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Decision Making For Effectiveness the New Smoking Free Policy in Malaysia Eateries Using Fuzzy Soft Matrices

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Abstract

Malaysia has introduced steps in the control of tobacco use in public places through its smoke-free legislation (SFL). The approach taken by the government should be seen as new way in implementing this policy and enlightening the people on the importance of this policy towards the wellbeing of their daily lives at the eating place. SFL implemented in other countries such as the United Kingdom (UK) have shown the contribution of successful SFL but the implementation of SFL in Malaysia has yet to show its success as in the UK in terms of reducing exposures and detrimental health effects. Here we report the decision making for effectiveness the new smoking free policy in Malaysia eateries using Fuzzy Soft Matrices. We show that the prioritization of comparison of four independent variables which are rules, profit of eateries, knowledge of policy and cigarette consumption in triangular fuzzy number. The results shows rules variable is the most prioritize that contribute to effectiveness the new smoking free policy in Malaysia eateries.

Keywords: Smoke-free legislation, Policy, Fuzzy Soft Matrices, Prioritization

1. Introduction

Tobacco use can kill up to half of all the people who use it, and half in middle age (WHO, 2020). This is a serious problem for any country, especially when there are many other health problems. Tobacco can kill the people who use it. It can also hurt the people who breathe in the smoke from other people's smoking. As involved with the World Health Organization-Framework of Convention on Tobacco Control (WHO FCTC), Malaysia has presented steps in the control of tobacco use in public places through its smoke-free legislation (SFL). The implementation of SFL in Malaysia, the efforts from every angle of the community and to address the gaps and new challenges faced in ensuring the effectiveness of this well-constructed legislation. Well-structured and positive commitments in shielding general society from the wellbeing risks of smoking and secondhand smoke (SHS) exposure have been shown by the Malaysian government. (Z. A, Najihah et al., 2016).

Malaysia will enforce a smoking ban at restaurants, coffee shops and hawker stalls nationwide from 1st January 2019 (Deputy Health Minister Lee Boon Chye, 2018). The ban will cover all air-conditioned and non-air-conditioned restaurants, coffee shops, as well as open-air hawker centres and street stalls. Those caught smoking at prohibited areas will be fined RM10000 and eateries found not enforcing the ban will be fined RM2500. The move was to not only encourage smokers to kick the habit, but also to protect non-smokers from second-hand tobacco smoke. Dr Lee likewise said smokers will have the right to smoke, but non-smokers also have the right to have smoke-free areas. SFL executed in different nations, for example, the United Kingdom (UK) have demonstrated the commitment of effective SFL on the augmentation in announced home-smoking restriction implementation and decreased smokers' populace (Hovell et al., 2000) post SFL usage. Until this point, the execution of SFL in Malaysia presently can't seem to show its success as in the UK regarding lessening presentations and impeding wellbeing impacts.

While evaluations of smoke-free policies have demonstrated major public health benefits, the impact on public smoking remains unclear. This study aims to make decision making which variables that contribute the effectiveness of smoke-free policy in all restaurants and premises legislation introduced by Malaysia government using Fuzzy Soft Matrices.

2. Literature Review

Rules

The rules focus now is to legislate tobacco control and smoking activities. When that legislation is approved, then there may be a way to regulate the vaping activities as well. Eateries that allow customers to smoke despite the ban will be fined up to RM2,500, while those who smoke at prohibited places will face a maximum fine of RM10,000 or two years' jail implemented by the new government. This new ruling is on top of the smoke-free areas that are already in place in government buildings and public spaces. Dr Lee Boon Chye said action will be taken under the Control of Tobacco Product Regulations 2004 against restaurant owners and smokers who flout the new ruling. (Malay Mail, 2018)

Profit of Eateries

Many previous studies have reported that introducing smoke-free laws does not have a significant economic impact either positive or negative on the hospitality industry. This study reinforces and refines this conclusion in three novel ways. First of all, many studies have not had access to data over a long-time period after the law on smoking was introduced. This leaves the studies open to the charge that they have failed to find the long-term effects because the time period or number of observations after the law was introduced was too small or because the public had not yet adjusted to the new laws. In contrast, this study uses a long time series with data for several years after the introduction of the law (M.O.Hans et al., 2012).

Knowledge of Policy

Such policies also encourage cessation by providing a supportive environment to quit smoking and these policies reduce tobacco initiation among young people because of the lower visibility of role models, fewer opportunities and diminished social acceptability and social advantages for smoking. These policies eventually result in improved health. (Department of Health and Human Services US, 2014). The level of public knowledge on the health hazards of SHS was positively associated with the level of support for smoke-free policies, particularly in the frequently visited areas such as shopping centres and public transport terminal (L. K Hock et al., 2018).

