

Modeling purchase intention towards edible bird's nest products among Malaysians

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Abstract

Interests in the nutraceutical or food supplement are growing around Asia in response to health and beauty concerns. Nutraceutical supplements seem to dominate the Malaysian market as the awareness of health conscious arise. The consumptions of these nutraceutical products are to cover insufficient nutrient in their diet intakes. Edible bird nest (EBN) is made from saliva produced by the male's swiftlet and been consumed as a health supplement due to their high nutritional value. Despite an ever-growing number of EBN products and options available in the market, there are still fewer purchasers among Malaysian consumers as compared to other countries. This study aims to determine factors that influence consumers' intention in purchasing EBN products. The number of complete response from the survey were 1310 samples. The questionnaire includes nine variables that are determined from the theory of planned behavior and marketing mix. Exploratory factor analysis with promax rotation is conducted to remove items with factor loading less than 0.5 and confirmatory factor analysis is constructed to measure the fitness of the model so that it can be used in predictive models. The three popular classification algorithms from predictive models which are decision tree, logistic regression, and artificial neural network will be used to analyze the dataset and determined the best model building. These comparisons are highly evaluated based on the prediction performance and it does not conclude that one method will be superior to other predictive methods. Results showed logistic regression outperforms other classifiers to develop the purchase intention model. There are five variables identified which consist of age, gender, price, accessibility and halal authorize. This study provides an input of consumers' concern and interest that can be used as a strategic tool and give special attention to those elements to promote the EBN products.

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Keywords

Edible bird's nest
Decision tree
Logistic regression
Modeling
Neural network
Purchase intention

Introduction

Interests in the nutraceutical or food supplement are growing around Asia in response to health and beauty concerns. Nutraceutical supplements seem to dominate the Malaysian market as the awareness of health conscious arise. Sien (2014) reported, 40.2% of adolescents consumed food supplements and been instructed by their parents. Food supplements can be easily obtained in the market and available in many forms such as liquids, powder, tablets, capsules, soft gels, chewable, and gels. The consumptions of these nutraceutical products are to cover insufficient nutrient in their diet intakes. Recently, interest in the bird nest products are growing around Asia in response to "edible bird's nest is a food with various beneficial effects." Edible bird nest (EBN) is made from saliva produced by the male's swiftlet and

been consumed as a health supplement due to their high nutritional value. Reported by Marcone (2005), the compositional properties of EBN mostly were protein (62.0%), carbohydrates (27.3%), moisture (7.5%), ash (2.1%) and lipid (0.1%). EBN collected from Malaysia has revealed the similar proportion of nutritional contents to other countries such as Thailand and Indonesia (Norhayati *et al.*, 2010; Hamzah *et al.*, 2013; Saengkrajang *et al.*, 2013; Zainab *et al.*, 2013). This verifies that the EBN from Malaysia revealed to have a good quality to stay competitive in the marketplace. Furthermore, a great number of studies clarified the beneficial properties of EBN in improving health and contains remedy to suppress the dangerous virus (Yagi *et al.*, 2008; Cao *et al.*, 2012; Haghani *et al.*, 2016). In fact, EBN can be used as a health supplement to speed recovery and promote faster healing after surgery. The properties

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in EBN has the therapeutic or healing effects for treatment benefits and to fight cancer reoccurrence (Chau *et al.*, 2003; Rashed and Nazaimoon, 2010; Roh *et al.*, 2011).

While much of the literature has focused on the nutritional contents and medicinal benefits, the consumer's perception of consuming EBN products has not been extensively studied. Despite an ever-growing number of EBN products and options available in the market, there are still fewer purchasers among Malaysian consumers as compared to other countries. Hence, this study aims to determine factors that influence consumers' intention in purchasing EBN products.

Materials and methods

The numbers of complete response from the survey were 1310 samples. Due to missing value exceed 20%, 3 samples were removed from the data set. The questions are mostly 5 multi-items Likert scales from 1 (strongly disagree) to 5 (strongly agree). The respondents required to rate their perceptions on EBN products in relation to the intention to purchase. The questionnaire includes nine variables that are determined from the theory of planned behavior (attitude, subjective norm, and perceived behavior control) and marketing mix (product features, price, promotion, place, halal authorize and health conscious). The target or dependence variable is dichotomous with "1 = have intention" and "0 = have no intention" to purchase EBN products.

