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PREFERENCE IN SELECTING HOME BROADBAND PLANS USING BEST-WORST METHOD

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Abstract

Online and distance learning and working from home is initiated into our daily routines today due to the Coronavirus outbreak since early 2020. Hence, it is very important to have a good internet connection to ensure it operates smoothly without any interruptions. There are many internets home broadband plans in the market. Customers' requirements are varying and each plan has its own benefits and limitations. The purpose of this research was to evaluate the importance of criteria when selecting a home broadband plan and determining the most preferred plan. The sample used was 50 university student volunteers. The method used to analyse the data is Best-Worst method. Results showed that reliability is the most significant criterion followed by accessibility, cost, customer service and advertisement. The most preferred plan is HBP1 followed by HBP2, HBP4, HBP3, HBP5, HBP8, HBP6 and HBP7. Product HBP1 is rank first based on reliability, accessibility and advertisement factors. Results from this study are beneficial for students and employees in choosing the best home broadband plan for their usage. Best-Worst method is used as an alternative in selecting multi criteria decision-making problems since it is highly feasible and reliable.

Keywords: Multi Criteria Decision-Making (MCDM), Best Worst Method, Home Broadband Plan, Marketing Segmentation, Product Pricing

INTRODUCTION

Due to the Coronavirus outbreak since early 2020, the Malaysian government has enforced a lockdown as an attempt to break the chain of the Covid-19 spread. Citizens are required to stay at home and are only allowed to go out with permission from the authorities. This has become an obstacle for everyone to maintain their daily affairs such as going to school, study at the university and going to work. As an initiative, many parties have converted their daily routine to work online. For an example, learning institutions initiated an Online and Distance Learning (ODL) method and many companies started a "Work from Home" (WFH) alternative to adapt to the new norm. With everything being online, it is crucial to have a good internet connection as it is a factor in ensuring all these initiatives to be effective. Moreover, a strong internet connection is also essential to stay online for many hours either to study, meeting and browsing for information. Therefore, it is very important to know and be aware of the many available broadbands, their specialty, benefits and limitations in order to determine the most effective and the best internet connection at home.

Broadband has been seen as a big source of economic growth and development due to social activities such as instant messaging, emailing and other tools that can be considered as the elements of the communications. Nowadays people treat broadband as important as the public transportation system, water and energy since the internet has become a necessity to survive in the workplace and school due to the pandemic. Devices are connected through broadband with high-speed connection with or without wires. Wired broadband internet service is accessible in four different types such as Digital Subscriber Line (DSL), fiber-optic, cable modem and satellite (Hathway, 2020; Argaez, 2017). Each type has its own advantages and limitations. Many criteria are considered in selecting and assessing certain products including HBP. Important factors in selecting the best deals of HBP are based on the type of broadband user, the purpose of using broadband, the internet service providers, pricing, speed, advertisements and promotions, word-of-mouth, availability, customer satisfaction ratings (reliability and customer service) and data quota (limit or unlimited data) (Schafer, 2021; Fernandez, 2018).

Objectives of Research

There are many internet service providers that offer home broadband plans (HBP) in the market and customers' have their own preferred criteria and purposes in choosing HBP. Hence to know the perception of students' decision in selecting HBP based on preferred criteria simultaneously, the research objectives are to

1. evaluate the most important criteria in selecting home broadband plans.
2. determine the rank of the preferred home broadband plan.

LITERATURE REVIEW

Internet Broadband

Broadband connection is a high-speed internet connection provided through DSL, fiber-optic, cable or satellite internet service. Broadband service is defined as data transmission speeds exceeding 200 kilobits per second (Kbps) in at least one direction either downstream or upstream, which shows that high-capacity bandwidth allows greater amount of information to be transported for communication purposes (Ludrusamy and Ramyah, 2009). Broadband network is not tied-up with phone lines, which reduces delay in accessing the Internet also the phone network. Thus, broadband networks are said to be different from the old dial-up networks.

