential property with medium property price. This research may limit to the opinions of the consumers, the recommendation for further researchers was to gather more thoughts from the policymaker or the developer to understand the overall situation for this issue.

Keywords: Housing Affordability, Analytical Hierarchical Structure, Property Price

1. Introduction

The residence is a location, shape or building that has served for humans as a domestic or surroundings the place the persons or families will live [1] - [9]. The building, too, is now listed as an vital factor of city development and monetary improvement [3], [8], [10], [11]. Housing is an indispensable funding for persons as housing will affect social interplay and the socioeconomic fame will be reflected. Many households will be stimulated by means of enhancing the nice of the team and the neighborhood relationship [4]. In fact, vulnerable financial increase would lead to higher housing prices. This will also have an effect on the charge of constructing substances such as combined concrete, stone, bolstered steel, sand and aggregate. The services and services of the residential property will at once influence the house price, because this is a necessary criterion when the consumer chooses the residential property [2], [3]. Based on the information provided, 66.7% of the population of Kuala Lumpur was in the low and middle-income groups [1]. The range of income...
was lower than RM 5,344.00 will be classified as low-income group while the range of income was between RM 5,345.00 and RM 10,564.00 will be classified as middle-income group [13].

According to the Sin Chew newspaper in 2019, the finance minister introduced a scheme for the first buyer to buy a residence with the fee varying from RM 300,000.00 to RM 2,500,000.00 would waive the stamp obligation charge. This plan was only free to pay stamp duty on the Sale and Purchase Agreement (SPA) price of the first RM 1,000,000.00 [14] - [18]. Furthermore, the property market report 2019 has confirmed the belongings’ rate has moderate improvement examine to the year 2018. but, the common property rate in Kuala Lumpur is round RM 780,564.00 which turned into the perfect frequent belongings charge in Malaysia, this caused those low-middle-income households who lived in Kuala Lumpur having affordability issues. Moreover, the volume of property transaction in Kuala Lumpur is 7,496 units inside the first quarter of year 2019 which changed into described as non-energetic property market compares to different states in Malaysia [19]. Based on the New Economic Policy (NEP) which has been delivered in the year 1970, the property developer ought to provide the bumiputera bargain such as reserve tremendous share of the residential property units for sales totally to bumiputera and promote these bumiputera quota units with discount rates to the bumiputera buyers [20]. However, these options did no longer help the B40 and M40 non-bumiputera buyers to buy their private residence as there are troubles of the supply-demand mismatch and the income increase slowly [21].

The intention of this study was to apprehend the homebuyers’ desire which the families’ profits was beneath low and middle-income group. Moreover, the pilot study will conduct to accumulate the data about B40 and M40 on buying a residence to decide the housing affordability of B40 and M40.

2. Literature review

2.1 Housing affordability

In Malaysia, housing prices for the low-income group and medium-income group have been turning into severely unaffordable. This work was carried out to decide the area of the residential property, whether the region is appropriate for low-and medium-income groups. The researchers discovered that the Putra Heights in Selangor were an appropriate region for low-and medium-income groups where transportation took place [22] - [26].

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2.2 Factors affect the housing affordability issue

The three major elements that will affect the affordability of housing are discrepancies between supply and demand for housing, newly delivered skewed toward the affordable range and residence price increase not equal to household income development. In addition, the researchers also provide 5 policy solutions to tackle Malaysia's housing affordability deficit [21], [31] - [34].

In Malaysia, to tackle accessibility and affordability issues, the authorities provided low-priced housing scheme for low-income earners. A work was carried out to apprehend the motives behind Malaysia’s low-priced housing shortage. The researchers have been recognized with the root reasons of this issue, and have supplied some feasible solutions. Nevertheless, the researchers mentioned that the qualitative approach affected seven states and one area was the challenge of this analysis. Research discovering was challenging to generalize across the world. Hence, a suggestion was given to the researchers which used quantitative approach to conduct the research [35] - [38].

