Optimizing Personalized Commitment with Particle Swarm Optimization

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Abstract

Nowadays, in Malaysia, many fresh graduates cannot afford to buy a house. The price of house increases, especially in urban area. Even though the price of the house grew over the years, the house is a basic need of humanity. However, the increased cost of housing leads to unaffordability to buy a house, especially most of them are just starting their job and earned insufficient payment to support their life. As to this, they need to choose the most affordable house. The affordable house in this context is to own a reasonably-priced and will not affect their financial constraint while having other commitments. This paper addresses the employment of Particle Swarm Optimization with the aim to obtain an optimal personalized commitment value to secure an affordable house. The characteristics of the affordable house, identification particle representation, and fitness function were determined. The findings demonstrate that the Particle Swarm Optimization offered acceptable results to assist the young graduates on their personalized commitment to buy an affordable house. The outcome has great potential in assisting fresh graduate and the other people to make a better decision in choosing the affordable house without affecting the other commitment on the use of salary.

Keywords: *Housing Price; Particle Swarm Optimization; Personalized Commitment; Young Fresh Graduate.*

1. Introduction

Malaysia's property has rapidly grown and prospered attract foreign investor to share their market to the local. Property such as building commercial and residential were examples of this event. Everyone needs a place where they can rest or even having a time with their loved one. A place such as house. The human races and scoping down to the Malaysian, make it is important to have a residential property or house. Owning a house is essential to family and is a dream of a successful person. The house has become a necessity for people to have a shelter. The housing proceeds to be a sign of family success and one of the highest-priced investment to the household [1].

Everyone needs a shelter, but not all could afford a comfort-able house for themselves such as young fresh graduates. Young fresh graduates suffer a great danger on affording a house because of their low payroll, loan disapproval, highly-paid house and small size of [2]. Not many of them can afford a house range RM200000 by giving a monthly commitment, partially from their revenue from job, at least RM3000. The bank institutions also restrict their approval for a loan, as they have insufficient income that to meet the loan agreement. Most of them already obligated to other loan, such as car and credit card bill [3]. The fresh graduate's income on average is RM2100 and have range of income between RM1500 to RM3600 [4] on the surveys that they manage. That fact eventually put the fresh graduates in the B40 group, the 40% lowest income, which have stated in the Eleventh Malaysia Plan, the household income that below than RM3860

Young fresh graduates faced difficulties to own a house due to the increment of house price and manage their budget for housing loan with their monthly revenue [4]. The housing price has risen, and this has an impact on ability to buy a house for young fresh graduates. Price of the house has been raised in major capitals, to an unavoidable state. This could burden the young, fresh graduates to pay their monthly commitment [5]. There must be a way to assist these fresh graduates to own an affordable house based on their commitments. Thus, it is good to identify the type of house and the character of an affordable house. This paper addresses the application of an evolutionary optimization to assist young graduates to find the optimal personalized commitment.

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## 2.	Related works

The house is a key requirement of basic life for people. However, not everyone could afford a dreamt house. Their most critical requirement to buy a house is having enough money for themselves [4]. Obtaining a house, a measure of accomplishment for a person in their life. Having a place to stay for themselves and families, guarded safe and sound, is good if it is affordable housing. Affordable means the people can buy a house, without constraining their expenditure with current revenue [5]. Demographic factors such as marital status, number of households, age distribution, educational level, and household income of different respondents might have influenced the housing market and have resulted in different levels of affordability [6]. The declining of housing affordability affected by many factors and one of the factors is the price of the house that is high. Higher house prices on the average, imply that the higher wealth effect the affordability on the population but it may false to a certain group of people such as lower-income [7].

House prices that increase every year in unthinkable amount, lead to the buyers in lower-income group hard to afford a house. Lower-income group in Malaysia, B40, which have 40% lower income, a household that earned a monthly income less than RM3860 per month. The average monthly household income for B40 in 2014 is RM2537, which lower than expected [8] The trend of house purchase in Malaysia differs between states due to economic factors such as the availability of jobs. There are many types of house that available such as terraced house and apartment. However, the affordability of fresh graduates is lower since they have just begun their job, and many things need to be considered.