Digital Subscriber Line (DSL) is an internet network that is established by using unused cable for phones so that it does not interrupt telephone service (Argaez, 2017). It is recognized as simple alternatives due to the fast approach of the outdated copper-based networks to its minimum speed limits. The internet connectivity of the DSL network often differs with the distance of the switching station, such that the closest the customer is to the switching station, the higher the internet speed will be. Therefore, this could be a primary consideration when deciding to choose between DSL line and cable link.

The newest broadband service is in a fiber-optic form. Fiber-optic network guarantees a solution to internet lag due to many users using the network at the same time. This network offers higher bandwidth that makes it the fastest internet access so far which has been recognized by telecommunication providers. Even though it takes a considerable time to complete the process of laying down of fiber-optic cables, it is still the best option chosen by internet users. Cable networks are also a form of broadband. The speed of the wired internet connection varies with the number of users on the service at a particular time. For example, given a particular area, the bandwidth of the broadband cable network is being shared among users which will lead to the decreasing performance of internet connection when the number of users increases. During the MCO period, office hours in the daytime is usually the peak times when many users access the internet.

The last type of broadband is satellite which is a decent alternative for dial-up. Satellite network offers a broad-spectrum service which benefits users who live in rural areas and those who work in the middle of the jungle, remote island or even up in the mountains. The internet connection is made available for the user without a phone line. However, this network is easily affected by the weather and is the slowest broadband service offered. The installation cost for this network is also very high. The old dial-up network is slower and it is not a broadband internet service. Although the dial-up network is cheaper, most internet users prefer a faster access to the internet, which is the broadband internet connection. To access the internet, the

dial-up connection requires a standard phone line and an analog modem. Usually those who live in rural areas would rely on this network due to the unavailability of broadband and cable.

Criteria in Selecting Internet Broadband

Among the the top best broadband services available in Malaysia are Maxis, TM Unifi and Time (www.mykris.net, 2021; Jodee, 2021; Shim, 2020). Each brand offers their own strength and specialty in some aspect such as speed (300Mbps, 800Mbps, 16GBps), coverage (limited / unlimited, rural/urban) and plan deals (bad, fair good services, low/fair price). Studies done on the criteria in selecting HBP included internet service providers, pricing, speed, advertisements and promotions, accessibility or availability, reliability, customer service, contract period and data quota (www.imoney.my, 2021). Shim (2020) revealed that speed used to be the most important aspect to look for in a broadband plan. With a high-speed network, users can rely on it anytime or anywhere they need it. Another crucial factor is to make sure that the equipment to install the broadband in our homes is provided since the quality of the equipment influences the performance of the brand's network. Customer service is also an important factor since customers always prefer to have after sales service and could depend on the company's technical support when connection problems occur. Companies that offer various packages such as bonuses and discounts are more likely to attract customers.

Jena (2017) carried out research to find out what customers look for when choosing a broadband plan in India. The findings show that most customers choose the cheapest broadband in the market. They are loyal to broadband companies that give many perks and advantages such as bonus or discounts. Customers are also more inclined to select broadband plans that are well-known since they are more familiar with that product and provide good customer service. Research by Vanara (2018) found that consumers preferred the particular broadband due to the quality of customer care services. More awareness needs to be generated for the public to promote the product.

The five criteria that are being evaluated in this research are cost, reliability, advertisement, accessibility and customer service and the description are as follows:

a) Cost: The pricing of all packages is evaluated based on the value of the plan. The best plan is the one with a low price while still providing a decent package deal.
b) Reliability: The reliability indicates the frequency of the broadband to easily or hard to be damaged. A good home broadband will not often damage or buffers from time to time. The performance of the broadband must be reliable for the user to utilize at anytime and anywhere.

c) Advertisement: Users are prone to select the broadbands that are well-advertised as it appears more promising to subscribers. Users normally select a broadband that they are familiar with and have knowledge on the broadband company.
d) Customer service: Broadband companies should be capable of providing a satisfactory customer service to their users. The services range from helplines performance to their action upon a complaint.
e) Accessibility: Users tend to go for broadband companies that are more accessible to and are accessible everywhere.