In this study, exploratory factor analysis with promax rotation is conducted to remove items with factor loading less than 0.5 and to determine numbers of factors to retain. Besides, this is to ensure any redundant items can be eliminated. The reliability test on each factor is checked to ensure high collinearity among the items under the same factors. Since orthogonal rotation method has employed, the problem of multi-collinearity is eliminated. Then, confirmatory factor analysis is constructed to measure the fitness of the model so that it can be used in predictive models.

The three popular classification algorithms from predictive models which are decision tree, logistic regression, and artificial neural network will be used to analyze the dataset and determined the best model building. The models build using IBM SPSS Modeler and the imputation has been made to replace any missing value.

Each model has different techniques in finding the important predictors or variables to influence the purchase intention. For decision tree, three

methods such as CART, QUEST, and C5.0 are used. CART stands for Classification and Regression Tree (Breiman *et al.*, 1984). Briefly, CART split up the dataset into the binary subset and each subset is more homogenous than previous one. The process is repeated until stopping criterion and the homogeneity criterion are satisfied by using gini coefficient (Trnka, 2010). While QUEST stands for quick, unbiased and efficient statistical tree. The method select variables with equal probability by using chi-square statistic ($P\text{-value} < 0.05$) (Trnka, 2010). Lastly is C5.0, it is easy to use as compared to QUEST. C5.0 does not require fulfilling and achieving any assumptions to presume as in statistics technique. C5.0 classifier developing a pattern by split up the dataset into multi subset using entropy coefficient (Trnka, 2010).

Logistic regression is analyzing a dataset with a dichotomous outcome ("1 = have the intention to purchase" and "0 = have no intention to purchase"). The independent variables can be either categorical or continuous (Hamid *et al.*, 2016). The most common methods for logistic regression to test the statistical significance of the coefficient are enter selection, forward selection and backward selection (Hosmer *et al.*, 2013). Enter-logistic regression is to start with the full model which the significance variables or covariates are determined. Forward-logistic regression is to start with an empty model and add significant variable one by one and stop until there is no other significance variable. Backward-logistic regression is otherwise, to starts with the full model and insignificance variables are removed one by one (Dreiseitl and Ohno-Machado, 2002).

The artificial neural network is an interconnected group of neuron inputs and neuron output to form a pattern that is arranged in relations with each other, similar to our brain network. This method uses automatic relevance determination or sensitivity analysis to identify the important variables for classification purpose. The artificial neural network can be grouped into two categories, multi-layer perceptron and radial basis function. Both of these methods are arranged to build unsupervised pattern classification with unidirectional connections between neuron inputs and output (Jain *et al.*, 1996). Multi-layer perceptron is trained by a back-propagation algorithm (Baldi and Homik, 1989), while radial basis function is trained similarly to K-means techniques.

