UNDERSTANDING CONSUMER LOYALTY USING NEURAL NETWORK

Deliana Y., Rum I.A. [*]

Abstract: Instant coffee products are very popular for consumers, at both urban and rural levels. Consumer loyalties respond to various attributes of instant coffee products, grouped by internal and external factors. The study using Artificial Neural Network (ANN) model. The proposed method provides a direct mapping from configuration loyalty attributes to consumer behavior. The algorithm used in training set is Scaled Conjugate Gradient (SCG) with random data division and the performance is calculated using MSE. The result revealed that internal factors were effective predictors of a lower preference in consumer loyalties whereas external factors were more effective in predicting a higher preference in consumer loyalties. This research represents a first attempt to use neural networking to model the relationship between consumer-producer attributes and consumer loyalties.

Key words: Consumer loyalty, internal factor, external factor, artificial neural network, and instant coffee

Introduction

Today more people drink coffee as their daily activity. In Indonesia, this phenomenon is also happening. Most people have a cup of coffee while working. Most Indonesian people prefer powdery instant coffee in their consumption (70% respondents from 4.991 data survey done by Jajak Pendapat App, 2016). Coffee in Indonesia has been a part of daily lifestyle for Indonesian modern society.

The value of the coffee market in Indonesia is growing rapidly. So that the competition in the market increases and the product offered becomes more widespread. This, in turn, means that the consumer is spoilt for choice when choosing one product from among the many available products on the market .The product categories are offered instant coffee of various brands and varieties, so the opportunity to trade-off is now given to the consumers (Kotler and Keller, 2009). Factors such as product quality, brand, convenience and preparation methods, and prices are complex factors that determine consumer decisions in the end (Chen, 2008).

The function of instant bottle or powdered coffee will be fulfilled if it is in accordance with consumer expectations and the level of demand, the selected product will offer products that match the sensory nature, facilitates the

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[*] **Yosini Deliana, PhD.** Senior Lecturer of Department of Agribusiness, Universitas Padjadjaran; **Irlan Adiyatma Rum,** Lecturer of Department of Economics, Universitas Padjadjaran

✉ Corresponding author: y.deliana@gmail.com

preparation, etc., thus making the leading producers and distributors of coffee continue to monitor consumers evaluate these subjective (Mokrysz, 2016).Thus understanding consumer behaviour and loyalty on instant coffee play an important role since manufactures and distributors recognize their choice as a determinant for production and marketing decisions (Zhang, 2015; O'Neil and Xiao, 2006).

Consumer's loyalty is a behavioural pattern as a combination of attitude and behaviour in buying a product. In industry and service marketing, consumer's loyalty is defined as consumer behaviour in buying a product or service repeatedly, not replacing it with other products (Reinartz and Kumar, 2000. Several factors influence the behaviour and loyalty of coffee consumers in Indonesia. Among the consumer expectations are faced with the product characteristics offered and the level of product adaptation (Khaniwale, 2015; Ramya and Ali, 2016; Yazdanifard and Lim, 2015).

The way to influence consumer perceptions and attitudes toward brands by building brand image in the minds of consumers, and stimulating actual consumer brand buying behaviour, increased sales, maximizing market share and developing brand equity are the most important things in corporate product marketing (Zhang, 2015; O'Neil and Xiao, 2006). The product is decided to be purchased into subjectivity, brand awareness, brand loyalty, brand association, and perceived quality to influence consumer decisions. These four factors are called brand equity (Rani, 2014; Chen, 2008). In addition to these four factors, there are also other proprietary brand assets, where the results are determined by the four main factors of brand equity. (Kemal et al., 2015).

Nam et al. (2011) wrote consumer-based brand equity is determined by key determinants, among many physical qualities, staff behaviour, ideal self-congruence, brand identification and lifestyle-congruence. Internal factors include cultural social factors, personal and psychology habits, satisfaction, choice, and people who influence in decision making. While the size, package, design, information and differentiation of products including external factors (Khaniwale, 2015; Ramya and Ali, 2016). In Yazdanifard and Lim (2015) opinion, define internal factors related to psychological approach and external factors related to situational, product and website designs.

Consumer's loyalty begins with consumers being satisfied with the product or service they buy. Strong brands can be a high indicator of consumer preferences and loyalty (Reinartz and Kumar, 2000; Kotler and Keller, 2009; Sahin et al., 2011). Consumer loyalty can be seen from research that asks consumer choice on some brands. Of the many consumers will be concentrated on one brand, and consumers buy it repeatedly (Lindstrom, 2011).