Multiple Criteria Decision-Making Models

Multi Criteria Decision-Making Models (MCDM) is an efficient method used to solve complex selection problems involving many different parameters and choices. It is one of the appropriate methods to evaluate all the criteria and alternatives simultaneously (Hwang and Yoon, 1981; Baffoe, 2018). The MCDM approach can calculate measurable parameters, determine the weight of each parameter for the cumulative score of the assessment subjects and allow decision-makers to provide a better and more detailed foundation for decision-making. Such frequently implemented approaches include the Technique for Order of Preference by Similarity to Ideal Solution (TOPSIS), Analytic Hierarchy Process (AHP) (Saaty, 1987) Preference Ranking Organization Method for Enrichment Evaluation (PROMETHEE) (Brans & Vincke, 1985) Best Worst Method (BWM) (Razaei, 2015) and many more (Bunari, 2017). The general process of MCDM consists of five stages, such that (i) Determine the goal, criteria and alternatives for the problem (ii) Weight the importance of each criterion (iii) Rank alternatives with their corresponding criteria (iv) Analysed results and (v) Confirm reliability and validity of results.

Regarding a study of MCDM, Kalpoe (2020) used a Multi-Criteria Analysis (MCA) to determine the technical choice of consumers in the sense of e-commerce apparel such as to increase customer online buying performance and prevent the return of apparel products. The result revealed that the most preferred alternative was product photographs, zoom function and static scale map for mix and match function. The least favoured alternative was Virtual Dressing Room (VDR). Another study by Wang et al. (2020), created an MCDM model named Supply Chain Operation Reference (SCOR) model which applied Analytic Hierarchy Process (AHP) and the Data Envelopment Analysis (DEA) method to improve their business strategies in reducing costs, improving production planning and to create a flexible adjustment according to the market. The five criteria used in this research are reliability, ability, agility, effective asset management and costs. The result indicated that the best requirements for the development of

the MCDM model for supplier's choice in the oil industry are reliability. Kheybari et al. (2019) also used the MCDM approach in finding the best area for bioethanol production in the provinces of Iran. This research was based on three dimensions which were social, environment and economic. The result showed that the economic dimension played the most important role, followed by social and environmental. It was concluded that Tehran, Qom and Khuzestan were among the most ideal places to manufacture bioethanol.

The TOPSIS method which was introduced by Hwang and Yoon in 1981, can be used for rating or choosing from a finite number of alternatives with respect to various parameters (Allaki et al., 2019). The positive-ideal solution (PIS) in TOPSIS is the one that maximizes the profit criteria and minimizes the cost criteria, whereas the negative-ideal solution (NIS) minimizes the benefit criteria and maximizes the cost criteria. Therefore, the PIS and NIS are defined by the parameter's values obtained by comparing alternatives. An AHP is a systematic decision-making process with several parameters; an approach proposed by Saaty in 1987. The AHP system uses hierarchical frameworks to explain and determine the relative importance of the criteria of the preferred selection factors. The decision analysis method enables the decision makers to evaluate complicated decision-making issues by breaking down their key issue into easier and accessible subproblems (Saaty, 1990; Saaty 2008; Enderson et al. 2008; Beltrán et al., 2014). Bunari (2017) studied students' preferences in selecting several postgraduate programmes in mathematics based on certain criteria. The weight of the criteria which was calculated using AHP showed that the most important factors were cost of education followed by financial assistance, courses offered, family and peers opinion, location of institution and institution facilities. Then, the ranking of mathematics programmes was done using the TOPSIS method. In another research using AHP, Mohamad Mazlan (2018) reported that preference of olive oil products was influenced by criteria such as form of olive oil, advertisement, nutritional benefits, price and availability.