2.3 Analytical Hierarchical Process (AHP)
The researchers have been conducting a dynamic evaluation on the public bus transport’s grant quality. This study was performed a questionnaire to accumulate information and performed the AHP approach to establish the desire weights for evaluators. The researchers referred to that the respondents want serious mental operate when the respondents were answering the AHP questionnaire where the data gathered may deliver to a bias result. Besides that, the researchers also noted that the desire order in hierarchical structure was very touchy when calculated the weighted rankings of the respective preceding stage [39] - [42].

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The researchers were using AHP to inspect the elements that may affect the consumer behavior in digital marketing. The precedence of the criteria was discovered according to the statistics accumulated from questionnaires and the face-to-face interview with experts. Based on the conclusion that made through researchers, the researchers cited that AHP was restricted to identifying the interrelationship within the criteria and sub criteria where AHP only can investigate the importance of the standards [45], [46].

As a summary, AHP is beneficial in solving intricate decision problems which can utilized in range fields which related to the economy, planning, electricity policy, health, warfare resolution, task choice and budget allocation, operations management, benchmarking, complete best management, win-win management, website selection and education. AHP is a technique that combines with quantitative evaluation method.

3. Methodology

3.1 Analytical Hierarchical Structure

In the decision-making process, there involve the selection about the choice and standards where the alternative includes an exceptional choice on each criteria and criteria includes unique importance. To choose the excellent standards and alternative, an appropriate perception about technique of dimension and scale measurement were needed. Scale size was not only relying on the measurement device which can measure the studying with sure unit accurately, but the scale dimension can also measure the scale based on dependable judgement and understanding. The judgement of an individual may not be accurate; however, this situation can be resolved through an interview with some predicted to gain the professional opinions and knowledge. The assessment between these criteria and choice may not be reliable, thus, this trouble could be solved by using supplying a comprehensive definition about the concept of analytical hierarchical process. Analytical hierarchical system (AHP) is a decision-making tool which can use in dealing with unstructured, complex and multi standards decision [47], [48].

The hierarchical structure was constructed in Step 1. In the technique of analytical hierarchical manner (AHP), a hierarchical structure was developed the place it consists the goal, criteria, and alternatives. The judgement or overall performance will make primarily based on the ratio scale and synthesized via the hierarchical structure. The hierarchical structure was started with the intention which placed at the top and continue with the criteria which may additionally consist of various stages that is depends on the sub-level of the criteria and the choice will discover at the bottom of the structure. The area of criteria is jointly different the importance of each standards where every criterion is not depending on each different or current any relationship between every other. The number of selections will have an effect on the consistency of judgement where the quantity of options should be small. The number of preferences should not higher than seven. If this scenario was occurring, the ranking mode in AHP may use in alternative level. The objectives of establishing the hierarchical
structure in AHP are to supply an ordinary view of complicated relationship seize the unfold of impact of criteria and allow the choice makers to make the assessment based on the weight of impact [48], [49], [52].

In step 2, the preference matrix will be created to compare the importance of the elements in each level from top to bottom as shown in equation (1). Pairwise comparison matrix, \( S = (s_{ij})_{p \times q} \), where \( p = q \).

\[
S = \begin{pmatrix}
  s_{11} & s_{12} & \ldots & s_{1q} \\
  s_{21} & s_{22} & \ldots & s_{2q} \\
  \vdots & \vdots & \ddots & \vdots \\
  s_{p1} & s_{p2} & \ldots & s_{pq}
\end{pmatrix}
\]  

(1)

with \( s_{ij} \geq 0 \) express the degree of preference of \( v_i \) to \( v_j \).

The choice of each element depends on the essential scale, which was developed through Saaty as showed in Table 1. The essential scale is insensitive about the small alternate in the preference where should minimize the uncertainty affect in the assessment [47], [50].

In the third step, which is synthesized, the weight of the various factors will be estimated via normalized the eigenvector in the preference matrix from top of hierarchical structure to the bottom. The weights of various factors should evaluate as the method cited in the equation (2) where every entry in the pairwise assessment matrix is approximate the ratio between two weights [47], [48], [50], [52].

| Verbal Judgement                                      | Numeric Value |
|------------------------------------------------------|---------------|
| Extremely important or preferred                     | 9             |
| Very strongly to extremely important or preferred    | 8             |
| Very strongly important or preferred                 | 7             |
| Strongly to very strongly important or preferred     | 6             |
| Strongly important or preferred                      | 5             |
| Moderately to strongly important or preferred        | 4             |
| Moderately important or preferred                    | 3             |
| Equally to moderate important or preferred           | 2             |
| Equally important or preferred                       | 1             |

\[ S_{ij} \approx \frac{\omega_i}{\omega_j} \]  

(2)

where \( \omega \) represent the weights for each entry in matrix \( S \).