The house preferences are what the house that needs to have. It includes the housing attribute, security, public services and neighborhood attractions, accessibility and the environment [9]. Housing attributes such as the number of rooms, type of house and cost is important into the buyers. There are two types of house, which are landed housing and high-rise housing. The most preferred structural attributes that can influence house preferences are number of bedrooms and bathrooms [10]. Other than that, the preferences of young house buyers are determined, which are ultimate necessity, living quality and environment, well-planned development, healthy environment, relaxing and comfortable home, harmonious neighborhood and appreciation of the property value [11].

Most people prefer a fast commute toward the cities as the city has much more access [12]. Their needs on the things and work derive them to choose urban than the rural area. Even so, there are still people that want to live in rural areas to have peace and quiet life. The urban people will likely have an access on medical, communication and education in much higher compared to rural. The house preferences also affect the price of the house [13]. The more preferences of the house, the more the price will be put on the house. The preferred house has more value than the others do since it benefits the homebuyers. This will encourage the developer to build a quality and more preferred house in the next future. The homebuyers may include the youngsters who apparently working or even adult that's been working in long period.

3. Data Acquisition

The application of optimization algorithm requires variables of an affordable house characteristics and the identification of the fitness function. Therefore, a survey was constructed that consists of demographic and house preferences. The questionnaires were distributed to the young fresh graduates from Bachelor's Degree of Universiti Teknologi MARA (UiTM). The young graduates age

is between 22-26 years that has a career. The questionnaires were distributed through online and manual. This data can help to determine the house preference characteristics by young, fresh graduates to buy an affordable house. It is an indicator to the optimal system to execute and evaluate the result. This questionnaire distributed through online platform and during the convocation day in UiTM, Shah Alam. Overall, all 113 respondents are reported that they cannot afford the house price with their salary for now. The respondent includes the fresh graduates' range between 22 to 26 years old that passed their degree within 1-year durations. Based on the analysis from expertise, interview, and the most important characteristics need to consider is the house price, salary and monthly commitments. The commitments can be divided into three types if basic commitment, namely; personal commitment, vehicle commitment and expense commitment.

From the survey, most of the respondents have less than the average household income for B40, which is RM2500 lower than the average, RM2537, in which reported by 55.8% of the total respondents as demonstrated in Figure 1.
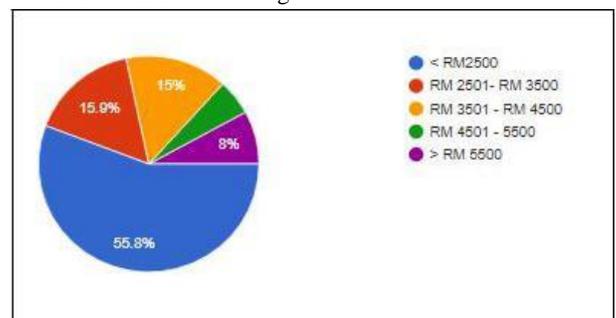

Fig. 1: Percentage of salary

Figure 2 shows that about 77.9 of the respondents have a desire to own a house at any time. The range of housing price that most of the respondents expected is in the range of RM100, 000 to RM200, 000, reported by 42.3% of respondents as demonstrated in Figure 3. Most of the respondents are unable to own a house. All information from the survey findings and expert were tabulated and analyzed.
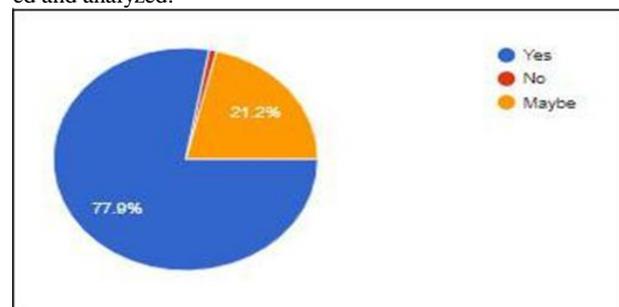