PROMETHEE was developed by Brans (2005) and further extended by Brans and Vincke (1985). PROMETHEE used an outranking method in the form of preference function and degree in ranking the preference of alternatives products. Several parameters for selection are involved and evaluating the influencing factors of the elements of a group of alternatives, as opposed to selecting or simply rating a particular one (Karlitasari et al., 2017; Deshmukh, 2013; Maidinsah and Raja Aziz, 2019) studied on preference criteria in purchasing local and international foundation cosmetic products using AHP and the preference of the cosmetic brands by experts using PROMETHEE. Word-of-mouth factor is the most important criteria followed by quality, availability, price, packaging and advertisements in choosing foundation

cosmetics. International products were most preferred based on their quality while local brands were chosen mostly because of influencer effect and fair price.

Applications of Best-Worst Method

Jafar Rezaei introduced the Best-Worst Method (BWM) in 2015. It is one of the systematic and reliable MCDM methods to assess all criteria and alternatives while providing a better comprehension to decision-makers in selection of alternatives. The method is used to determine the best alternative out of all options considered, rank all alternatives from best to worst and categorize all alternatives into their respective classes. Calculation of criteria weights uses two vectors of pairwise comparisons. The best and worst criteria are identified. The best criterion compared to other criteria is the Best-Other (BO) comparison, and the other criteria compared to the worst criterion results into the Other-Worst (OW) comparison. This method also has been proved to be successful in diminishing the possibility of bias coming from decision-makers due to its strategy of creating options with opposite references which are the most preferred and least preferred alternatives. Theoretically, this method can be used whenever there is a problem that needs to rank and decide the best alternative out of all alternatives. The BWM has been applied to solve many real-world MCDM problems in various fields such as business and economics, health, information technology, engineering, education and agriculture.

For instance, Omrani et al. (2019) accessed road safety in Iran using BMW. This research used the input indexes such as passenger kilometres, tone kilometres, kilometres of highway length, number of vehicles registered, number of speed cameras and population for reviewing the road safety. Performance for analysing road safety quality scores is the number of deaths, injuries and collisions in Iran. The result showed the most important index was the number of deaths while the two least important indices were the number of injuries and collisions. In another research, Liao et al. (2018) studied the impact on hospital management performance by applying a hesitant fuzzy linguistic BWM. This research evaluated social benefits, medical service quality, comprehensive management ability and sustainability. The finding revealed that comprehensive management ability was the core criterion. Mohamad (2020) used BWM in ranking criteria for selecting favourite coffee chain shops. Out of the sixth chosen criteria, Halal certification was the criterion most concerned with, followed by customer service, pricing, accessibility, advertisement and flavour variation.

METHODOLOGY

Sample

This research used a survey design where 50 undergraduate science students voluntarily responded on-line. Majority of the respondents (70%) are female and the remaining 30% are male. As many as 92% of the respondents stayed at home during Movement Control Operation (MCO) or lockdown period, while 8% stayed at the university campus. Most of the students (70%) are from urban areas compared to 30% lived in rural areas.

Instrument

The questionnaire consists of pairwise comparison of criterion over other criterion and selection for HBP preference (Appendix A). The questionnaire is distributed online in Google Form to the respondents for 14 days. Students gave their feedback via social media such as WhatsApp and Telegram.

Data Analysis

The collection of primary data was examined and analysed using Microsoft Excel. In BWM, the three main stages to achieve objectives of the research are to (i) define criteria and alternatives for selection (ii) evaluate the weightage of each criterion and rank by using BWM and (iii) rank each alternative based on performance ratings. The stages are as follows:

Stage 1: Define criteria and alternatives for selection

Table 1 and Table 2 show the set of criteria {c_1 c_2 ..., c_n} and alternatives of HBP {$a_1, a_2 ..., a_m$} and their description used in this research.

Table 1: Description of Criteria for Home Broadband evaluation

Criteria		Description
Cost	c_1	The price of the package that needs to be paid.
Reliability	c_2	The availability of internet connection, uninterrupted internet connection and internet stability.
Advertisement	c_3	The promotion of product, brand or service.
Customer Service	c_4	The assistance and advice provided by company to those who use its product.
Accessibility	c_5	The quality of being easy to obtain or use.

