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RESEARCH ARTICLE

NUMERICAL MODELLING FOR CATERERS' GRADING SYSTEM IN PAHANG

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Glossary of Abbreviations

FIFO – first in first out
FQCD – Food Safety and Quality Division
MLR – Multiple Linear Regression
MOH – Ministry of Health
WHO – World Health Organization

ABSTRACT

Background: The hygiene level of the premise reflect the safety and quality of the food served in the food services kitchen and the poor sanitary condition can contribute to food poisoning outbreaks. Recently, many food poisoning cases reported from food services sector and most of the cases are from institutional food services. These premises sometimes are graded as clean or very clean which can be questioned, mostly at institutions such as schools. Objectives: The aim of this research is to establish mathematical models using multiple linear regression (MLR) technique to determine the food safety level and premise grading of active caterers in Pahang State, using artificial neural network.
Methods: In this research, the premises have been categorised into 3 categories namely institutional, event caterers and premise at Rest and Rescue Area (RnR) along the East Coast Highway. A total of 268 premises were involved in this study with 139 (51.87%) institutional, 63 (23.51%) event caterers and 66 (24.63%) RnR. The instrument used in this research is based on the official risk based premise inspection form currently used by Ministry of Health Malaysia. The important focusing items in the inspection form are process control, building and facilities, equipment and utensils, cleaning and maintenance, as well as food handler's requirements. These items consist of a total thirty (31) elements with respected weight age score based on risk to food safety. In this research, stepwise method is used where several significant models will be developed.
Results: The results show that the best and significant model is the 33rd model where the independent variables explain 100% of the dependent variables (R-square=1.00, p-val=0.00).
Conclusion: As a conclusion, it is expected that this system will help the related authorities by confirming national standards and create more uniformity in catering inspections. In the future, it is suggested that the result can be improved by revising **Part A:** Process Control, in the Malaysian premise inspection form where the elements should be elaborated more details by comparing to the ones used in other countries.

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INTRODUCTION

Food safety has become an important agenda of the authorities worldwide from the increases of the related food borne illness. Many factors can contribute to the food borne illness such as lack of hygiene during handling process, inadequate storage and cooking temperatures. (Hai, Wan Nadhirah Wan Chik, Fatimah Abu Bakar, Nazamid Saari, and Nor Ainy Mahyudin, 2012; Osimani and Clementi, 2016).

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In Malaysia, the preparation and sales of food are regulated by Malaysian Food Act 1983, Food Regulations 1985 and Food Hygiene Regulations 2009. The food must be free from any hazardous material and fit for human consumption. This Acts and Regulation also cover the requirement for the food preparation including the premises structures, maintenance, cleaning and food handler's requirements which all food handlers shall undergo food handlers training and being vaccinated (Food Act 1983, n.d., Food Hygiene Regulations 2009, n.d.). In modern society culture has resulted in an increasing number of people consuming meals away from home (Osimani and Clementi, 2016), and this also happen in

Malaysia which eating out was a common among the Malaysian urban society (Noraziah Ali and Mohd Azlan Abdullah, 2012). This increasing pattern, the food premises or food services provider has a bigger role in in contributing to food borne illness (Henson *et al.,* 2006). Consumer need a current information about the premises to choose. Inspection grading and score is one of the method can easily interpreted by the consumer in assessing the food safety risk in the food premises which there are many other unobservable safety elements by the consumers. This paper consists of five sections. The first section is the introduction and background of this research. The second section is about the related literatures on food catering and food services followed by food premises inspection and food safety contributing factors in catering services. The third section is the methodology which include the instrument, research design and description of MLR, then followed by result and discussion in fourth section and conclusion in the final section.