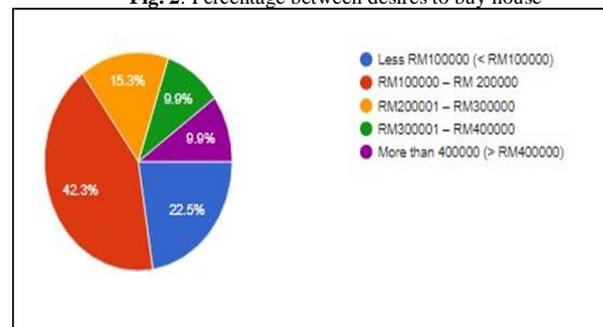**Fig. 2**: Percentage between desires to buy house

Fig. 3: Percentage between expected house price.

4. Application of Particle Swarm Optimization

4.1 Solution representation and fitness function

This section explains the construct of the solution mapping. The elements were selected based on the survey and interview with property expert. Table 1 indicates the attributes and the representation of each attribute. Each of the attributes has its own representation. The target for the solution is to find the optimal personalize commitment that later will assist the young graduates to buy a house.

Table 1. Attributes and its values

Attributes	Range (RM)
Price of House	100,000 – 800,000
Salary	0 - 7000
Vehicle Commitment	0 - 3000
Expense Commitment	0 - 3000
Personal Commitment	0 - 3000

Figure 4 shows a particle based on the attribute and its values as stated in Table 1. As for price of the house – H, it shows the range of price of a house represent RM100000-RM8000000. Salary, S, has shown the range of salary. The amount monthly commitment in the vehicle, V, which consist of the commitment of car or motorcycle that the person possessed. The amount of monthly commitment of personal, P, which consist the personal loan, or repayment of education loan. The commitment of expenses, E, such as utilities and fuel expenses. These three commitments range above or equal to RM0 until RM3000. This particle later used to optimize the commissioning plan and assist the fresh graduates to make better choices of affordable house to buy.

H	S	V	E	P

Fig.4: Particle representation

The equations that were obtained by the expert is Debt Service Ratio (DSR) and Expected Loan Approval are as follows:

$$DSR = \left(\sum Commitment \right) / Salary * 100 \tag{1}$$

$$Expected\ Loan\ Approval = \left[(Salary * DSR) - \sum commitment \right] * 200 \tag{2}$$

Where;
DSR is the percentage of total commitments divide by salary Expected loan approval is the salary by DSR minus with total commitments multiply with 200.

Both equation (1) and (2) are analyzed, hence, the objective function is formulated as in equation (3).

$$f(x) = \left[(s * D) - \sum C \right] * W \tag{3}$$

Where;
f(x) is the maximum loan can be applied for h which, s is salary, D is DSR, depending on, C is commitment and W is constant equal to 200.

4.2 PSO steps

PSO were applied in many research domains [14-17]. The particle representation and fitness function where the applied in PSO algorithm. The algorithm is shown in Figure 5. The algorithm starts with the initialization of the population of particles or swarm size, followed by the initialization of the inertia weight (W) and acceleration constants (C1 and C2). Step 4 and 5 initialize the minimum value (Vinitialize(min)) and maximum value of velocity (Vinitialize(max)) and minimum position (Dmin) and maximum

value of position (Dmax), respectively. Next is the calculation of Pbest and Gbest value for each particle. Step 9 calculates the new velocity value for each particle using equation 2.1. Step 10 updates the new position, D(new) using equation 2.2. Finally, Pbest (new) and Gbest (new) are determined based on the fitness value set for the problem. Iteration starts from step 7 until step 13 to update the current velocity and position of each particle. This iteration will be done until it satisfies the stopping condition.