Cigarette Consumption

Dr Lee noted that the exercise's ultimate objective was for the consumption of cigarettes and tobacco products to reduce over the years. Malaysia is complying with what World Health Organisation (WHO) has advocated and also Malaysia's goal to be a smoke-free nation by 2045. Areas with a smoking ban make up less than one per cent of the entire surface area in the country (Deputy Health Malaysia, 2018).

Tobacco consumption among certain segments of the population had fallen; the average age of the critical mass of smokers has also fallen progressively. And, with Malaysia's demographic transition bulge in the 20- to 40-year-old cohorts, the problem will only worsen if left unchecked (Rueben Dudely, 2017). That is why, on World No Tobacco Day on May 31, WHO and its partners will highlight the health and other risks associated with tobacco use and advocate for effective programs and activities to reduce tobacco consumption. According to WHO member, nation is urged to introduce and strengthen policies and implement actions to protect their citizens from the harms of tobacco use and reduce its toll on its economy.

3. Methodology

Fuzzy AHP

The Analytic Hierarchy Process (AHP) is one of the most and widely applied method for selecting factors that are important in decision making (DM) was proposed by Saaty (1980). AHP is structure method for organizing and analyzing complex decision which contain subjective judgments. In other word AHP is a traditional selection making technique in order to determining the priorities among different criteria, evaluating the selection alternatives for every criterion and determining an overall ranking of the decision alternatives that cater both qualitative and quantitative data. Besides that, it provides a specific mechanism for checking the consistency of the evaluation measures and alternative determined by way of a selection maker. Thus, it could lessen bias in selection making (Ariff, Salit, Ismail & Nukman, 2008; Lixiong, Liang & Minzhong, 2010). The concept of AHP to Fuzzy AHP was first extend by Laarhoven and Pedrycz in 1983, for presented in effectively the vagueness and uncertainty form subjective performance and the experience of decision maker in solving the hierarchy problem. The eavaluation of the pair-wise comparison was described by using triangular fuzzy number in this method.

There are a few methods in Fuzzy AHP, Fuzzy LLSM introduced by Van laarhoven and Pedrycz (1983), Extend Analysis introduced by Chang and Lambda-Max method, found by Leung and Cao in 2000 and 2001, while Csutora and Buckley suggested another Lambda-Max method which is the direct fuzzification of the well-known Lambda-Max method. Iftikar et al. (2017) were applied Fuzzy AHP, which is used triangular fuzzy numbers for the pair-wise comparison to cater tie-breaking procedure in order to finding the ordering relation and ranking among the participant. The fuzzy AHP (Lamda-max method) is also utilized by Samsiah et al. (2011, 2012, and 2017) in solving group decision making method by determining the criteria weight for the main and sub criteria. Liana and Lazim (2013) was applied the fuzzy multi-criteria decision making(MCDM) to evaluate the cause option with respect to road accident problem and analyzed the consistency ratio of pair-wise comparison matrix for every criteria and alternatives using Lambda-max Method. In 2018, Mochammad et al, analyze the best quality of gemstone that can be easy to select the and assess the quality of gemstones to be traded.

This research utilized the Fuzzy AHP (Lambda-Max Method) to analyse and prioritize the comparison of four independent variables which are rules, profit of eateries, knowledge of policy and cigarette consumption in triangular fuzzy number. It is because Fuzzy AHP method can be applied and effective for many problems in real life applications, is easy to compute and can provide a direct and definite value by expert and do not reflect the human thinking style method can be applied and effective for many problems in real life..

Triangular Fuzzy Number

Definition 1: Fuzzy Number (Bansal, 2011)

A fuzzy set $\tilde{A}$, defined on the universal set of real number R, is said to be a fuzzy number if its membership function has the following characteristics:

i. $\tilde{A}$ is convex
i.e., $\mu_{\tilde{A}}(\lambda x_1 + (1-\lambda)x_2 \geq \min(\mu_{\tilde{A}}(x_1), \mu_{\tilde{A}}(x_2)) \forall x_1, x_2 \in R, \forall \lambda \in [0,1],$

ii. $\tilde{A}$ is normal i.e., $\exists x_0 \in R$ such that $\mu_{\tilde{A}}(x_0) = 1,$

iii. $\mu_{\tilde{A}}$ is piecewise continuous.

