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Segmenting Consumers Purchase Intention towards Edible Bird's Nest Products using the Decision Tree Techniques

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***Abstract -* Domestic consumption of nutritional products and food supplements are on the rise. This is due to the fact that consumers have become more affluent and aware of their health. Edible bird's nest (EBN) is used as a health supplement for medicinal benefits to improve health quality. However, issues such as contamination and counterfeit EBN have caused fluctuation of the product's price over time and consumers are slowly shunning away from consuming EBN products. Marketing effort is a strategy tool often used to convince buying intention among consumers and therefore relieve the public's anxiety. Presently, the extent of marketing mix that can convince consumers' intention to purchase EBN products remains unknown. Thus, this study aimed to analyze the influence of marketing mix towards consumers' intention to purchase EBN products. Principle component analysis and decision tree models were used to analyze the data. The performance of three decision tree models was compared based on accuracy and sensitivity rate. Result showed that all three models possessed similar accuracy rate (CART = 84.35%, C5.0 = 84.73%, QUEST = 83.08%), while C5.0 had the highest sensitivity (CART = 84.7%, C5.0 = 87.46%, QUEST = 85.59%). The important variables derived from C5.0 model are health conscious, gender, promotion, race, price, employment, and income. The outcomes from the present study through the performance prediction have provided informative profile of the consumers which will be useful to target potential consumers and to narrow down the market segment for the marketers' benefit.**

Keywords - Edible bird's nest, Classification, Decision tree, Marketing mix, Purchase intention

1. Introduction

Malaysia's government allocated approximately RM 25 billion for public healthcare in 2017. Domestic consumption of nutritional products and food supplements are on the rise. In principle, the demands for health or food supplements are rising as consumers have become more affluent and aware of their health and appearance. Edible bird's nest (EBN) is used as a health supplement for medicinal benefits to improve human health. EBN is gaining popularity because it is among the most expensive animal products that can be used as a health supplement consume by humans. EBN is made from solidified saliva from a bird species called Swiftlet, or scientifically known as *Fuciphagus Aerodramus*. There are several wild Swiftlet that can be found in Malaysia, but only two species that can produce their nest with saliva. Malaysia exported EBN products to several countries such as China, Hong Kong, Vietnam, Thailand, and Indonesia. China is the main importer of EBN driven by their belief in high medicinal benefits in EBN. Some of the benefits reportedly include improve respiratory and digestive problems [13] improve skin complexion, slow anti-aging and simulate epidermal growth [23], prevent influenza viruses [7], depress the production of tumour necrosis factor alpha [3], increase bone strength and skin thickness when administered with 100 mg/kg of bird's nest extract [20], and improve immune system or joints [17]. The consumption of EBN is tremendous in Southeast Asian region but according to [1], more than 50% of the global market has not been met.

EBN possesses higher market value that attracts many investors and producers to venture into this business. House farm can be easily found in Malaysia either in urban or countryside. The Swiftlet farming industry has mushroomed and there are 60,000 ranchers estimated in Malaysia [18]. The current price of raw EBN is between RM 3 000 to RM 3 200 per kilogram and clean EBN between RM 4 000 to RM 6 000 per kilogram [5]. The price of this product fluctuates from time to time and the seemingly never-ending issues such as contamination and counterfeit EBN have resulted in consumer losing confidence to consume the EBN products. In fact, the Chinese refused to buy Malaysia's EBN after high nitrate level was found in the product, thereby costing consumer's trust in the most valuable nutritional product [10]. Besides, the adulteration in EBN with less expensive materials [8], [15] to increase the quantity and make more profits is one of the major global concerns. The rising anxiety among consumer coupled with counterfeit issues of EBN products in the market have caused severe price declination and

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affecting related industries. According to Yap [26], information on the quality of the nests was not reported accurately. To overcome this, Malaysian Ministry of Health enforces strict standard operation procedure to farmers and producers so that the presence of contamination in raw and commercial EBN remains below the permissible level. Proper handling from the scratch is vital in ensuring the quality of EBN. It is hopeful that with numerous efforts carried out thus far will be able to solve these issues. Nevertheless, contaminant and adulterant in food have long existed and they are always associated with the public's concern for health. Proper handling methods and guidelines provided by experts could solve these matters and gradually improve consumer's perception on the risks of consuming EBN products. Besides, clear and truthful label information on the product should be another initiative from producers that can be used to regain consumer's confidence.