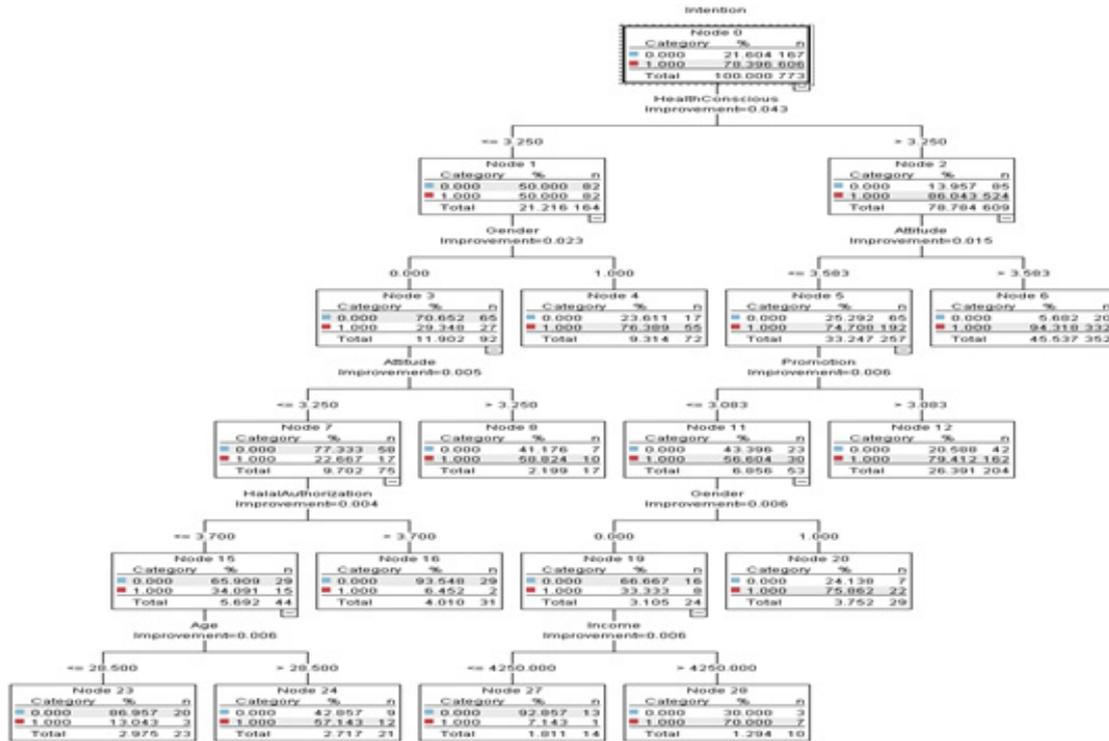


Figure 1: CART Model

Table 1: Maximum Likelihood for Theory of Planned Behavior and Marketing Mix

Factors	Items	Reliability Coefficient
Theory of Planned Behavior		
Subjective Norm	6	0.953
Attitude	6	0.926
Perceived Behavioral Control	4	0.837
Kaiser-Meyer-Olkin	0.937	
Barlett's Test of Sphericity:		
Approc. Chi-Square	17685.878	
D.F.	120	
Significance	0	
Factors	Items	Reliability Coefficient
Marketing Mix		
Promotion	6	0.946
Halal Authorization	5	0.939
Health Conscious	6	0.926
Product Features	6	0.884
Accessibility	6	0.931
Price	4	0.866
Kaiser-Meyer-Olkin		0.961
Barlett's Test of Sphericity:		
Approc. Chi-Square		38107.653
D.F.		528
Significance		0

Results

The descriptive analysis of this study shows most of the respondents are female (59.8%) and age between 28 and 37 years old (36.9%). Around 702 respondents have income levels below RM3000 (53.7%). Majority of respondents are Malay (73.9%), Muslim (75.5%) and live in an urban resident area (72.6%). A total of 478 respondents have degree (36.4%) and followed by secondary (22.7%), diploma (20.9%), master (16.5%), doctorate (2.4%), never attend school (0.6%) and primary school (0.5%). Most of the respondents working for the private sector (50.9%) and they are married (55.6%).

Exploratory factor analysis using maximum likelihood with promax rotation is used and found 3 factors. Table 1 shows reliability coefficient for each factor. Subjective norm with 6 items has reliability coefficient 0.953, attitude with 6 items has 0.926, and perceived behavioral control with 4 items has 0.837. The Kaiser-Meyer-Olkin is 0.937, while Barlett test and chi-square show the factors are significant.

The exploratory factor analysis for marketing mix identified 6 factors. Table 1 shows the reliability coefficient for promotion with 6 items is 0.946, halal authorize with 5 items is 0.939, health conscious with 6 items is 0.926, product features with 6 items is 0.884, accessibility with 6 items has 0.931 and price with 4 items is 0.866. Total variance shows the factors is 69.0% explained all factors. The Kaiser-Meyer-Olkin is 0.961, while Barlett test and chi-square show the factors are significant.

Confirmatory factor analysis is carried out and the result of Kurtosis for all items are below 3 and skewness is between -1 and 1 which shows normally distributed. Besides, Mahalanobis distance also shows there is no outlier present in the data. The collinearity coefficient for all factors are more than 0.4, shows a strong correlation. However, the collinearity coefficient is not exceed 0.8 then we can assure there is no multi-collinearity between factors.