Consumer's loyalty is important to the company for the sustainability of the company's profit. In marketing the company's coffee products adjust to the culture, lifestyle, habits, tastes, and purchasing power of the community. As in Italy, people are referencing espresso and cappuccino (Schleenbecker and Hamm, 2015). In order for the company's profits to be sustainable and increasing, in addition to

POLISH JOURNAL OF MANAGEMENT STUDIES
Baron I.S., Agustina H.

2017
Vol.16 No.2

paying attention to the culture and habits of people in drinking coffee, it is also necessary to consider factors that influence consumer loyalty. These factors are satisfaction of product or service, product quality, expectation, image, brand personality, trust worthies, the importance of relationship, termination cost, importance of product, intimacy of relationship, supplier and salesman (Kuusik, 2007; Chinomona, 2013).

Research Methodology

This study builds an ANN model based on specific training parameters with the aim to know the loyalty of consumer purchases. There are many study that use ANN to model consumer behavior (Zheng et al., 2013; Stencl et al., 2011). As in many references, the first step, especially in the ANN model, is to develop a behavioural model by dividing consumer loyalty into 2 groups as the target or output of this model. The ANN model will be trained on the use of this output. The model uses multi-layer perception type, with 3 numbers of layer, 11 inputs, 11 hidden layers, and 2 output neurons. In this study the output of neurons is used in the behavioural level to determine the classification. The situation when consumers have repeatedly consumed certain brands of instant coffee is a loyalty that tends to be high. Consumers often emphasize that they will not want to switch to another brand because they often consume the brand despite the same categorization. In the future the consumer situation may change with the choice of brands, the consumer loyalty in this preference is lower.

The weights w_i that fit the different connection strengths between the neurons multiplied by each input of x_i. The activation function f processes the weighted input summed in v_o bias, usually for most of the known objectives the exact sigmoid function.

$$z_i = \sum_i v_i X_i + v_o \qquad (1)$$

$$Z_i = f(z_i) = \frac{1}{1+e^{-z_i}} \qquad (2)$$

The output y is $y_i = f(Z_i) = \sum_i w_i Z_i + w_0$ and is transferred to other neurons. The larger bias likes positive decisions, and the weighted amount is corrected by bias, where the importance of assessing the weight of each input. In accordance with the negative and positive decisions, the activation function $f(x)$ ranges from 0 ($x \rightarrow -\infty$) to 1 ($x \rightarrow \infty$). Note that the number of inputs or outputs does not have any restriction so that any desired function $f(x_1, x_2, \dots) = y_1, y_{2,\dots}$ can be approximated by the ANN
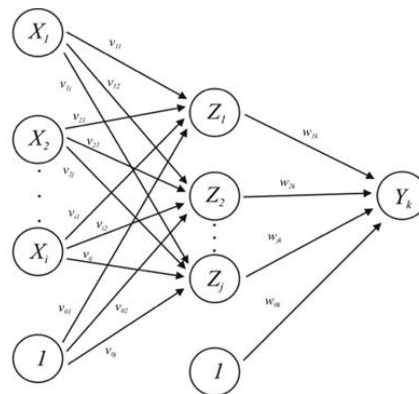
Figure 1. Architecture of ANN model (Silva et al., 2017)

Minimization of quadratic errors can be reduced by the use of linear regression analysis, i.e.:

$$\epsilon = \sum_{i}^{N_t}(f_i - y_i)^2 \tag{3}$$

where

N_t is the size of training set, f_i is the predicted behavior by the ANN, and y_i is the corresponding behavior in the training set.

The random sampling technique was chosen in this study using primary data collection, respondents taken as many as 237 people in Bandung in 2016. Collection of instrument variables from the survey included demographic data, brand awareness, brand loyalty, brand switching, brand quality, product differentiation and consumer decisions. Explanatory variables and 1 group variable as target are the variables used in this study by defining consumer loyalty. Three separate analyzes were performed by us as described in Table 1. First, the full explanatory variables (internal and external factors) and the dependent variable level of our consumer loyalty are modeled by linking them. Second, between the internal influence variables only and the size of loyalty is done by connecting the sub-analysis. Finally, our second sub-analysis is done by connecting between external influencing variables and loyalty measures.   Coffee consumed by adults who are 13 years old and above becomes the respondent group. We target samples by choosing among people who reported consuming occasional coffee only occasionally. Questionnaires are used in direct interviews and all responses are incorporated into worksheet documents. The accuracy of the output prediction is ensured by selecting the appropriate indicator for the input variable as the first step in developing a neural network model (Deliana and Irlan, 2017). Monitored neural network learning is important because of the potential independent variables selected, the learning time will decrease if the explanatory and output variables are more relevant.