An organization has put enormous efforts in countering the issues aligned with the requirement imposed by Malaysian Ministry of Health and through their marketing strategy to regain the confidence of the consumers. Strategy tools such as marketing mix has been used widely to help reduce the anxiety and convince consumer's buying intention [2], [12]. According to Kotler [14] consumers' perception of certain product generated from the marketing tactic are used by companies to achieve their business goals. The widely accepted product gaining positive response helps company to retain their customers and expand their business. Presently, the extent of marketing mix approach to convince consumers' intention to purchase EBN products is still unknown. Thus, this study aimed to analyze the influence of marketing mix towards intention in purchasing EBN products using decision tree methods.

2.   Research Methodology

The present study aimed to understand the purchase intention among local consumers and determine market segmentation for marketing purposes based on six factors: product, price, place, promotion, halal authorization and health conscious. Marketing mix from McCarthy [21] was adopted in this study. The Four Ps' in marketing mix namely product, price, place, and promotion, were used as a tool to gain insights on the buyer's influence for a specific product. Consumer's interest driven by new marketing ideas and initiatives help create the company's new offering. It is one of the biggest contributions in the field of marketing to influence demand among consumers to buy their products. In addition, concern in the halal authorization of the product was also included as a predictor to study the purchase intention considering

majority of Malaysian are composed by Muslim. Thus, religious belief is an essential factor in determining consumer's purchase intention towards bird's nest products among Malaysian. Health conscious was also included as a predictor because EBN is a functional food with various beneficial effects and can be used as a supplement to enhance body metabolism. Health conscious is addressed as the willingness of being healthy [24]. Perception and belief that EBN has nutritional benefits to health have led to dramatic rise in the amount of product choice in the market.

The study was conducted in Klang Valley which covered ten districts: Selayang, Gombak, Ampang, Kuala Lumpur, Serdang, Kajang, Puchong, Subang Jaya, Petaling Jaya and Shah Alam. A total of 800 structured questionnaires were distributed to targeted respondents using purposive sampling (age more than 18 years old). The questionnaire was developed based on literature and consisted of questions based on product features, price, accessibility, promotion, halal authorization, health conscious, purchase intention towards bird's nest products and socio-demographic.

The validity test was conducted using principle component analysis with Varimax rotation method, with factor loading margin more than 0.7 [9]. Then, the reliability test was carried out to verify the internal consistency with Cronbach' alpha value greater than 0.70 [19]. There were 786 usable responses out of 800 responses received from the survey conducted. Missing value was found below 20% in the 786 samples and imputation was conducted to treat and replace missing value on the data. According to Entezari-Maleki, Rezaei, and Minaei-Bidgoli [6], machine learning techniques such as decision tree requires large sample size (500 to 1000 samples) for more stable result. The accuracy rate also improved compared to sample size below 500. The data was partitioned into training (70%) and validation (30%) samples. Training sample was used to develop the decision tree model, whereas the validation sample was used to estimate the performance prediction for model selection.

Data were analyzed using descriptive analysis, principle component analysis, and decision tree. Descriptive analysis was used to describe the respondents' profile. Data reduction was required since the present study used Likert scale type of data. Principle component analysis was carried out to remove less significant attributes and projecting new relevant attributes to remove redundant information. It was also used to improve the predictive performance of decision tree techniques [11]. The decision tree with different splitting criteria based on three models, namely CART (Classification and Regression Tree), C5.0 and QUEST (Quick Unbiased

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Efficient Statistical Tree) were carried out. CART uses Gini coefficient where the split that increases the purity the most was chosen as the first split and the subsequent splits [4]. The Gini score of the first best split would be close to 1. While the C5.0 model finds an attribute based on maximum information gain [25], the best split is entropy score close to zero. The QUEST model generates a classification tree based on the significant test on each predictor [16]. The decision criteria for selecting variables were Chi-square for categorical inputs and variance for continuous inputs. The performance prediction for three decision tree models were evaluated and compared based on accuracy, sensitivity and error rate. This three classification methods can handle both categorical and continuous predictors. Meanwhile, target variable can either be dichotomous or polytomous. As the level of purchase intention was emphasized on this study, the target variable was coded as one if the consumers have the intention to purchase whereas zero if it was otherwise (have no purchase intention).

3.   Results and Discussion

Table 1 shows the gender of respondents comprised of larger number of women (58.5%) compared to men (41.5%). Most of the respondents were Malays (77.4%), Muslim (80%) and aged between 28 to 37 years old (33.3%). About 77.4% of the respondents were from urban, while the smaller percentage of the respondents were from the suburb (22.6%). Majority of the respondents were married (57.3%) and income range below RM 2,000 per month (36.8%). A large percentage was educated at tertiary level (73.3%) and worked for the private sector (42%).