Premise Inspection and Grading

Premise inspection is process of evaluation of food premise using a specified checklist which include all related element in food processing, handling, hygiene, maintenance and the building condition. The instrument and checklist used by regulatory authorities are develop based on mathematical and scientific procedures (Diogo Thimoteo Da Cunha, Rosso, and Stedefeldt, 2016). This checklist type of inspection allows a score to be calculate and translate into grade or symbol. This symbol then posted for consumer for easy evaluation of the premise current hygiene status (Costa, Puckett, Scott, and Robert Gravani, 2003). Food premises inspection is the onsite process of evaluation of the premises condition and operational status at the time of inspection, while combining with risk based will have a more meaningful result compared to traditional methods. (Hoag, Porter, Uppala and Dyjack, 2007). The risk based inspection will focus on the risk factors that may cause food borne diseases and this method will support the ultimate purpose of safeguarding the consumers (FAO/WHO, 2009). Premise inspection and grading system have been practiced worldwide. There are two main type of grading system mainly practice. The pass/fail or symbol/grading (NSW Food Authority, 2011). The purpose of having grading system is a commitment of the regulatory body to signalling the consumer about the status of the premises and its food safety risk associated with (Henson *et al.,* 2006), and at the same time increasing the transparency to the consumer. The consumer can make their own judgment about the premises. Similar programme was introduced by The Danish Government so called "Smiley Scheme" in 2001 and "Score on The Doors" by United Kingdom in 2004, the results are published at the premises. This action will help the consumers to identifies the hygiene information inspection of the premises. In the "Smiley Scheme" (Smiley face ranging from big smile to sad face) are posted at the premises entrance while in UK the results also available online for consumers viewing. (Djekic *et al.,* 2014). Premise inspection is a one way to unsure the food services follow the minimum requirements of the regulation and the violation of certain point of inspected element during food premises inspection reduced during the second inspection compared to the first inspection(Diogo T. da Cunha *et al.,* 2016; Kwon, Choi, Liu, and Lee, 2012; Wong *et al.,* 2015). The inspection itself can take as awareness among the premises owner. In early implementation, this grading approach is more acceptable by the by many consumer groups but is not supported by industry and has received mixed reactions from regulatory agencies (Costa *et al.,* 2003). Nowadays, this grading system for food premises are being accepted and used by many municipal and authority such letter grade, numerical scores, coloured cards, symbols such star and smiley faces (Diogo T. da Cunha *et al.,* 2016; Djekic *et al.,* 2014; NSW Food Authority, 2011).

Advantages and disadvantages of grading System

Wong *et al.*(2015) found that the premises got good score in first inspection will maintain the grade for the next inspection. This shows that the commitment of the premise owner in maintaining the hygiene and cleanliness their premises which is directly beneficial to the owner and indirectly to consumer. At the same time this will decrease the number of inspection by the regulatory authority. As study done by Jin and Leslie, (2005)shows that the premises with good grade (e.g A and B) have an increment in revenues by 5.7% and 0.7 % respectively while the C Grade having negative impact by decreasing revenues by an average 1%. The grading system also facilitate to decrease risk for food borne related to hygiene practice such as violation for inadequate hand washing facilities and workers hygiene (Wong *et al.,* 2015) and supported by analysis done by (Jin and Leslie, 2005) shown that the percentage of admitted people which related to food related illness was decreased by 20% in Los Angeles. The grading system also helping the customers to make a decision with simple symbol or grading posted on the premises and this also supported by (Wong *et al.,* 2015) where their study in New York suggested that customers approve the grading programme and use it when making decision on premise selection.

MATERIALS AND METHODS

Instrument

The inspection form used in this study are the standard risk based food premise inspection by Ministry of Health Malaysia (MOH). This form used by MOH in obtain the compliance of the caterers to the Malaysia standards and regulations which contain a total of thirty (31) elements under the thirteen (13) main section as listed below;

A. Process Control (25)
B. Building (7)
C. Food Handlers (13)
D. Equipment and Utensils, Food Preparation Area (9)
E. Water Supply (5)
F. Drainage and Plumbing (3)
G. Sanitation Facilities (6)
H. Waste Management (2)
I. Pest Control (3)
J. Premise Cleaning and Maintenance (2)
K. Transportation and Delivery (1)
L. Others Operation (1)
M. Others Process (Related to Public Health Risk) (10)

Research design

Figure 1 shows the research flowchart. This study was conducted between Mac 2017 until October 2017. A stratified random sampling procedure was used for selecting the participants in this study and a total of 268 caterers was selected from three type of caterers namely institutional, event caterers and RnR Caterers in Pahang State.

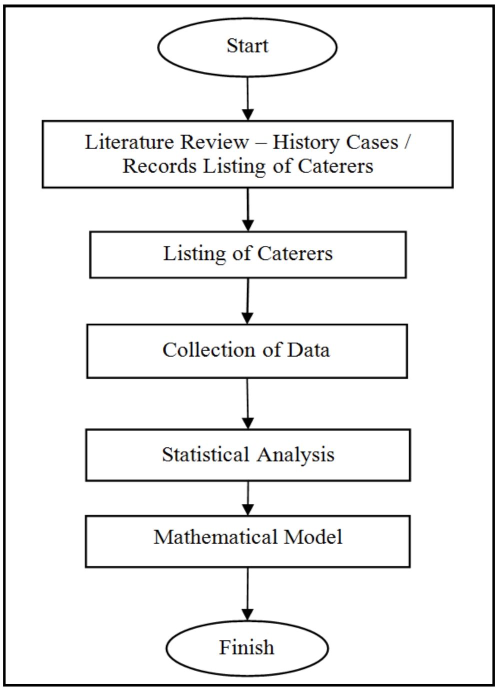


Figure 1. Research Flowchart

The proportion of the sample are 66 (24.63%) RnR, 63 (23.51%) event caterers and139 (51.87%) of institutional caterers. The each selected caterers were inspected using standardize risk-based inspection form used by Ministry of Health Malaysia which focusing on the risk at the onsite food preparation.