POLISH JOURNAL OF MANAGEMENT STUDIES
Baron I.S., Agustina H.

2017
Vol.16 No.2

Table 1. Input and Output Variables used in each Analysis

Analysis	Explanatory Variable	Dependent Variable
A1-Analysis 1	All variables	
A2-Analysis 2 (Internal factors)	Market power (A2) Habits (A2) Satisfaction (A2 Choice (A2) Influence (A2)	Level of loyalty 1=higher preference 0=lower preference
A3-Analysis 3 (External factors)	Size (A3) Package (A3) Design (A3) Information (2 nodes; A3) Differentiation (A3)	
Note: explanatory variables use scale 1-5. 1=strongly disagree, 5=strongly agree		

Results and Discussion

If we compare brand awareness and their age, we can find that these 3 top brands have different market segmentation. Using crosstab analysis using cell percentage as in Table 2, between age and their consumption we can find that for youth age 13-24 year old, they consume more on Good Day brand (41.66%), while for elder people, above 45 year old, they consume more on Kapal Api brand (11.81%). For ABC brand, their consumers are from age 19-14 year old. This data show that neural network analysis can be used for market segmentation (Beida, 2014). Segmentation strategy will optimize purchasing level and might create impact to consumer loyalty (Sosilo, 2016). However, how it will impact depends on what factors that consumer consider. When we define level of preference in consumer loyalty, we find that Indonesia consumer (based on the sample) overall tends to have moderate preference.

Table 2. Market Segmentation Three Top Instant Brand in Indonesia

Age	Consume (%)			Total (%)
	ABC	Good Day	Kapal Api	
13-18	1.39	9.72	1.39	12.50
19-24	7.64	31.94	10.42	50.00
25-29	2.78	0.69	1,39	4.86
30-35	2.08	1.39	2.08	5.56
36-45	3.47	3.47	2.08	9.03
46-65	3.47	2.08	11.81	17.36
> 65	0.69	0.00	0.00	0.69

From the total sample, we find that around 51.05% of respondents will have a possibility to switch to other instant coffee brands. And around 48.95% of

respondents say they will not switch to other brands in the future. This is the implication when consumer is spoilt for choice when many available instant coffee products compete in the market

Internal and External Factors influence Consumer Loyalty of Instant Coffee Products

In competitive business, creating and maintaining brand loyalty with consumers is critical for the sustainability of a company (Mellen et al., 1996; Heskett, 2002; McMullan and Gilmore, 2008). Brands for instant coffee are excessive, companies need to have a strong brand to compete in business. Fosgacs (2006) argued that branding is the most important trends in the global marketing industry.

Between input descriptor variables and consumer loyalty levels should be mapped so that their preferences can be understood. Respondents are made up of 3 groups of 70-15-15 proportions in this approach by training, validation and testing. The assignment to each set were made randomly. There are 11 explanatory variables that explain Results for the first model, among them. With an overall accuracy percentage of 62.4% in the training procedure, 247 respondents were employed with 154 classifications of those respondents as a higher or lower preference in their loyalty. So that the level of consumer loyalty can be predicted (> 50%) of both types of variables (internal and external influences) on the results shown.
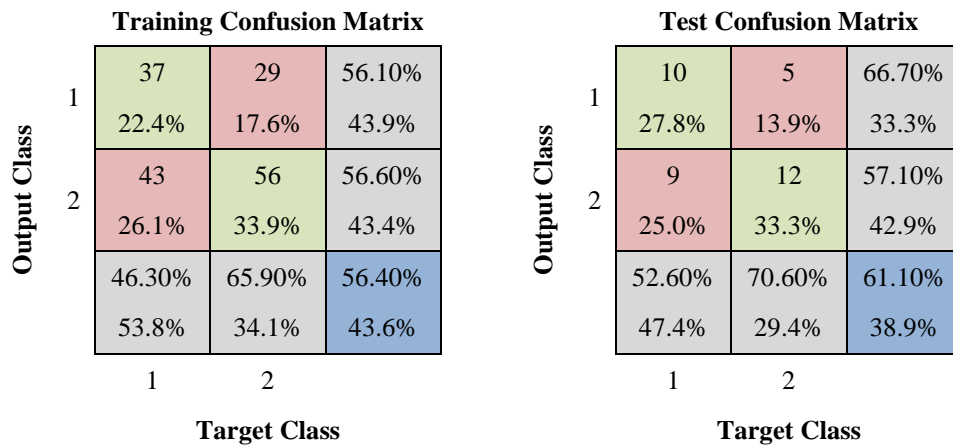