Table 2: Model Measurement Fit

Fit statistic	Recommended	Obtained
Chi-Squared	-	4445.617
Df	-	1074
Chi-Squared significance	$p < 0.05$	0.000
Chi-Squared significance/df	< 5.0	4.139
GFI	> 0.9	0.864
AGFI	> 0.9	0.844
NFI	> 0.9	0.926
CFI	> 0.9	0.942
IFI	> 0.9	0.943
TLI	> 0.9	0.937
RMSEA	< 0.05	0.049

Table 2 shows the model measurement fit for overall latent factors. The chi-square result reveals that the model is statistically significant (p -value < 0.05). It has been debated among researchers that large sample size (500 or more) would always have a significant result. Hence, other alternatives to measure model fit have been identified. The table shows that GFI and AGFI value are slightly less than 0.9 that indicate an acceptable fit. However, the result of model fit are considered to be good fit as the value for RMSEA less than 0.05 and other fit indices greater than 0.9 (RMSEA = 0.049, NFI = 0.926, CFI = 0.942, IFI = 0.943, and TLI = 0.937). Based on this measurement fit, the dataset has an acceptable model fit with 9 latent factors.

Table 3 shows the comparison of predictive models which consist of three main models, decision tree, logistic regression, and artificial neural network. The decision tree models reveal that the best model is CART because it has the highest accuracy (82.8%) and the lowest error rate (17.2%) as compared to C5.0 and QUEST. Figure 1 shows the decision tree for CART model. The criteria of the respondents based on CART model shows there are seven groups from 10 decision rules. The first group are male respondents that have less health conscious, negative attitude, no halal verification on the product, and age less than 28 years old have no intention to purchase EBN products. The second groups have similar criteria as the first group, but a positive attitude towards EBN products does convince them to purchase. The Third and fourth group are female respondents, and despite their level of health conscious will not change their intention to purchase EBN products. The Fifth group are male respondents with high health conscious, negative attitude, less influenced by promotional offers, and income level less than RM4250 have no purchase intention. While income level more than RM4250 is otherwise. Meanwhile, sixth and seventh group are respondents that highly care about their health lead them to have purchase intention of EBN products.

The comparison of logistic regression from table 3 reveals the best model is an enter-logistic regression with highest accuracy (83.0%) and lowest error rate (16.9%). From table 4, there are five significant variables which consist of age, gender, price, accessibility, and halal authorize. It seems that female and older consumers are more likely to have purchase intention. Moreover, reasonable price and accessibility are positively influencing consumers' intention to purchase. While halal authorize negatively influencing the purchase intention. The chi-square statistic is 195.767 with the p -value less than 0.05, indicates that the model is significant. The Nagelkerke R square is 0.368, indicates 36.8% of the variation in the purchase intention explained by the variables.

Table 3: Comparisons of Predictive Models

Predictive Models		Accuracy	Sensitivity	Specificity	Error Rate
Decision Tree	CART	82.8%	83.1%	97.8%	17.2%
	C5.0	80.3%	85.2%	90.3%	19.7%
	QUEST	79.3%	80.9%	96.2%	20.7%
Logistic Regression	ENTER	83.0%	84.6%	95.7%	16.9%
	FORWARD	82.6%	84.8%	94.7%	17.4%
	BACKWARD	82.7%	84.6%	95.2%	17.3%
Neural Network	MLP	81.6%	85.1%	92.6%	18.4%
	RBF	81.5%	82.9%	96.1%	18.5%

Table 4: Enter-Logistic Regression Results

Variables	B	Sig.	Exp(B)	Variables	B	Sig.	Exp(B)
Constant	2.336	.695	10.344	Gender	1.37	.000	3.937
Age	.033	.028	1.033	Promotion	-.128	.934	.880
Race=1	-.802	.480	.448	Attitude	-.003	.987	.997
Race=2	-.540	.644	.583	Features	.351	.792	1.42
Race=3	-.465	.709	.628	Price	.857	.000	2.356
Education=1	-1.026	.505	.358	Accessibility	.627	.001	1.873
Education=2	-1.778	.246	.169	Health conscious	-.041	.891	.960
Education=3	-.973	.243	.378	Halal authorize	-.664	.001	.515
Education=4	-1.252	.128	.286	Norm	.087	.596	1.091
Education=5	-.803	.318	.448	Perceive behavioral control	.319	.145	1.376
Education=6	-.625	.448	.535				
	Chi-square				195.767***		
	Nagelkerke-R-Square				0.368		