This form is formally used by MOH in obtain the compliance of the caterers to the Malaysia standards and regulations which contain a total of thirty (30) elements under the thirteen (13) main section as in Table 1. All 268 data collected were analysed using Neural Network SPSS, IBM SPSS Statistics for Windows, Version 22.0.

Multiple Linear Regression

Table 1 represents the variables used in this research as well as the explanations of each variable, and illustrates the theoretical framework of this research in order to achieve the main objective. In this research, we adapted multiple linear regression, stepwise method. Several models will be developed and the best model will be selected eventually.A linear regression model that contains more than one predictor variable is called a multiple linear regression model. The following model is a multiple linear regression model with thirty two predictor variables,

$$x_1, x_2, x_3, x_4, x_5, x_6, x_7, x_8, x_9, x_{10}, x_{11}, x_{12}, x_{13}, x_{14}, x_{15}, x_{16}, x_{17}, x_{18}, x_{19}, x_{20}, x_{21}, x_{22}, x_{23}, x_{24}, x_{25}, x_{26}, x_{27}, x_{28}, x_{29}, x_{30}, x_{31}, x_{32}, x_{33}.$$

$$Y=\beta_0+\beta_1*x_1+\beta_2*x_2+\beta_3*x_3+\beta_4*x_4+\beta_5*x_5+\beta_6*x_6+\beta_7*x_7+\beta_8*x_8+\beta_9*x_9+\beta_{10}*x_{10}+\beta_{11}*x_{11}+\beta_{12}*x_{12}+\beta_{13}*x_{13}+\beta_{14}*x_{14}+\beta_{15}*x_{15}+\beta_{16}*x_{16}+\beta_{17}*x_{17}+\beta_{18}*x_{18}+\beta_{19}*x_{19}+\beta_{20}*x_{20}+\beta_{21}*x_{21}+\beta_{22}*x_{22}+\beta_{23}*x_{23}+\beta_{24}*x_{24}+\beta_{25}*x_{25}+\beta_{26}*x_{26}+\beta_{27}*x_{27}+\beta_{28}*x_{28}+\beta_{29}*x_{29}+\beta_{30}*x_{30}+\beta_{31}*x_{31}+\beta_{32}*x_{32}+\beta_{33}*x_{33}+\varepsilon \quad (1)$$

Table 1. The Variables Used in This Research

No.	Variable(s)	Parameters	Notation	Type
1.	Dependent	Total Mark	The total score to determine the grade of the premise	Continuous
1.	Independent	Workers	Number of workers in the premise	Continuous
2.		District	Districts in Pahang	Categorical
3.		A1	Critical control points	Continuous
4.		A2	Raw materials specification	Continuous
5.		A3	Control of cross contamination	Continuous
6.		B4	Away from source of contamination	Continuous
7.		B5	Suitable floor condition	Continuous
8.		B6	Suitable floor and wall	Continuous
9.		B7	Adequate lighting	Continuous
10.		B8	Adequate ventilation	Continuous
11.		C9	Food handlers health examination	Continuous
12.		C10	Food handlers practice	Continuous
13.		C11	Protective clothing	Continuous
14.		C12	Training and records	Continuous
15.		D13	Food Contact Surface	Continuous
16.		D14	Non-food contact surface	Continuous
17.		D15	Hygiene facilities and method	Continuous
18.		D16	Suitable storage and FIFO	Continuous
19.		E17	Adequate and safe water supply	Continuous
20.		F18	Effective waste water	Continuous
21.		F19	Plumbing - no cross and back flow	Continuous
22.		F20	Plumbing - well fitted	Continuous
23.		G21	Adequate toilets	Continuous
24.		G22	Adequate changing room	Continuous
25.		G23	Complete hand washing facility	Continuous
26.		H24	Adequate waste bin	Continuous
27.		H25	Maintenance of disposal area	Continuous
28.		I26	Effective pest control	Continuous
29.		J27	Cleaning and maintenance	Continuous
30.		J28	Separate storage cleaning chemical	Continuous
31.		K29	Transportaion condition	Continuous
32.		L30	Other documentation	Continuous
33.		M31	Risky other related activity	Continuous