Table 1. Socio-Demographic of Respondents

Characteristics	Frequency	Percentage
Gender		
Female	326	58.5
Male	460	41.5
Race		
Malay	608	77.4
Chinese	116	14.8
Indian	35	4.5
Others	27	3.4
Religion		
Islam	629	80.0
Buddha	54	6.9
Christian	68	8.7
Hindu	30	3.8
Others	5	0.6
Age (years)		
18-27 years old	252	32.1
28-37 years old	262	33.3
38-47 years old	116	21.1
48-57 years old	88	11.2
Above 58 years	18	2.3
Resident Area		
Urban	608	77.4
Suburb	178	22.6
Marital Status		
Single	310	39.4
Married	450	57.3
Divorcee	26	3.3
Income per month (RM)		
2,000 and below	289	36.8
2,001 – 4,000	249	31.7
4,001 – 6,000	128	16.3
6,001 and above	67	8.5
Education Level		
No formal education	6	0.8
Primary education	3	0.4
Secondary education	201	25.6
Tertiary education	576	73.3
Employment		
Government	324	41.2
Private	330	42.0
Retired	14	1.8
Student	98	12.5
Unemployed	20	2.5

Principal component analysis with Varimax rotation was undertaken for the 34 items, resulting in six-

factor solution. As shown in Table 2, accessibility, health conscious and product features toward EBN products consisted of six sub-variables. Meanwhile, promotion, halal authorization, and price conscious toward EBN products consisted of seven, five and four sub-variables, respectively.

The Cronbach's alpha or reliability coefficient measures the internal consistency of a set of items. As a rule of thumb, reliability of 0.60 or higher is acceptable for internal consistency [22]. The reliability coefficient estimated for promotion is 0.941, accessibility is 0.930, health conscious is 0.922, halal authorization is 0.925, product features is 0.875 and price is 0.847. The reliability coefficients are within the range of 0.847 and 0.941, indicating that the study has a high degree of internal consistency. The total variance explained for extracted factors is fairly high (73.34%). Meanwhile, the Kaiser Mayer Olkin measure is 0.959 and Bartlett's test is significant at $p < 0.05$, indicating that the variables have patterned relationship.

Table 2. Factor Analysis and Reliability

Factors	Items	Reliability Coefficient
Promotion	7	0.941
Accessibility	6	0.930
Health Conscious	6	0.922
Halal Authorization	5	0.925
Product Features	6	0.875
Price	4	0.847
Total Variance (%)		73.34
Kaiser-Meyer-Olkin Measure		0.959
Bartlett's Test of Sphericity	Approx. Chi-Square	23049.192
	Df	561
	Sig.	0.000

Combining several items into a single composite measure is called summated scales [9]. This approach is either to sum or to the take average of the items from factor analysis for ease of use in subsequent analysis. Hence, product features, accessibility, and health conscious were each calculated as mean of six items rated by 5-point Likert scales from 1 = strongly disagree to 5 = strongly agree. Promotion was calculated as the mean of seven items rated by 5-point Likert scales from 1 = strongly disagree to 5 = strongly agree. Halal authorization was calculated as the mean of five items rated by 5-point Likert scales from 1 =

strongly disagree to 5 = strongly agree. Price was calculated as the mean of four items rated by 5-point Likert scales from 1 = strongly disagree to 5 = strongly agree. These six factors resulted from the principle component analysis with socio-demographic were used in decision tree models to determine the level of purchase intention.

Table 3 shows the comparisons of decision tree models. C5.0 has the highest accuracy (84.73%) and sensitivity (87.46%) compared to CART and QUEST. Furthermore, C5.0 has the lowest error rate (15.27%). Consequently, C5.0 is selected as the best model to predict purchase intention of consumers toward bird's nest products.