PSO Steps
1: Begin
2: Initialize number of particles and populations
3: Declare W, C1 and C2
4: Initialize Vinitialize(min) and Vinitialize(max)
5: Initialize Dmin and Dmax
6: Calculate Pbest and Gbest value for each particle
7: Do
8: For each particle
        9: Calculate new velocity value, V(new)
        10: Calculate new position, D(new)
        11: Calculate Pbest (new)
        12: Calculate Gbest (new)
13: While stopping condition is reached
14: End

Fig. 5: Canonical PSO algorithm [18]

4.3 Computational Experiments and Findings

Each of the experiment will run for 5 datasets and the average of fitness is calculated as shown in Table 2.

Table 2. Parameter setting

Parameter	Value
Iteration No	500,1000,1500
Swarm Size	10,20,30
Datasets	5

Table 3 shows 5 data sets were run for each swarm size of 10, 20 and 30. The highest value is in dataset 1 in which the swarm size is 30, obtained the value of RM263,400. The lowest value is RM259, 200 that runs at sample 5 in swarm size of 10. The values were inconsistent when run for 10 swarm sizes, but for 20 and 30 of swarm size, the results are consistent.

Table 3. Results for Iterations of 500 based on different swarm sizes

Swarm Size	Sample					
	1	2	3	4	5	Average
10	262400	260800	260400	261600	259200	260880
20	262200	261800	262200	262000	262800	262200
30	263400	262600	262800	263000	262000	269360

Table 4 shows 5 samples were run for each swarm size of 10, 20 and 30. The highest value is in samples 5 which swarm size is 20 with the value of 234400. The lowest value is 183400 which runs at sample 2 in swarm size of 10. The values were inconsistent when run for 10 swarm sizes, but for 20 and 30 of swarm size, the value results are consistent.

Table 4. Results for Iterations of1000 based on different swarm sizes

Swarm Size	Sample					
	1	2	3	4	5	Average
10	204200	183400	222000	227600	206800	208800
20	205200	209000	221600	219000	234400	217840
30	210200	220000	221400	221800	220000	218680

Table 5 shows the average value for each swarm size of 10, 20 and 30. The highest value to swarm size is 30 with the value of 218680. The lowest value is 208800 which runs in swarm size of 10. The values were drastically increased when run for 20 swarm sizes, but for 30 of swarm size, the value results are nearly completed.

Table 5. Iterations of 1500 with 5 samples run and average final best

Swarm Size	Sample					
	1	2	3	4	5	Average
10	236800	219400	209200	225400	213600	220880
20	240600	249800	215000	204400	214000	224760
30	227600	217600	203600	220200	202400	214280

Based on the averages for the iteration that produces almost the similar value. As the system is supposed to find minimum value fitness, it shows that the result is feasible. The data is then compared with the value given by the expert of the domain itself from his perspective. Table 6 shows the commonly personalize commitment for fresh graduates given by the expert, the house price with salary. It shows the most nearly to the desired house, which have price of RM200000. From the result, the percentage of accuracy may reach to 95%, which will give different personalized of commitments. Although the percentage of accuracy is high, but the result of the system may need to consider many things such as age, status of marital, places, commute and many more. The accuracy is calculated based on the average and the input house price.

Table 6. Recommendation by expert.

Salary	House Price	Vehicle Commitment	Personal Commitment	Expenses Commitment
2650	200000	200	200	200

The results from the experiments provide a potential solution for the PSO. It has the capability to explore regions of the search space and exploit the search to refine a feasible solution. These search strategies are influenced by the parameters; acceleration constants (C_1 and C_1) and inertia weight [14] that has been applied in the PSO algorithm. Thus, the setting of these parameters is important to optimize the search space [15-16]. Thus, more experiments with different parameters can be done to improve the results.

5. Conclusion

The results from the experiments provide a potential solution for the PSO. PSO has the capability to explore regions of the search space and exploit the search to refine a feasible solution. These search strategies are greatly influenced by by the parameters; acceleration constants and inertia weight that has been applied in the PSO algorithm. The outcome is also capable to assist fresh graduate to choose an affordable house based on salary and house price including their commitment. The result of this system is quite acceptable that the output is desirable. Thus, in future, more experiments with different parameters to improve the results.

Acknowledgement

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