Table 2. Descriptive Statistics

Variables	Mean	Std. Dev	N
Total Mark	88.14	7.047	268
District	4.42	2.888	268
Category	2.01	.695	268
Number of workers	5.80	4.248	268
Critical control points	14.72	2.033	268
Raw materials specification	4.63	1.316	268
Control of cross contamination	3.13	2.423	268
Away from source of contamination	.98	.148	268
Suitable floor condition	1.20	.981	268
Suitable floor and wall	1.52	.854	268
Adequate lighting	.96	.207	268
Adequate ventilation	.99	.121	268
Food handlers health examination	1.77	.641	268
Food handlers practice	3.60	1.206	268
Protective clothing	2.49	1.133	268
Training and records	3.25	1.561	268
Food Contact Surface	2.15	1.355	268
Non-food contact surface	.79	.410	268
Hygiene facilities and method	2.63	.988	268
Suitable storage and FIFO	1.49	.872	268
Adequate and safe water supply	4.93	.607	268
Effective waste water	.86	.349	268
Plumbing - no cross and back flow	.96	.199	268
Plumbing - well fitted	.91	.291	268
Adequate toilets	1.00	.061	268
Adequate changing room	2.00	.000	268
Complete hand washing facility	2.70	.905	268
Adequate waste bin	.76	.425	268
Maintenance of disposal area	.91	.291	268
Effective pest control	1.80	1.472	268
Cleaning and maintenance	.74	.440	268
Separate storage cleaning chemical	.96	.190	268
Transportation condition	1.00	.061	268
Other documentation	.96	.207	268
Risky other related activity	9.93	.862	268

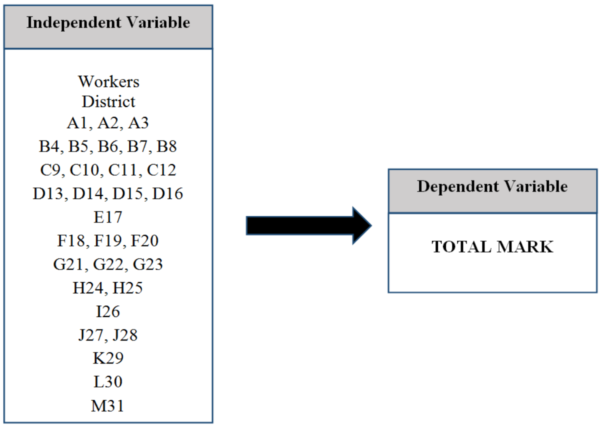
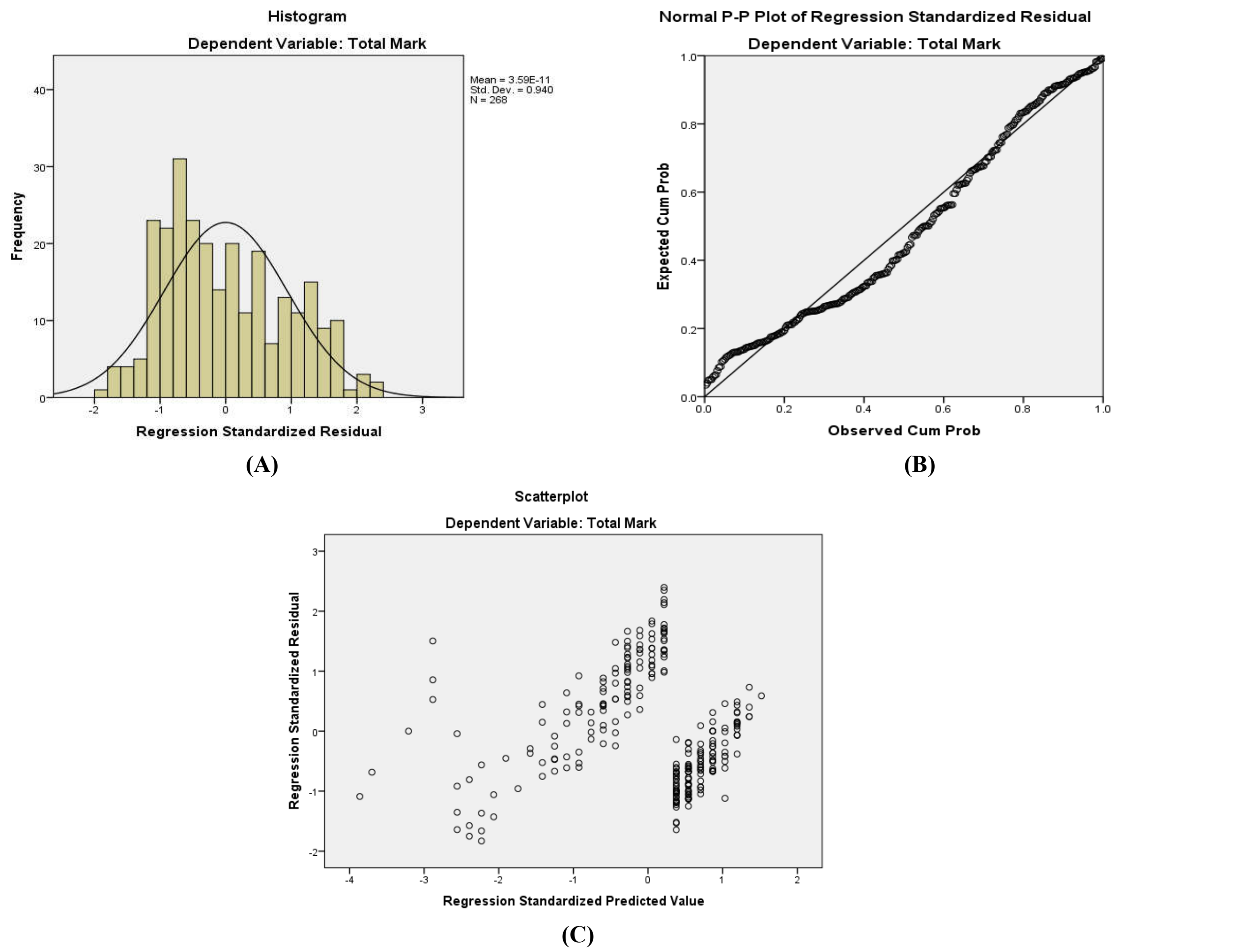