Figure 2. **Results with Internal Factors Only**

Training Confusion Matrix

	1	2	
1	50 30.3%	37 22.4%	57.50% 42.5%
2	34 20.6%	44 26.7%	56.40% 43.6%
	59.50% 40.5%	54.30% 45.7%	57.00% 43.0%

Output Class (vertical axis) — Target Class (horizontal axis: 1, 2)

Test Confusion Matrix

	1	2	
1	8 22.2%	11 30.6%	42.10% 57.9%
2	9 25.0%	8 22.2%	47.10% 52.9%
	47.10% 52.9%	42.10% 57.9%	44.40% 55.6%

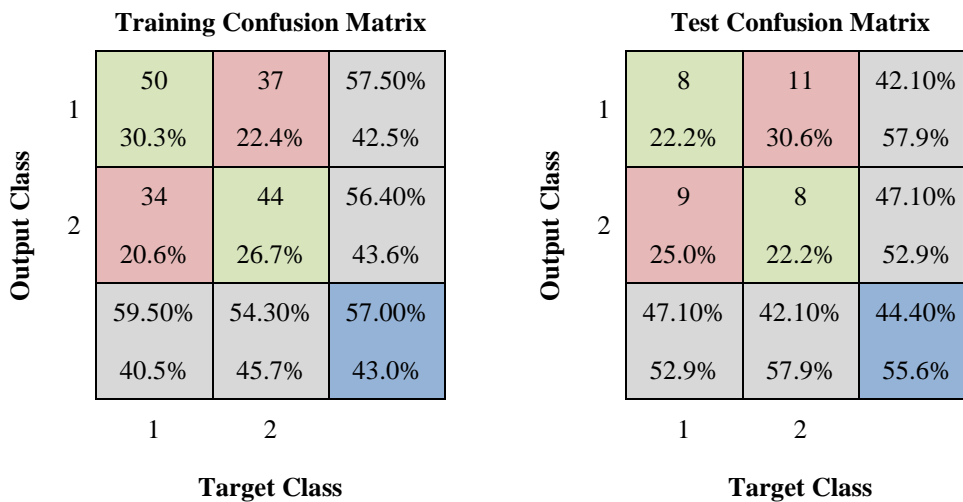Output Class (vertical axis) — Target Class (horizontal axis: 1, 2)

Figure 3. Results with External Factors Only

Although branding is a complex entity, it has to be simple and has value-based message (Needham, 2005) that must be consistent both internally and externally integrated in a coherent marketing strategy (White and de Chernatony, 2002). Although companies do agrgresive promotion does not mean that the company will succeed in getting big profit, because of diiferences in consumer taste. Thus it should be noted that different communication for high brand identifier and disidentifier (Khalifa and Paurav , 2017).

The use of internal factors in Figure 2 is only shown for sub-analysis. A total of 247 respondents who were sampled we trained for the first step, there were 139 out of 247 respondents who correctly classified higher or lower their loyalty or by 56.4%. The next step, 150 of 247 respondents were correctly classified to be applied to the test set network and classification accuracy with the achievement of 61.1%.In Figure 3 shows the third analytics with only the external factors as the inputs we use. The neural network training set provided 57% overall prediction accuracy, with an accuracy of just 44.4% for the test set.

Raghav (2013) wrote that internal and external factors influence consumer behaviour. Factors such as age, income level, interest, mood state, knowledge, involvement, and attitude are things that include internal factors. While the situation and environment in which consumers are interconnected is driven by external factors due to the interrelated then external factors are more special and unpredictable. When all variables use the highest predicted accuracy, higher loyalty consumer preferences are predicted to be much more successful in external factors, with a classification accuracy of 30.3% compared to only 22.4% of classification accuracy for internal factors only. These results provide counter support for the hypothesis. A higher preference in consumer loyalty is created by the overall pattern of highly relevant external factors. This results inline with study

from Greve (2014), as external factors will drive consumer engagement that lead to the formation of loyalty.