In this study triangular fuzzy number (TFN) is adopted in the Fuzzy AHP method. The basic definition of TFN is stated as:

Definition 2: Triangular Fuzzy numbers (Liu et al., 2007)

A fuzzy number $\tilde{A} = (l, m, u)$ is said to be a triangular fuzzy number $(\mathrm{TFN})\,\tilde{A}$ if its membership function is given by, where $l \leq m \leq u$ as shown in Figure 2.1. The membership functions $\mu_{\tilde{A}}(x)$ are defined as:

$$\mu_{\tilde{A}}(x) = \begin{cases} \dfrac{x-l}{m-l}\ ; & l \leq x \leq m, \\ \dfrac{u-x}{u-m}\ ; & m \leq x \leq u, \\ 0 \quad\ ; & \textit{otherwise.} \end{cases}$$

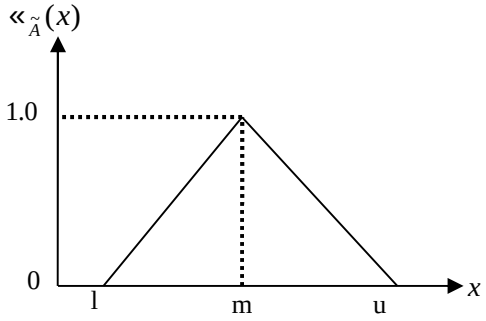

Figure 1: A Triangular Fuzzy Number $\tilde{A} = (l, m, u)$

Where *l* stand for lower, *u* stand for upper value support of M respectively, and *m* represent the middle value. The triangular numbers can be denoted by order triplet (l, m, u) of real number.

Some basic arithmetic operations of positive triangular fuzzy numbers that will be used in this research are illustrated. Given any two positive triangular fuzzy numbers (TFN_S) $\tilde{A} = (l_1, m_1, u_1)$ and $\tilde{B} = (l_2, m_2, u_2)$, *the arithmetic operators of* $\tilde{A}$ *and* $\tilde{B}$ *are as follows:*

i.Addition

$$(l_1, m_1, u_1) \oplus (l_2, m_2, u_2) = (l_1 + l_2, m_1 + m_2, u_1 + u_2) \quad (1)$$

ii.Inverse

$$(l_1, m_1, u_1)^{-1} = \left(1/u_1, 1/m_1, 1/l_1 \right) \quad (2)$$

iii.*Multiplication*

$$(l_1, m_1, u_1) \otimes (l_2, m_2, u_2) = (l_1 l_2, m_1 m_2, u_1 u_2) \quad (3)$$

iv.*Scalar Multiplication*

$a.(l_1, m_1, u_1) = (a l_1, a m_1, a u_1)$, where a is a positive real number, (4)

where,

l_i : lower / left component of TFN,

m_i : middle component of TFN,

u_i : upper / right component of TFN.

The symbols, $\oplus$ and $\otimes$ represent the arithmetic operations between fuzzy numbers and $i = 1,2.$

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Lambda-Max Method

The procedure of the Lambda – max method involves 4 steps as follows:

Step 1: Apply $\sim -$ cut. To obtain the positive matrix of decision maker s, let $\sim = 1$, $\widetilde{T}_m^s = \left[\widetilde{r}_{ij}\right]_m^s$, and let $\sim = 0$ to obtain the lower bound and upper bound positive matrices of decision maker s, $\widetilde{T}_l^s = \left[\widetilde{r}_{ij}\right]_l^s$ and $\widetilde{T}_u^s = \left[\widetilde{r}_{ij}\right]_u^s$. Calculate the weight vector based on the weight calculation procedure in AHP, $W_m^s = \left(w_i\right)_m^s$, $W_l^s = \left(w_i\right)_l^s$, and $W_u^s = \left(w_i\right)_u^s$, $i = 1,2,\ldots,n.$

Step 2: In order to minimize the fuzziness of the weight, choose two constants, M_l^s and M_u^s, as follows;

$$M_l^s = \min\left\{\frac{w_{im}^s}{w_{il}^s}\right\},\ 1 \le i \le n \quad M_u^s = \min\left\{\frac{w_{im}^s}{w_{iu}^s}\right\},\ 1 \le i \le n$$

and the upper bound and lower bound of the weight are defined as:

$W_{il}^{*s} = M_l^s w_{il}^s$, $W_{iu}^{*s} = M_u^s w_{iu}^s$,

so the lower bound and upper bound weight vectors are $\left(w_i^*\right)_l^s$ and $\left(w_i^*\right)_u^s$, $i = 1,2,\ldots,n.$

Step 3: By combining the upper bound, the middle bound and lower bound weight vectors, the fuzzy weight matrix for decision maker s can be obtained and is defined as $\widetilde{W}_i^s = \left(w_{il}^{*s}, w_{im}^{*s}, w_{iu}^{*s}\right), \quad i = 1,2,\ldots,n.$

Step 4: Calculate local fuzzy weights and global fuzzy weight with repetition from step 1 until step 3. Calculate local weights and global weight with repetition from step 1 until step 3.