Figure 3. Theoretical Framework

The model is linear because it is linear in the parameters β_0, β_1, β_2, β_3, β_4, β_5, β_6, β_7, β_8, β_9, β_{10}, β_{11}, β_{12}, β_{13}, β_{14}, β_{15}, β_{16}, β_{17}, β_{18}, β_{19}, β_{20}, β_{21}, β_{22}, β_{23}, β_{24}, β_{26}, β_{27}, β_{28}, β_{29}, β_{30}, β_{31}, and β_{32}. The parameter β_0 is the intercept of this plane. Parameters β_1, β_2, β_3, β_4, β_5, β_6, β_7, β_8, β_9, β_{10}, β_{11}, β_{12}, β_{13}, β_{14}, β_{15}, β_{16}, β_{17}, β_{18}, β_{19}, β_{20}, β_{21}, β_{22}, β_{23}, β_{24}, β_{26}, β_{27}, β_{28}, β_{29}, β_{30}, β_{31}, β_{32}andβ_{33} are referred to as partial regression coefficients. In this research, the general model is

$$TotalMark = \beta_o + \beta_1 * Workers + \beta_2 * A1 + \beta_3 * A2 + \beta_4 * A3 + \beta_5 * B4 + \beta_6 * B5 + \beta_7 * B6 + \beta_8 * B7 + \beta_9 * B8 + + \beta_{10} * C9 + \beta_{11} * C10 + \beta_{12} * C11 + \beta_{13} * C12 + \beta_{14} * D13 + \beta_{15} * D14 + \beta_{16} * D15 + \beta_{17} * D16 + \beta_{18} * E17 + \beta_{19} * F18 + \beta_{20} * F19 + \beta_{21} * F20 + \beta_{22} * G21 + \beta_{23} * G22 + \beta_{24} * G23 + \beta_{25} * H24 + \beta_{26} * H25 + \beta_{27} * I26 + \beta_{28} * J27 + \beta_{29} * J28 + \beta_{30} * K29 + \beta_{31} * L30 + \beta_{32} * M31 + \beta_{32} * District + \varepsilon \quad (2)$$



(A) (B) (C)

Figure 2. Plots of the standardized residuals; (A) Histogram, (B) Normal P-P Plot of Regression Standardized Residuals, and (C) Scatter Plot