Table 2: Description of home broadband plans*

Alternatives		Mbps	Quota	Cost (RM)	Coverage	Customer Service
HBP1	a_1	100	Unlimited	129	high	bad
HBP2	a_2	100	Unlimited	149	high	fair
HBP3	a_3	300	Unlimited	219	high	fair
HBP4	a_4	500	Unlimited	299	high	fair
HBP5	a_5	800	Unlimited	99	high	fair
HBP6	a_6	100	Unlimited	99	low	fair
HBP7	a_7	500	Unlimited	139	low	fair
HBP8	a_8	1Gbps	Unlimited	199	low	fair

*Data from Shim (2020) and Jodee (2021)

Stage 2: Evaluate the weightage of each criterion and rank process

This stage consists of four steps as follows:

Step 1. Selection on best and worst criteria

Respondents decided on which criteria is the best (e.g. most important, most desirable) and the worst (e.g. least important, least desirable) based on their preferences.

Step 2. A pairwise comparison between criterion {c_1 c_2 ..., c_n} using scale as in Table 3.

Table 3: Discrete Scales of Pairwise Comparison

Numeric Values	Explanation
1	Equally important
3	Moderately more important
5	Strongly more important
7	Very strongly more important
9	Extremely more important
2, 4, 6, 8	Intermediate judgement

a) Respondents made comparisons between best criterion (B) with other criteria (O). Vector $A_B = (A_{B1}, A_{B2}, ..., A_{Bj}, ..., A_{Bn})$ is the result of the BO comparisons, where a_{Bj} the preference of the criterion *B* over criterion *j*.

$a_{BB} = 1$ because it gives an equal importance between the best criterion and the most preferred criterion.

b) Respondents made comparisons between other criteria (O) with the worst criterion (W). Vector $A_W = (A_{1W}, A_{2W}, ..., A_{jW}, ..., A_{nW})^T$ is the result of OW comparisons, where a_{jW} is the desired criterion *j* over criterion *W*.

$a_{WW} = 1$ as it gives an equal importance between the worst criterion and the least preferred criterion.

Step 3. Evaluate weightage for each criterion

The optimal weights for each criterion $(w^*_1, w^*_2, ..., w^*_n)$, determined by the maximum absolute differences of $\left|\frac{w_B}{w_j} - a_{Bj}\right|$ and $\left|\frac{w_j}{w_W} - a_{jW}\right|$ for all *j* should be minimized, and translated to the minmax model in model (1) and transform as in model (2):

Model (1)

$$min\ max_j \left\{\left|\frac{w_B}{w_j} - a_{Bj}\right|, \left|\frac{w_j}{w_W} - a_{jW}\right|\right\}$$

Subject to

$$\sum_{j=1}^{n} w_j = 1$$

$$w_j \geq 0, \text{for all j}$$

Model (2)

min ξ

Subject to

$$\left|\frac{w_B}{w_j} - a_{Bj}\right| \leq \xi, \text{ for all j}$$

$$\left|\frac{w_j}{w_W} - a_{jW}\right| \leq \xi, \text{ for all j}$$

$$\sum_{j=1}^{n} w_j = 1$$

$$w_j \geq 0, \text{ for all } j$$

By solving model (2), the optimal weights $(w^*_1, w^*_2, ..., w^*_n)$ and the optimal value of pairwise consistency ξ can be obtained. The closer the value of ξ to 0, the greater the consistency, the more reliable the comparison becomes. Calculations for BWM were carried out using the Data Solver of Microsoft Excel.

Step 4. Ranking of criteria

The criteria are ranked according to the value of the weight, the higher the weight, the higher the rank and the more important the criterion.

Stage 3: Ranking of HBP (alternatives)

There are two steps to determine the ranking of each alternative.