Therefore, matrix \( S \) can be expressed as equation (3).

\[
S = \left( \frac{\omega_i}{\omega_j} \right)_{p \times q} = \begin{pmatrix}
  \omega_1 & \omega_2 & \ldots & \omega_1 \\
  \omega_2 & \omega_2 & \ldots & \omega_2 \\
  \vdots & \vdots & \ddots & \vdots \\
  \omega_p & \omega_p & \ldots & \omega_p \\
  \omega_1 & \omega_2 & \ldots & \omega_q \\
  \omega_2 & \omega_2 & \ldots & \omega_q \\
  \vdots & \vdots & \ddots & \vdots \\
  \omega_p & \omega_p & \ldots & \omega_q
\end{pmatrix}
\]  

(3)
A condition of multiplicative reciprocity $s_{ij} = \frac{1}{s_{ji}}$ matrix $S$ can simplify as the equation (4):

$$S = \begin{pmatrix}
s_{12} & \cdots & s_{1q} \\
\frac{1}{s_{12}} & \ddots & \vdots \\
\vdots & \ddots & \ddots \\
\frac{1}{s_{1q}} & \cdots & \frac{1}{s_{2q}}
\end{pmatrix}$$

(4)

The last score of the alternative is to sum the product of the weight for every criterion time the scaled weight with recognize to the criterion, where the sum consists of all the criteria. There include two synthesis modes which are distributive and perfect mode. Distributive mode is the mannequin that normalizes an alternative score beneath every criterion and sum into one. This mode depends on the performance of the choice where the rank may reversal. However, the best mode is unique in contrast with distributive mode where the rating of every choice will divide through the score of the excellent alternative under the criterion. This mode will hold the rank if the unimportant preferences are deleted or delivered [47], [48].

In the final step of AHP, the sensitivity analysis ought to conduct to apprehend how the changes, weight should affect the outcome. The selection maker can check and improve the consistency through using the eigenvalue. The inconsistency was being described as 10% of complete difficulty with the consistency dimension or one order of magnitude less vital than consistency [47], [48]. The consistency index, CI for matrix $S$ can calculate by using equation (5).

$$CI(S) = \frac{\lambda_{\text{max}} - p}{p - 1}$$

(5)

where $\lambda_{\text{max}}$ is the maximum eigenvalue for matrix $S$ and $p$ is the number of rows of matrix $S$.

The consistency ratio also can calculate by using the formula stated in equation (6).

$$CR(S) = \frac{CI(S)}{RI_p}$$

(6)

where $RI_p$ is the random index.

The random index can estimate, according to Table 2 which display the estimated value for $RI_p$.

**Table 2 Estimated value for $RI_p$**

| $p$ | 3    | 4    | 5    | 6    |
|-----|------|------|------|------|
| $RI_p$ | 0.5247 | 0.8816 | 1.1086 | 1.2479 |
| $p$ | 7    | 8    | 9    | 10   |
| $RI_p$ | 1.3417 | 1.4057 | 1.4499 | 1.4854 |

When the value of CR is smaller than 0.1, the matrix $S$ will be accepted. However, the value of CR is larger than 0.1, the matrix $S$ will be rejected. If the value of CR is equal to one which shows that the judgement is 10% constant [51].

AHP will conduct through using the software named Microsoft Excel. In Microsoft Excel, the tables and matrices used in AHP can assemble easily and clearly. This can simplify the complex system in AHP.

4. Result and discussion

Housing selection is a key decision to be made for the attainable consumers due to the fact to own a residence is essential for most people. The housing selection should be affected via a few factors. For
instance, the view of the house, location, consumer monetary status, infrastructure, facility, type of residence and characteristics of house. Fig. 1. was displayed the relationship between the goal, criteria, and alternatives.