Table 3. Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate	Change Statistics					Durbin-Watson
					R Square Change	F Change	df1	df2	Sig. F Change	
1	.511[a]	.261	.259	6.068	.261	94.132	1	266	.000	
2	.608[b]	.369	.365	5.617	.108	45.366	1	265	.000	
3	.680[c]	.463	.457	5.193	.094	46.088	1	264	.000	
4	.742[d]	.550	.544	4.761	.087	51.098	1	263	.000	
5	.786[e]	.618	.611	4.395	.068	46.546	1	262	.000	
6	.814[f]	.663	.655	4.140	.044	34.387	1	261	.000	
7	.848[g]	.719	.711	3.789	.056	51.567	1	260	.000	
8	.871[h]	.758	.750	3.520	.039	42.151	1	259	.000	
9	.892[i]	.796	.789	3.240	.038	47.719	1	258	.000	
10	.908[j]	.824	.817	3.017	.028	40.680	1	257	.000	
11	.924[k]	.854	.848	2.747	.031	53.922	1	256	.000	
12	.938[l]	.880	.874	2.502	.025	53.683	1	255	.000	
13	.949[m]	.901	.896	2.273	.021	54.921	1	254	.000	
14	.960[n]	.922	.917	2.027	.021	66.372	1	253	.000	
15	.970[o]	.941	.937	1.765	.019	81.804	1	252	.000	
16	.979[p]	.959	.957	1.465	.019	114.626	1	251	.000	
17	.984[q]	.968	.966	1.305	.008	66.137	1	250	.000	
18	.988[r]	.976	.974	1.136	.008	80.912	1	249	.000	
19	.991[s]	.982	.980	.987	.006	82.136	1	248	.000	
20	.991[t]	.982	.980	.988	.000	1.635	1	248	.202	
21	.993[u]	.986	.985	.866	.004	76.020	1	248	.000	
22	.995[v]	.989	.988	.766	.003	69.740	1	247	.000	
23	.996[w]	.992	.991	.662	.003	85.187	1	246	.000	
24	.997[x]	.995	.995	.521	.003	151.806	1	245	.000	
25	.998[y]	.997	.996	.435	.002	108.224	1	244	.000	
26	.999[z]	.997	.997	.380	.001	75.595	1	243	.000	
27	.999[aa]	.998	.998	.310	.001	123.318	1	242	.000	
28	1.000[ab]	.999	.999	.224	.001	224.846	1	241	.000	
29	1.000[ac]	1.000	.999	.166	.000	196.952	1	240	.000	
30	1.000[ad]	1.000	1.000	.097	.000	463.864	1	239	.000	
31	1.000[ae]	1.000	1.000	.066	.000	271.540	1	238	.000	
32	1.000[af]	1.000	1.000	.003	.000	101534.210	1	237	.000	
33	1.000[ag]	1.000	1.000	.003	.000	4.387	1	236	.037	.573

Table 4. ANOVA

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	3465.656	1	3465.656	94.132	.000[b]
	Residual	9793.310	266	36.817		
	Total	13258.966	267			
2	Regression	4897.129	2	2448.564	77.599	.000[c]
	Residual	8361.837	265	31.554		
	Total	13258.966	267			
3	Regression	6139.941	3	2046.647	75.897	.000[d]
	Residual	7119.025	264	26.966		
	Total	13258.966	267			
4	Regression	7298.074	4	1824.518	80.499	.000[e]
	Residual	5960.892	263	22.665		
	Total	13258.966	267			
5	Regression	8197.305	5	1639.461	84.861	.000[f]
	Residual	5061.661	262	19.319		
	Total	13258.966	267			
6	Regression	8786.554	6	1464.426	85.461	.000[g]
	Residual	4472.413	261	17.136		
	Total	13258.966	267			
7	Regression	9526.774	7	1360.968	94.811	.000[h]
	Residual	3732.192	260	14.355		
	Total	13258.966	267			
8	Regression	10049.157	8	1256.145	101.359	.000[i]
	Residual	3209.809	259	12.393		
	Total	13258.966	267			
9	Regression	10550.166	9	1172.241	111.650	.000[j]
	Residual	2708.801	258	10.499		
	Total	13258.966	267			
10	Regression	10920.342	10	1092.034	120.008	.000[k]
	Residual	2338.624	257	9.100		
	Total	13258.966	267			
11	Regression	11327.228	11	1029.748	136.465	.000[l]
	Residual	1931.738	256	7.546		
	Total	13258.966	267			
12	Regression	11663.174	12	971.931	155.310	.000[m]
	Residual	1595.792	255	6.258		
	Total	13258.966	267			