We use the following linguistic variables and the image of its membership function in this study obtained by Bozbura & Beskese, (2006) is shown in **Table 1**:

Table 1: Triangular fuzzy conversion table: importance/preference of one alternative over another

Linguistic Scale	Triangular Fuzzy Scale	Triangular Fuzzy Reciprocal Scale
Just Equal	(1,1,1)	(1,1,1)
Equally influencing	(1/2,1,3/2)	(2/3,1,2)
Weakly more influencing	(1,3/2,2)	(1/2,2/3,1)
Strongly more influencing	(3/2,2,5/2)	(2/5,1/2,2/3)
Very strongly more influencing	(2,5/2,3)	(1/3,2/5,1/2)
Absolutely more influencing	(5/2,3,7/2)	(2/7,1/3,2/5)

3.0 Data Collection

The data is obtained from a set of questionnaire distributed among selected customers in two eateries in Bandaraya Melaka. They are considered as decision makers in this study. 52customers completed the questionnaire and the input from them was analyzed based on the Fuzzy AHP (Lambda-Max Method) by using Microsoft Excel 2013. They are required to give an opinion on the evaluation of pair-wise comparison of the criteria included in the research; there are Rules (R), Profit of Eateries (PR), Knowledge of Policy (KP) and Cigarette Consumption among the Public (CCP).

4. Results and discussion

There are 52 selected customers of two eateries be as a decision makers and were labeled as DM_1, DM_2, $DM_2, \cdots, DM_{52}$. They were selected to perform the evaluation of fuzzy pair-wise comparison for Rules (R), Profit of Eateries (PR), Knowledge of Policy (KP) and Cigarette Consumption among the Public (CCP) that contribute to effectiveness the new smoking free policy in Malaysia eateries. From the pair-wise comparison of the decision makers for each criterion, evaluation matrices are formed into triangular fuzzy number as in **Table 2** to **Table 5.**

Table 2: Fuzzy pair-wise comparison for the effectiveness of smoke free policy at Malaysian eateries given by DM_1

	R	**PR**	**KP**	**CCP**
R	$(1,1,1)$	$\left(\frac{1}{2},\frac{2}{3},1\right)$	$\left(\frac{1}{2},1,\frac{3}{2}\right)$	$\left(\frac{2}{3},1,2\right)$
PR	$\left(1,\frac{3}{2},2\right)$	$(1,1,1)$	$\left(\frac{2}{3},1,2\right)$	$\left(1,\frac{3}{2},2\right)$
KP	$\left(\frac{2}{3},1,2\right)$	$\left(\frac{1}{2},1,\frac{3}{2}\right)$	$(1,1,1)$	$\left(1,\frac{3}{2},2\right)$
CCP	$\left(\frac{1}{2},1,\frac{3}{2}\right)$	$\left(\frac{1}{2},\frac{2}{3},1\right)$	$\left(\frac{1}{2},\frac{2}{3},1\right)$	$(1,1,1)$

Table 3: Fuzzy pair-wise comparison for the effectiveness of smoke free policy at Malaysian eateries given by DM_2

	R	**PR**	**KP**	**CCP**
R	$(1,1,1)$	$\left(2,\frac{5}{2},3\right)$	$\left(1,\frac{3}{2},2\right)$	$\left(\frac{1}{2},1,\frac{3}{2}\right)$
PR	$\left(\frac{1}{3},\frac{2}{5},\frac{1}{2}\right)$	$(1,1,1)$	$\left(\frac{1}{2},\frac{2}{3},1\right)$	$\left(\frac{1}{2},\frac{2}{3},1\right)$
KP	$\left(\frac{2}{3},1,2\right)$	$\left(1,\frac{3}{2},2\right)$	$(1,1,1)$	$\left(\frac{2}{5},\frac{1}{2},\frac{2}{3}\right)$
CCP	$\left(\frac{1}{2},1,\frac{3}{2}\right)$	$\left(1,\frac{3}{2},2\right)$	$\left(\frac{3}{2},2,\frac{5}{2}\right)$	$(1,1,1)$

Table 4: Fuzzy pair-wise comparison for the effectiveness of smoke free policy at Malaysian eateries given by DM_3