Firstly, the view of the residence is issue to the consumer prefers. The property with no view could be highly decrease price evaluate to the similar property that offers the great view. Besides that, the backyard view should be quite less expensive than the metropolitan view and the view dealing with landmark in Kuala Lumpur, for instances, Kuala Lumpur City Centre would have the slightly better price compared to the others within the same house building.

For location, property which is under the perfect residential scheme that beneath the gated and guarded protection and management would extra tremendously higher charge than the others. Apart from this, the comparable type of property that is close to the City Centre should be greater quite expensive than the Kuala Lumpur fringe and decentralized area. Thus, the property in rural place is extra low-priced through the consumer compared to the other locations.

On the consumer monetary status, the less dedication and the monetary ranking demonstrated via the client should have excessive proportion for mortgage approval. The extra dedication happens will purpose the plausible consumer practice loan with less figure. If the greater the expenses, the lower the chance to have greater percentage or full loan; and vice versa.

Whereas for infrastructure, the similar type of residential constructing which are nearer to the public transport is having the highest price evaluate to those farther from the public transport. For the facility, the residential property consists of more facilities will affect the property price. For instance, the residential property with swimming pool, gymnasium, secured and strict security shield are having the greater price than the others. The less infrastructure and facility inside the residential area, the less expensive the price for the residential property.

Furthermore, housing type should be categorized as low cost, medium price and excessive rise, which offers unique facilities and specification for the consumer consideration. Lastly, the variety of characteristics of residential property should have unique type of prices. For example, three rooms house unit is the most high-priced within the development, accompanied via 2 rooms house unit and studio unit.

Based on the interview with the Chief Executive Office of property Consultant, the CEO noted the monetary capacity of the consumers is the most important criteria as the consumers should be aware of the potential of economic during the housing transaction.

Besides, the location of the house will be the second criteria, as the consumers can choose the desired area that match with the monetary ability. The type of house is the third vital criteria after the location, the consumers can choose the desired residential property in the unique region as the type of residence do not consisted all in every location.

Moreover, the infrastructure near to surrounding is the fourth significance criteria as every region have particular infrastructure such as school, hospital, public transport, public market, and jogging park. After the infrastructure near to surrounding, the facility of the residence and the characteristics of the house is the next important criteria as each task has specific facility and the characteristics of the house.

Lastly, the view of residence is the least importance criteria. The view of residence is not one of the essential criteria have to be concerned. The priority weight and the consistency ratio were calculated based on the importance scale that provided by the Jackson Cheng which is 3.46%. when the consistency ratio is lower than 10%, the decision matrix is accepted. Furthermore, as the lower the consistency ratio, the consistent the decision matrix.
Figure 1 illustrated the monetary ability of the consumers was exceptionally contributed to the choice guideline as the priority weight was the best in the figure. Moreover, the view of house, characteristics of house, facility of housing and infrastructure of the house were not the vital criteria beneath consideration.

As a summary, the medium property price was the great selections that should be selected, and the monetary capacity of the consumer criterion was the criterion that contributed the best priority weight in AHP. Therefore, the consumers ought to concern about the monetary ability during the housing selection. Moreover, the medium property price was the excellent alternative that can supplied to the B40 and M40 buyers.

5. Conclusion

This chapter will conclude this study through summarizing the outcome of the statistics evaluation and conclusion. Besides that, suggestions for further research will be discussed.

By using Analytical Hierarchical Process (AHP), the pleasant choice for the housing decision purpose is medium property price. By ranking the seven important criteria contributed to the decision making in housing selection, the medium property price will be the excellent alternative. The attainable consumers should think about the residential property with the medium property price.

Refer to the result of AHP, the best alternative for housing selection would be the medium property price where the homebuyers ought to purchase a house which is underneath the medium property price range. The procedure of AHP was tricky where any adjustment will immediately affect the outcome. Therefore, the outcome was reliable and convey benefits for the homebuyers who was involved with the housing selection in Kuala Lumpur.

This research was subjective to the point of view of the consumers which may not definitely included the opinion from the policy maker, property developer and the property proprietor where remarkable position
will provide the different thoughts that may provide the recommended assistant in questionnaire, personal interview and focal point group discussion.

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