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13	Regression	11946.879	13	918.991	177.903	$.000^{n}$
	Residual	1312.087	254	5.166		
	Total	13258.966	267			
14	Regression	12219.557	14	872.826	212.452	$.000^{o}$
	Residual	1039.409	253	4.108		
	Total	13258.966	267			
15	Regression	12474.282	15	831.619	267.073	$.000^{p}$
	Residual	784.684	252	3.114		
	Total	13258.966	267			
16	Regression	12720.285	16	795.018	370.441	$.000^{q}$
	Residual	538.682	251	2.146		
	Total	13258.966	267			
17	Regression	12832.979	17	754.881	443.019	$.000^{r}$
	Residual	425.987	250	1.704		
	Total	13258.966	267			
18	Regression	12937.454	18	718.747	556.644	$.000^{s}$
	Residual	321.513	249	1.291		
	Total	13258.966	267			
19	Regression	13017.444	19	685.129	703.505	$.000^{t}$
	Residual	241.522	248	.974		
	Total	13258.966	267			
20	Regression	13015.852	18	723.103	740.610	$.000^{u}$
	Residual	243.114	249	.976		
	Total	13258.966	267			
21	Regression	13072.890	19	688.047	917.021	$.000^{v}$
	Residual	186.076	248	.750		
	Total	13258.966	267			
22	Regression	13113.860	20	655.693	1116.125	$.000^{w}$
	Residual	145.106	247	.587		
	Total	13258.966	267			
23	Regression	13151.184	21	626.247	1429.336	$.000^{x}$
	Residual	107.782	246	.438		
	Total	13258.966	267			
24	Regression	13192.418	22	599.655	2207.667	$.000^{y}$
	Residual	66.548	245	.272		
	Total	13258.966	267			
25	Regression	13212.866	23	574.472	3040.564	$.000^{z}$
	Residual	46.100	244	.189		
	Total	13258.966	267			
26	Regression	13223.804	24	550.992	3807.843	$.000^{aa}$
	Residual	35.162	243	.145		
	Total	13258.966	267			
27	Regression	13235.674	25	529.427	5500.530	$.000^{ab}$
	Residual	23.293	242	.096		
	Total	13258.966	267			
28	Regression	13246.916	26	509.497	10189.839	$.000^{ac}$
	Residual	12.050	241	.050		
	Total	13258.966	267			
29	Regression	13252.348	27	490.828	17798.032	$.000^{ad}$
	Residual	6.619	240	.028		
	Total	13258.966	267			
30	Regression	13256.716	28	473.454	50278.332	$.000^{ae}$
	Residual	2.251	239	.009		
	Total	13258.966	267			
31	Regression	13257.915	29	457.169	103504.735	$.000^{af}$
	Residual	1.051	238	.004		
	Total	13258.966	267			
32	Regression	13258.964	30	441.965	42787734.823	$.000^{ag}$
	Residual	.002	237	.000		
	Total	13258.966	267			
33	Regression	13258.964	31	427.709	41999312.362	$.000^{ah}$
	Residual	.002	236	.000		
	Total	13258.966	267			

The final model will include only the significant predictors to explain Total Mark.

RESULTS AND DISCUSSION

Table 2 shows the descriptive statistics of the variables in this research. Based on Table 3, it is clear that there are 33 significant models possible to explain the Total Mark, which determines the grade of the premise. This can be proven by the ANOVA, Table 4 which clearly proof that all the 33 models are significant where $p<0.05$. However, using stepwise method, the best model was the 33rd model.

The coefficients are as shown in Table 5. Table 6 shows the residual statistics for model 33. The 33rd model is reliable since the standardized residuals are normally distributed as proven by Figure 2 (A), Figure 3(B) and Figure 3(C). The best model to determine Total Mark is

$$TotalMark = 0.105*Workers + 0.395*A3 + 0.332*A1 + 0.240*I26 + 0.255*C12 + 0.221*D13 + 0.160*B5 + 0.197*C10 + 0.215*A2 + 0.161*D15 + 0.139*B6 + 0.185*C11 + 0.141*M31 + 0.148*G23 + 0.142*D16 + 0.099*E17 + 0.048*H25 + 0.057*F18 + 0.072*J27 + 0.067*D14 + 0.069*H24 + 0.048*F20 + 0.032*F19 + 0.034*B7 + 0.034*L30 + 0.031*J28 + 0.024*B4 + 0.020*B8 + 0.010*G21 + 0.010*K29 + \varepsilon$$

Table 5. Coefficients (Model 33)