Step 1. Evaluate performance rating for each alternative

Respondents decide their preference on each criterion using discrete scales of pairwise comparison (as in Table 3) based on the chosen alternatives. Their preferences are arranged as in matrix D in (3):

$$D = \begin{array}{c} \\ a_1 \\ \vdots \\ a_m \end{array} \begin{array}{c} \begin{array}{ccc} c_1 & \dots & c_n \end{array} \\ \begin{bmatrix} d_{11} & \cdots & d_{1n} \\ \vdots & \ddots & \vdots \\ d_{1m} & \cdots & d_{mn} \end{bmatrix} \end{array} \tag{3}$$

$$w_j^* = [w_1^*, w_2^*, \dots, w_n^*] \tag{4}$$

where $a_1, a_2, \dots, a_m$ are the possible alternatives selected in this study, $c_1, c_2, \dots, c_n$ represents the extracted decision criteria, d_{ij} represents the performance scores of every criterion towards the selected alternatives for all value of $i = 1,2,3, \dots, m$ and $j = 1,2,3, \dots, n$ respectively and w_j^* is the optimal weight (4).

Step 2. Ranking of alternatives

Weighted scores are obtained by multiplying the optimal weight of each criterion in (4). Then, the value of alternative *i*, V_i is determined by adding the weighted score as in (5).

$$V_i = \sum_{j=1}^{n} d_{ij} w_j^* \tag{5}$$

The higher the value of V_i, the higher the ranking of the alternative.

Step 3. Calculate consistency index

To confirm the reliability of the result obtained, the consistency index, ξ was determined after each weight of the criterion was calculated. The consistency index was calculated by applying formula (6).

$$\xi = \frac{\lambda\, max - n}{n - 1} \tag{6}$$

RESULTS AND DISCUSSION

Weight Evaluation and Ranking of Criteria Using BWM

Table 4 shows the weightage and rank of each criterion. By formula (6), the consistency index, $\xi = 0.2819$. Since the value is close to zero, it is concluded that the

result of the weight and rank obtained is highly reliable. Respondents' most preferred criterion when selecting a HBP is reliability factor followed by accessibility, cost, customer service and the least preferred criterion is advertisement. Rationally, consumers would hope for a reliable product as it will be worth the purchase. Reliable broadband would not require a lot of maintenance and lasts a long time. In addition, a reliable broadband service will also not easily lose its connection in certain areas such as the rural areas. On the contrary, respondents do not think that advertisement is an important aspect because a well-known or famous brand in social media may not reflect the quality of HBP. Even though advertisement is usually an effective marketing strategy for many products, in selecting HBP it is a less crucial factor.

Table 4: Overall weightage and rank for each criterion

	Cost	Reliability	Advertisement	Customer Service	Accessibility
*w**	0.1510	0.3192	0.0871	0.1396	0.3032
Rank	3	1	5	4	2

Note: *w** denotes the aggregated weight of each criterion

The second preferred criteria in selecting HBP is accessibility, with an average weight of 0.3032. Some broadbands are not accessible nationwide and only available in urban areas. Thus, certain broadband providers are hardly access and had to resort to any available broadband in their area. Cost or pricing is the third rank in selecting BHP. Reasonable cost of product is subjective and relies on the willingness of respondents to spend. However, a quality product that matches the value of the price can lead to great satisfaction among consumers. Customer service is ranked the fourth most important criteria with an aggregated weight of 0.1396. This suggests that customer service is less preferred by the respondents. Nowadays, many broadband's customer services are available online using artificial intelligence system. The process to seek help for any inquiries is easy, fast and friendly. Hence, customer service is the least important criterion for selecting HBP.

Selection and Ranking of Home Broadband Plans

Table 5 shows the performance ratings of the eight HBP. To obtain the overall performance score, the optimal weight of each criterion is multiplied with the average performance ratings.