The comparison of artificial neural network from table 3 reveals the best model is multi-layer perceptron with highest accuracy (81.6%) and sensitivity rate (85.1%). The error rate for multi-layer perceptron is slightly lower than radial basis function. Hence, it is selected as the best model for the artificial neural network. The relative importance of input variables found from multi-layer perceptron are health conscious and followed by attitude, gender, norm, income, features, promotion, education, halal authorize, and perceived behavioral control.

As expressed in table 3, enter-logistic regression has the highest accuracy and sensitivity rate as compared to other predictive models. For this reason, logistic regression is selected as the best predictive model to determine factors that influence consumers' intention.

Discussion

Several method procedures are executed to analyze the dataset so that the aim of this study can be determined. Firstly, exploratory factor analysis and confirmatory factor analysis are conducted to be used for a cleaner result in predictive models. The influential factors are discovered after comparing several predictive models that have highest performance prediction. Accordingly, the logistic regression is selected as the best classifier for predicting consumers purchase intention. The result shows that female are more likely to have the intention to purchase EBN products than males and this is supported in many studies on supplements intake (De Jong *et al.*, 2003). Age also indicated a

statistically significant between Malaysian adults and purchase intention of EBN products. The prevalence of the supplement intakes among adults in developing countries have vast consumptions (Barnes *et al.*, 2008)

As pointed out by Sharifuddin *et al.* (2014), there were three significant factors affecting purchase intention towards EBN products. The first factor was the attitude that indicated individuals' belief and knowledge could lead to the purchase intention. The second factor was the subjective norm that shows the intention to purchase could be influenced by normative belief and social pressure. Finally, the third factor was perceived behavioral control which stipulated an individuals' self-efficacy in obtaining the product. However, the factors are seemed not significantly to influenced consumers' intention in this study.

Furthermore, the widely accepted product gain positive response in which help company to retain their customers and expand their business. But, caught in a scandal or controversial can harm the reputation that was built to gain consumer's trusts. EBN products have been in severe controversy and people in this industry aware of the drawbacks. Hence, marketing mix is a tool used by companies to convince buying intention in consumers' mind. Perception of a certain product also generates from the marketing tactic of one company used to achieve their business goals and parallel to this, two factors from marketing mix are significant variables.

Majorities of the population in Malaysia are Muslim and hence food products must acquire halal qualification (Golnaz *et al.*, 2010). In this study, halal authorize refers to the certification received from

the official body such as JAKIM, as an evidence that the preparation process, cleaning, and handling of the products follow the holy Quran (Guntalee and Unahannda, 2005). Malaysian consumers are familiar with halal logo approved by Jakim than halal logo from different countries. However, EBN products are imported from other countries, such as China, Thailand, and Indonesia. This proved that the unrecognized halal logo that acquired and authorize by other private company does not deter the level of consumers' purchase intention.

Conclusion

This article has discussed performance prediction for predicting the dichotomous outcome of the consumers' purchase intention towards EBN products. The classifier is chose based on the accuracy and error rate calculated for best outcome prediction. The technique of choice was depended on the dataset nature and the limitation of the classifier. Logistic regression outperforms other classifiers to develop the purchase intention model. These comparisons are highly evaluated based on the predictive performance and it does not conclude that one method will be superior to other predictive methods. Further research will be acquired to determine the possible mixed or hybrid technique incorporates either with the decision tree model or the neural network model for best outcome's performance prediction. The finding of this study significantly contributes in revealing consumers' profile in a specific category and determine factors that influence their purchase intention towards EBN products, consequently achieved the research aim. The corresponding result of logistic regression revealed predictors that are statistically significant causing the consumers' intention to purchase. This provides a valuable guide for marketers and producers to influence demand for EBN products. Besides that, the finding of this study also provides an input of consumers' concern and interest that can be used as a strategic tool and give special attention to that element to promote the EBN products.

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