Variables	Notations	Unstandardized Coefficients	Standardized Coefficients	t	Sig.
		Std. Error	Beta		
	(Constant)	.006		360.547	.000
Workers	Food handlers health examination	.000	.105	2948.837	.000
A3	Control of cross contamination	.000	.395	13224.032	.000
A1	Critical control points	.000	.332	11384.415	.000
I26	Effective pest control	.000	.240	7777.359	.000
C12	Training and records	.000	.255	7613.080	.000
D13	Food Contact Surface	.000	.221	7422.501	.000
B5	Suitable floor condition	.000	.160	5182.167	.000
C10	Food handlers practice	.000	.197	6560.793	.000
A2	Raw materials specification	.000	.215	7211.111	.000
D15	Hygiene facilities and method	.000	.161	5427.652	.000
B6	Suitable floor and wall	.000	.139	4406.688	.000
C11	Protective clothing	.000	.185	5474.248	.000
M31	Risky other related activity	.000	.141	4981.020	.000
G23	Complete hand washing facility	.000	.148	4993.308	.000
D16	Suitable storage and FIFO	.000	.142	4797.870	.000
E17	Adequate and safe water supply	.000	.099	3316.054	.000
H25	Maintenance of disposal area	.001	.048	1464.288	.000
F18	Effective waste water	.001	.057	1824.445	.000
J27	Cleaning and maintenance	.001	.072	2279.056	.000
D14	Non-food contact surface	.001	.067	2230.972	.000
H24	Adequate waste bin	.001	.069	2072.787	.000
F20	Plumbing - well fitted	.001	.048	1514.444	.000
F19	Plumbing - no cross and back flow	.001	.032	1042.926	.000
B7	Adequate lighting	.001	.034	1100.905	.000
L30	Other documentation	.001	.034	1066.979	.000
J28	Separate storage cleaning chemical	.001	.031	1054.182	.000
B4	Away from source of contamination	.001	.024	773.795	.000
B8	Adequate ventilation	.002	.020	668.906	.000
G21	Adequate toilets	.004	.010	328.263	.000
K29	Transportation condition	.004	.010	318.069	.000

Table 6. Residual Statistics

	Min	Max	Mean	Std. Dev.	N
Predicted Value	60.92	98.85	88.14	7.047	268
Std. Predicted Value	-3.862	1.519	.000	1.000	268
Standard Error of Predicted Value	.000	.003	.001	.000	268
Adjusted Predicted Value	60.93	98.85	88.20	6.925	266
Residual	-.006	.008	.000	.003	268
Std. Residual	-1.831	2.397	.000	.940	268
Stud. Residual	-2.034	2.494	.001	1.006	266
Deleted Residual	-.007	.008	.000	.003	266
Stud. Deleted Residual	-2.048	2.522	.002	1.009	266
Mahal. Distance	4.659	266.004	30.884	30.332	268
Cook's Distance	.000	.044	.005	.007	266
Centred Leverage Value	.017	.996	.116	.114	268

a. Dependent Variable: Total Mark

Conclusion

The objectives are well-achieved. The significant factors to determine the grade of a premise are:

- Food handlers' health examination
- Control of cross contamination
- Critical control points
- Effective pest control
- Training and records
- Food Contact Surface
- Suitable floor condition
- Food handlers practice
- Raw materials specification
- Hygiene facilities and method
- Suitable floor and wall
- Protective clothing
- Risky other related activity
- Complete hand washing facility
- Suitable storage and FIFO
- Adequate and safe water supply
- Maintenance of disposal area
- Effective waste water
- Cleaning and maintenance
- Non-food contact surface
- Adequate waste bin
- Plumbing - well fitted
- Plumbing - no cross and back flow
- Adequate lighting
- Other documentation
- Separate storage cleaning chemical
- Away from source of contamination
- Adequate ventilation
- Transportation condition

The food handler's knowledge is very important in maintaining of the hygiene and safety of the food in the catering premises. Knowledge and behaviour are better among who had middle or higher school education combining with working experience in the catering sectors which the food handlers learn more throughout their daily task and hearing the basic theory of hygiene and food handling (Garayoa, Vitas, Díez-Leturia, and García-Jalón, 2011). Improper handling of food can lead to food poisoning through many factors. As reported in Taiwan, the primary cause of food poisoning is cross contamination (between raw and cooked food), insufficient heating, long holding period at room temperature, contamination by infected food handlers and contaminated by inadequately cleaned equipment (Ko, 2013). While in United State the risk factor which related to food poisoning are listed as improper holding temperatures, inadequate cooking, contaminated equipment, unsafe source; and poor personal hygiene (U.S Food and Drug Administration Public Health Services, 2015). The hygiene level of the kitchen and the food handlers practice is very important in maintaining the safety of food prepared such as temperature controls and most of the working surface in the kitchen. In Malaysia, the reported main reason for foodborne illness is related to insanitary food handling procedures which contribute 50% of the cases (Abdul-Mutalib, Syafinaz, Sakai, and Shirai, 2015).In future work, this research will be extended throughout all Malaysian states.

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