Table 5: Average performance ratings for each alternative

Criteria /Alternatives	Cost	Reliability	Advertisement	Cust. Service	Accessibility
HBP1	7	7	6	6	7
HBP2	6	6	5	6	7
HBP3	6	6	5	6	6
HBP4	6	6	6	6	7
HBP5	6	6	6	6	6
HBP6	7	6	5	6	5
HBP7	6	6	5	6	6
HBP8	7	6	5	6	6

Table 6 shows overall performance score for each alternative. The discussion of HBP preference is divided into three aspects based on each criterion, on BHP and the overall rank of HBP. In terms of cost, HBP6 which costs RM99 per month provides the best price as it has the highest score (0.9968). The product pricing is essential to represent the value of a product, thus the cost must be affordable and reasonable. The brand's reputation would be enhanced by a low-cost home broadband. Meanwhile, the least preferred alternative broadband plan is HBP5 which cost RM299 per month, with the lowest performance score (0.8851). For reliability factor, BHP1 is ranked the highest with a score of 2.1575. This signifies that this plan has a stable and reliable internet connection. Having a stable internet connection is essential nowadays as the internet has become a medium for communication, online studying and working from home. With a reliable plan, consumers will be able to enjoy using it as intended with least interruptions. BHP5 is last with the lowest performance score (1.9277). This unfavourable product may be due to its easily interrupted internet connection.

Table 6: Overall performance score for each alternative

Criteria HBP	Cost $(d_{i1}w_1^*)$	Reliability $(d_{i2}w_2^*)$	Advertisement $(d_{i3}w_3^*)$	Service $(d_{i4}w_4^*)$	Accessibility $(d_{i5}w_5^*)$	$V_i=(\sum_{j=1}^{n} \boldsymbol{d_{ij}w_j^*})$	Rank
HBP1	0.9787	2.1575	0.5119	0.7649	2.0737	6.4867	1
HBP2	0.9727	1.9788	0.4684	0.8067	1.9706	6.1972	2
HBP3	0.9092	2.0171	0.4632	0.7984	1.9403	6.1281	4
HBP4	0.9153	1.9915	0.4858	0.8235	1.9767	6.1928	3
HBP5	0.8851	1.9277	0.4789	0.8486	1.9403	6.0805	5
HBP6	0.9968	1.9788	0.4475	0.8067	1.6493	5.8791	7
HBP7	0.9606	1.9915	0.4214	0.8067	1.6917	5.8719	8
HBP8	0.9757	2.0107	0.4249	0.8011	1.7281	5.9405	6

CONCLUSION

The Best Worst Method is feasible and highly recommended for Multi Criteria Decision-Making research. Selection of HBP by students and their parents is important in this Covid-19 pandemic period since the amount of tasks such as online classes, meetings and assignments of students and workers are highly dependent on HBP. In this study, BWM is used to rank the eight alternatives of HBP based on the five chosen criteria. Reliability has the highest weight of importance in selecting HBP followed by accessibility, cost, customer service and advertisement. HBP1 is the most preferred product and was chosen because of its high reliability, accessibility and good attraction through advertisement. The students' preference criteria in selecting HBP is inconsistent with Shim (2020), Jena (2017) and Vanara (2018). The ranking result of alternative HBP could vary accordingly since the overall result is based on a preferential decision. The results of the research could benefit telecommunication companies to evaluate their strengths and weaknesses from the overall performance ratings by customers. Hence, they can improve their products and services. Consumers such as students, teachers and workers can use the results as a guideline in making wiser decisions in selecting HBP.

This study could be further enhanced and improved to create an effective weighing tool for ranking preferences. Comparison research with other MCDM methods such as using AHP and TOPSIS can be carried out to evaluate the ranking of criteria and the products of BHP. The number of respondents in this study is limited to a small sample due to the vast calculation of data using Microsoft Excel done manually. Hence, the number could be increased to avoid any prejudice on selecting the preferred criteria and alternatives by using other available built-in calculators or scientific tools.

In addition to identifying more and/or relevant criteria for ranking preferences, future study should investigate applying Best Worst Method in other areas of marketing. One such area is in the finding optimal product pricing. This method may be able to assist in better identifying product differentiating factors, hence customers' willingness to pay or actual product value from customers' perspective.

Further analyses can be conducted for different market segment either by customer segmentation or product segmentation. These segmentations together with customers' perceived product values shall provide the basis for establishing optimal product prices.