External factors such are effective predictors of a higher preference in consumer, as firms compete with other firms in winning the market. This result indicates that consumer is more driven by external factors in determining their consumer choice, which is differ from what Broddie et al. (2009) mentioned about determinant factors for brand loyalty. Successful products should be able satisfy the tastes and desires of consumers. Information about consumers is important, because the consumer is the recipient of the product that company creates. Product must be innovative to attract consumers to buy them.

Managerial Implication and Further Research

This research obtained consumer loyalty model in instant coffee in Indonesia. This study found three important notes. The first note, external factors such as size, package, design, product information and differentiation of coffee products become the determinant factor to maintain consumer loyalty. Companies need to take these variables to their business strategy to increase and maintain consumer loyalty. The second note, there is market segmentation for instant coffee products. Ones that have more variant taste are much prefer by young group, around 19-24 years old. While coffee that have strong flavor are preferred by old group, age 46-65. The last note, since there might exist big companies to monopolizes the market share, it is necessary to review the implementation of antitrust law in Indonesia especially in food and beverage industries.

Further research that can be done in study is to see how other important variables might affect to consumer loyalty, such as demographic and personality variables in internal factors. In addition, other external factor such as culture, role and status, group reference can also affect to their loyalty. This study is using single layer Artificial Neural Network model which can be extended to more complex model.

Conclusion

Neural network analysis is a useful tool in recognizing consumer loyalty preferences in this case we show in this study so that the size of collective patterns of internal and external behavior can be generated. We show that internal factors can be used as predictors of consumer loyalty, when modeled without an assumption of linearity. Our neural network can recognized whether the respondents would have higher or lower preference in nearly 58.2% of cases. These findings support the contention that the internal and external influence can play an important role in explaining why consumers differ in their preference. We also found that external factors were highly effective predictors of a higher preference but that internal factors were more effective predictors of a lower preference of consumer loyalty. Internal factors are not dominant in consumer loyalty in coffee purchases, compared with external factors, this is line with Greve (2014),

POLISH JOURNAL OF MANAGEMENT STUDIES
Baron I.S., Agustina H.

2017
Vol.16 No.2

Nevertheless, both internal and external factors have a similar role in the loyalty of coffee consumers. This is in agreement with the research conducted by White and de Chernatony (2002) and Khalifa and Paurav, (2017). By paying attention to the consumer then the consumer will be loyal and in the end company will get the profit continually.

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ZROZUMIENIE LOJALNOŚCI KONSUMENTA PRZY WYKORZYSTANIU SIECI NEURONOWYCH

Streszczenie: Produkty kawy rozpuszczalnej są bardzo popularne wśród konsumentów, zarówno w obszarach miejskich, jak i wiejskich. Lojalność konsumentów reaguje na różne cechy wymienionych produktów kawowych, można je pogrupować według czynników wewnętrznych i zewnętrznych. Badanie przeprowadzono z wykorzystaniem modelu sztucznej sieci neuronowej (ANN). Proponowana metoda zapewnia bezpośrednie odwzorowanie atrybutów lojalnościowych i konfiguracji zachowań konsumenckich. Algorytmem używanym w badaniu jest Scaled Conjugate Gradient (SCG) z losowym podziałem danych, a wydajność obliczana jest za pomocą MSE. Rezultaty wskazują, że czynniki wewnętrzne były skutecznymi predyktorami niższej preferencji w lojalności

konsumentów, podczas gdy czynniki zewnętrzne były bardziej skuteczne w przewidywaniu wyższych preferencji w lojalności konsumentów. Badania te stanowią pierwszą próbę wykorzystania sieci neuronowych do modelowania relacji między cechami producent-konsument a lojalnością konsumenta.

Słowa kluczowe: lojalność konsumentów, czynnik wewnętrzny, czynnik zewnętrzny, sztuczna sieć neuronowa i kawa rozpuszczalna

用神經網絡理解消費者忠誠度

摘要：速溶咖啡產品在城市和農村都非常受消費者青睞。消費者忠誠度響應速溶咖啡產品的各種屬性，按內部和外部因素分組。該研究使用人工神經網絡（ANN）模型。所提出的方法提供從配置忠誠屬性到消費者行為的直接映射。訓練集中使用的算法是隨機數據劃分的縮放共軛梯度（SCG），並使用MSE計算性能。結果顯示，內部因素是消費者忠誠度較低的有效預測因子，而外部因素在預測消費者忠誠度的較高偏好方面更為有效。這項研究代表了第一次嘗試使用神經網絡來模擬消費者 — 生產者屬性和消費者忠誠度之間的關係。

關鍵詞：消費者忠誠度，內部因素，外部因素，人工神經網絡和速溶咖啡