Table 3. Comparison of Decision Tree Models

DECISION TREE MODELS	CART	C5.0	QUEST
ACCURACY	84.35%	84.73%	83.08%
SENSITIVITY	84.70%	87.46%	85.59%
SPECIFICITY	97.91%	94.21%	94.53%
ERROR RATE	15.65%	15.27%	16.92%

The C5.0 model identified seven variables that influence purchase intention of bird's nest products. The decision rules are listed in Table 4 and Figure 1 shows the C5.0 model. The most important variable is health conscious, followed by gender, promotion, race, price, employment, and income. Table 4 shows seven groups of respondents that have the intention to purchase EBN products. The first group consisted of females who highly regarded themselves as being health conscious. However, the male respondents with low health conscious have no purchase intention. The second group consisted of males with high health conscious with promotional offers being the important variable that influenced their purchase intention. Contrary, females with low health conscious and less influenced by promotional offers have no purchase intention. The third group consisted of females and Malay with promotional offers influencing their purchase intention. Chinese, Indian and other races composed the third group with no purchase intention. The fourth group has a similar profile with the third group, but the price of EBN influenced their purchase intention. Meanwhile, male respondents that are retired and unemployed composed the fifth group with purchase intention because they are highly conscious about their health. Contrary, respondents working for government sector are on the opposite side. The fifth and sixth groups have similar profiles with purchase intention, but the respondents were working for the private sector and earned more than RM 4,001 per month. The male respondents who earned an income less than RM 4,000 per month feel otherwise. Finally, the

seventh group is represented by male students with high health consciousness with the intention to purchase.

Table 4. The Decision Rules

	Have purchase intention	Have no purchase intention
Group 1	▪ Health conscious is high ▪ Female respondents	▪ Health conscious is low ▪ Male respondents
Group 2	▪ Health conscious is high ▪ Male respondents ▪ More promotion offers	▪ Health conscious is low ▪ Female respondents ▪ Fewer promotion offers
Group 3	▪ Health conscious is low ▪ Female respondents ▪ More promotion offers ▪ Malay respondents	▪ Health conscious is low ▪ Female respondents ▪ More promotion offers ▪ Chinese, Indian and others
Group 4	▪ Health conscious is low ▪ Female respondents ▪ More promotion offers ▪ Price is reasonable	▪ Health conscious is low ▪ Female respondents ▪ More promotion offers ▪ Price is not reasonable
Group 5	▪ Health conscious is high ▪ Male respondents ▪ Fewer promotion offers ▪ Retired and unemployed	▪ Health conscious is high ▪ Male respondents ▪ Fewer promotion offers ▪ Government sector
Group 6	▪ Health conscious is high ▪ Male respondents ▪ Fewer promotion offers ▪ Private sector ▪ Income range more than RM 4,001	▪ Health conscious is high ▪ Male respondents ▪ Fewer promotion offers ▪ Private sector ▪ Income range below RM 4,000
Group 7	▪ Health conscious is high ▪ Male respondents ▪ Fewer promotion offers ▪ Student	

4. Conclusion

The present study narrows down the market segments using the marketing mix, which will benefit the marketers.

Important characteristics of the consumers were identified through the performance prediction that is useful for targeting potential consumers in purchasing EBN products. Besides, new market offerings could be used as a strategy to influence non-consumers by using the information of those with no purchase intention. The results revealed that C5.0 is the best model for predicting consumer's purchase intention with higher accuracy and sensitivity performance compared to CART and QUEST. Health conscious is essentially the most important variable since EBN products have nutritional benefits and can be used as a health supplement. The findings also indicated that the consumers are very concerned with promotional offers and price of EBN products. EBN products are the most expensive animal products renown by its medicinal benefits but it requires tedious procedure of prolong cleaning process by removing feather and other foreign matters. Furthermore, this study suggests that consumers' purchase intention may differ by their economic situation and individual's personal characteristics. Outcomes from this study have provided clear path for marketers to consider various decision that is cost-effective for different groups to motivate buying behavior.
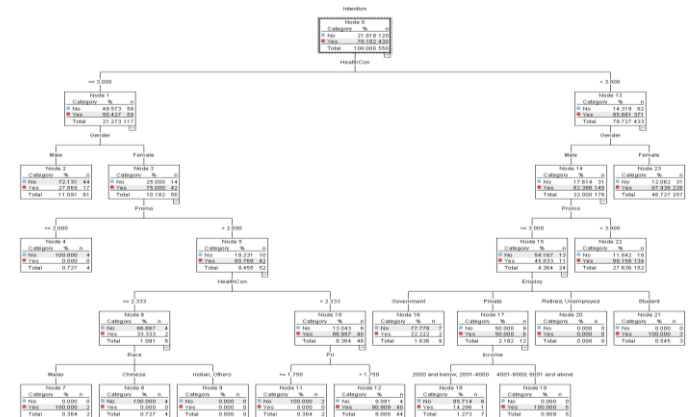

Figure 1. The C5.0 model

Acknowledgement

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