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APPENDIX A

SECTION 1: Preference of criteria in selecting home broadband plan

There are five (5) criteria that are considered in selecting the home broadband plan.

1. Cost - The price of the package that needs to be paid monthly.
2. Reliability - The availability of internet connection, uninterrupted internet connection and internet stability.
3. Advertisement - The promotion of product, brand or service.
4. Customer service - The assistance and advice provided by a company to those people who buy or use its products or services.
5. Accessibility - The quality of being easy to obtain or use and have a wide range of coverage.

A: Please tick '✓' in only one box)

1. Which of the following criteria is the "most important" for choosing home broadband?

☐	Cost
☐	Reliability
☐	Advertisement
☐	Customer service
☐	Accessibility

2. Meanwhile, which criteria do you think is the "least important" in choosing home broadband?

☐	Cost
☐	Reliability
☐	Advertisement
☐	Customer service
☐	Accessibility

B: Use the following discrete scales of pairwise comparison to answer the following questions:

Numeric Values	Explanation
1	Equally important
3	Moderately more important
5	Strongly more important
7	Very strongly more important
9	Extremely more important
2,4,6,8	Use even number for intermediate judgement

1. How much more important is the "most important criteria" compared to other criteria based on a discrete scale?

	1	2	3	4	5	6	7	8	9
Cost									
Reliability									
Advertisement									
Customer Service									
Accessibility									

2. How much more important are other criteria compared to the "least important criteria" based on a discrete scale?

	1	2	3	4	5	6	7	8	9
Cost									
Reliability									
Advertisement									
Customer Service									
Accessibility									

SECTION 3: Selection of home broadband plan

Home Broadband Plan (HBP) to be selected based on your preference and requirements.

BRAND	**PLAN**	**SPEED**	**COVERAGE**	**CUSTOMER SERVICE**	**COST / month**
HBP1	Try Me (Unlimited)	100 Mbps	High	Bad	RM129
HBP2	ONEHome (Unlimited)	100Mbps	High	Fair	RM129
HBP3	ONEHome (Unlimited)	300Mbps	High	Fair	RM149
HBP4	ONEHome (Unlimited)	500Mbps	High	Fair	RM219
HBP5	ONEHome (Unlimited)	800Mbps	High	Fair	RM299
HBP6	Fibre (Unlimited)	100Mbps	Low	Fair	RM99
HBP7	Fibre (Unlimited)	500Mbps	Low	Fair	RM139
HBP8	Fibre (Unlimited)	1Gbps	Low	Fair	RM199

Please tick '✓' only in one of the boxes based on your criteria preference for each HBP using this scale:

Numeric Values	Explanation
1	Not competitive at all
3	Moderately competitive
5	Strongly competitive
7	Very strongly competitive
9	Extremely competitive
2,4,6,8	Use even number for intermediate judgement

BHP1

	1	2	3	4	5	6	7	8	9
Cost									
Reliability									
Advertisement									
Customer Service									
Accessibility									

BHP2

	1	2	3	4	5	6	7	8	9
Cost									
Reliability									
Advertisement									
Customer Service									
Accessibility									

BHP3

	1	2	3	4	5	6	7	8	9
Cost									
Reliability									
Advertisement									
Customer Service									
Accessibility									

BHP4

	1	2	3	4	5	6	7	8	9
Cost									
Reliability									
Advertisement									
Customer Service									
Accessibility									

BHP5

	1	2	3	4	5	6	7	8	9
Cost									
Reliability									
Advertisement									
Customer Service									
Accessibility									

BHP6

	1	2	3	4	5	6	7	8	9
Cost									
Reliability									
Advertisement									
Customer Service									
Accessibility									

BHP7

	1	2	3	4	5	6	7	8	9
Cost									
Reliability									
Advertisement									
Customer Service									
Accessibility									

BHP8

	1	2	3	4	5	6	7	8	9
Cost									
Reliability									
Advertisement									
Customer Service									
Accessibility									