	R	**PR**	**KP**	**CCP**
R	$(1,1,1)$	$\left(\frac{3}{2},2,\frac{5}{2}\right)$	$\left(1,\frac{3}{2},2\right)$	$\left(1,\frac{3}{2},2\right)$
PR	$\left(\frac{2}{5},\frac{1}{2},\frac{2}{3}\right)$	$(1,1,1)$	$\left(1,\frac{3}{2},2\right)$	$\left(1,\frac{3}{2},2\right)$

KP	$\left(\frac{1}{2},\frac{2}{3},1\right)$	$\left(\frac{1}{2},\frac{2}{3},1\right)$	$(1,1,1)$	$\left(1,\frac{3}{2},2\right)$
CCP	$\left(\frac{1}{2},\frac{2}{3},1\right)$	$\left(\frac{1}{2},\frac{2}{3},1\right)$	$\left(\frac{1}{2},\frac{2}{3},1\right)$	$(1,1,1)$

Table 5: Fuzzy pair-wise comparison for the effectiveness of smoke free policy at Malaysian eateries given by DM_{52}

	R	**PR**	**KP**	**CCP**
R	$(1,1,1)$	$\left(\frac{3}{2},2,\frac{5}{2}\right)$	$\left(2,\frac{5}{2},3\right)$	$\left(1,\frac{3}{2},2\right)$
PR	$\left(\frac{2}{5},\frac{1}{2},\frac{2}{3}\right)$	$(1,1,1)$	$\left(\frac{5}{2},3,\frac{7}{2}\right)$	$\left(2,\frac{5}{2},3\right)$
KP	$\left(\frac{1}{3},\frac{2}{5},\frac{1}{2}\right)$	$\left(\frac{2}{7},\frac{1}{3},\frac{2}{5}\right)$	$(1,1,1)$	$\left(1,\frac{3}{2},2\right)$
CCP	$\left(\frac{1}{2},\frac{2}{3},1\right)$	$\left(\frac{1}{3},\frac{2}{5},\frac{1}{2}\right)$	$\left(\frac{1}{2},\frac{2}{3},1\right)$	$(1,1,1)$

The Lambda –max method (Csutora & Buckley, 2001) is used to calculate the prioritization between independent variables which are the Rules (R), Profit of Eateries (PR), Knowledge of Policy (KP) and Cigarette Consumption among the Public (CCP). To compute the calculation, there are several steps as mention in Lambda-Max Method has to follow. The prioritizations between independent variables are shown in Table 7 and each of the independent variables is transformed into the fuzzy number as shown in **Figure 1**.

Table 6: The prioritization of comparison of four independent variable contribute to the effectiveness of smoke free policy at Malaysian eateries in triangular fuzzy number

Rules	0.3142	0.3355	0.3441
Profit of Eateries	0.2503	0.2726	(0.2863)
Knowledge of Policy	0.1974	0.2122	(0.2253)
Cigarette Consumption among the Public	(0.1678)	(0.1747)	0.1861

By using Average method the prioritization of Rules (R), Profit of Eateries (PR), Knowledge of Policy (KP) and Cigarette Consumption among the Public (CCP) will be converted in Crisp value as shown in **Table 7**.

Table 7: The prioritization of comparison of four independent variable on the effectiveness of smoke free policy at Malaysian eateries

Rules	**0.3350**
Profit of Eateries	**0.2728**
Knowledge of Policy	**0.2140**
Cigarette Consumption among the Public	**0.1782**

The result of questionnaire survey about four independent variables (Rules (R), Profit of Eateries (PR), Knowledge of Policy (KP) and Cigarette Consumption among the Public (CCP)) that contribute to effectiveness the new smoking free policy are calculated using Lambda-Max Method are shown in **Table 6**. Based on the result in Table 7, we can see that the highest score with 0.3350 is Rules. It showed that the Rules is the most influence on the effectiveness the new smoking free policy in Malaysia eateries compare to Profit of Eateries (PR), Knowledge of Policy (KP) and Cigarette Consumption among the Public (CCP).

4. Conclusions

Rules of new smoking free policy can prevent smokers from smoking in the public and can save the second smoker from diagnosing diseases. Other than that, it can reduce the public addiction towards cigarette. By implementing paying a fine, this rule will encourage the public to obey the rule. The Health Ministry's move to ban smoking in all eateries will help millions of smokers to dissociate smoking and meal times. The approach taken by the government should be seen as new way in implementing this policy and enlightening the people on the importance of this policy towards the wellbeing of their daily lives at the eating place.

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