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COMPREHENSIVE ANALYSIS OF BANKRUPTCY PREDICTION ON STOCK EXCHANGE OF THAILAND SET 100

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Abstract:
This research aims to analyze the companies listed on SET 100 from the year 2013-2014 using Original Altman's Z-score bankruptcy prediction model and investigate the relationship of Altman's Z-score among variables: liquidity, profitability, leverage, solvency, and activity. The study utilized the survey method of gathering the financial information of 100 companies listed on SET 100 using SETSMART database. A multiple linear regression model has been used to assist the data analysis in terms of the relationship, descriptive analysis, ANOVA analysis, correlation analysis, and coefficients using PHSTAT program. The majority of the 100 companies listed on SET 100 were most likely in the "Safe Zones" for bankruptcy based on the analyzed financial data. The industrial industry appears to be more resilient to bankruptcy risk among other industries. The solvency variable is high volatile for both years among the variables. We concluded that monitoring of solvency variable is important before the liabilities surpass the assets and the firm becomes bankrupt. For the year 2013 the liquidity variable has high correlation, we recommended that liquidity variable should be handled with extreme caution since this variable is significant because it reflects whether a business will be able to pay off its short term debt. Finally, we concluded that Original Altman's Z-score model fits in analyzing the companies listed on SET 100 for both years. F-test result suggest that all variables affects the Original Altman's Z-score wherein they are very significant in predicting bankruptcy that gives an early warning system for the management and investors.

Keywords: Bankruptcy, Financial ratio, Original Altman's Z-score model, SET 100

1. INTRODUCTION

Bankruptcy prediction is the art of predicting bankruptcy and it is a vast area of finance and accounting research. An appropriate prediction of firm bankruptcies influences the important and has a great attention to a wide range of relevant financial actors. For the prediction of business failure gives interest to all stakeholders, mostly investors and creditors. Bankruptcy prediction models are mostly known as measures of financial distress and methods of financial distress of public firms.

Around the world, including Thailand is not exempted in any business failures. In Thailand, the SET 100 was created to accommodate the issuing of index futures and set some options and to provide a benchmark of investment in the Stock Exchange of Thailand (SET) in the future. It empowered the strength of business and the investors to match the right of financial opportunities of their clients and intermediaries by expanding business issuers and the investor base by satisfying their financial needs and strengthening intermediaries for mutual growth and success. Bankruptcy prediction plays a vital role to avoid business failures in the companies listed on SET 100.

The prominent and most-widely used, multiple discriminant analysis method is the one suggested by Edward Altman, Professor of Finance at the Stern School of Business, New York University. Altman's Z-score, or zeta model, which joined various measures of profitability or risk. The resulting model was one that demonstrated a company's risk of bankruptcy relative to a standard. Altman's initial study proved his model to be very accurate; it correctly predicted bankruptcy in 94% of the initial sample (Altman 1968).

Business bankruptcy for a certain company is an absolute affirmation of its inability to endure current operations given its current debt obligations. If the bankruptcy was expected ahead of time, investors of the companies have the ability to secure their companies and could take actions to reduce risk and loss of business and perhaps avoid bankruptcy itself (Meeampol, Lerskullawat, Wongsorntham, Srinammuang, Rodpetch, & Noonoi, 2014). The purpose of this study is to analyze the companies listed on SET 100 from the year 2013-2014 using Original Altman's Z-score bankruptcy prediction model.

2. LITERATURE REVIEW

Thailand was aware of the bankruptcy since an economic crisis occurred in 1997, particularly resilient destroyed by the bankruptcy. Furthermore, the steady increase of bankruptcy cases being filed in the Legal Execution Department (LED) an agency of the Ministry of Justice in charge of bankruptcy administration in Thailand (Kanok Jullamon, 2010).

The enactments of listed firms in developing capital market such as Thailand aid the expansion of public and private sectors either they were listed on the Stock Exchange of Thailand (SET).

2.1. Stock Exchange of Thailand (SET)

The SET empowered business and investors through their strengths to match the right of financial opportunities of their clients and intermediaries by expanding business issuers and the investor base by satisfying their financial needs and strengthening intermediaries for mutual growth and success. They offered a wide range of attractive products and services to create value and match financial opportunities across different segments of business and investors. It operates with flawless execution according to international standards to ensure efficiency, effectiveness, flexibility and global connectivity.

SET 100

The SET100 were created to accommodate the issuing of index futures and options in the future, and to provide a benchmark of investment in the Stock Exchange of Thailand (SET). The indices are calculated from the stock prices of companies that are included in the SET Index, the index consists of a subset of those stocks by a ranking based on large market capitalization, high liquidity and compliance with requirements regarding the distribution of shares to minor shareholders: those stocks ranked as the top 50 such stocks are the component stocks of the SET50 Index and those ranked as

the top 100 — which also includes the top 50 — are the component stocks of the SET100 Index. The base dates used are 16 August 16, 1995 (SET50 Index) and 30 April 2005 (SET100 Index), which are the respective dates that the two indices were first published and were set to a base value of 1000 points. The base market value is continually adjusted to correspond to changes in the market values of the underlying securities of each index. *(*Stock Exchange of Thailand, 2012). The complete list of SET 100 for the year 2013 and 2014 is found in Appendix A.

2.2. The Altman's Z-score

The Z-Score was developed in 1968 by Edward I. Altman, an Assistant Professor of Finance at New York University, as a quantitative balance-sheet method of determining a company's financial health. A Z-score can be calculated for all non-financial companies and the lower the score, the greater the risk of the company falling into financial distress. This predictor is a statistical model that combines five financial ratios to produce a product called a Z-score. The model has recognized to be a reliable instrument in forecasting failure in a diverse mix of business entities. Dr. Altman's original model was calculated as follows:

$$Z = 1.2X1 + 1.4X2 + 3.3X3 + 0.6X4 + .999X5$$

The Original Z-score component definitions variable definition weighting factor are as follows:

X1 = Working Capital / Total Assets
X2 = Retained Earnings / Total Assets
X3 = Earnings Before Interest and Taxes / Total Assets
X4 = Market Value of Equity / Total Liabilities
X5 = Sales / Total Assets

Variable selection

Altman initially selected 22 financial ratios on the basis of their popularity in academic literature and their potential relevancy to bankruptcy prediction. After evaluating the discriminant powers of the variables in an iterative process. The variables are classified into five standard ratio categories: liquidity, profitability, leverage, solvency, and activity wherein:

- X1 = Working Capital/Total Assets (WC/TA). Working capital is defined as the difference between current assets and current liabilities. The WC/TA ratio is a measure of liquidity in relation to total capitalization. Firms headed towards bankruptcy would be expected to have a shrinking WC/TA ratio. A positive working capital indicates a firm's ability to pay its bills. A business entity with a negative working capital will experience difficulty meeting its obligations. Altman's research finds this ratio to be more helpful than other liquidity ratios, such as the current ratio or the quick ratio. (Altman, 2000).
- X2=Retained Earnings/Total Assets (RE/TA). This ratio, a measure of cumulative profitability over time, is an indicator of the firm's age. A young company is less likely to have been able to build up its retained earnings since it would have to reinvest much, if not all, of its earnings to stimulate growth. More mature and stable companies would have a higher RE/TA ratio. The younger firm is somewhat discriminated against by this ratio, but it turns out that this is precisely the situation in the real world. Altman (1993) shows that the frequency of bankruptcy is much higher in a firm's earlier years.
- X3 = Earnings before Interest and Taxes/Total Assets (EBIT/TA). This ratio is a measure of the productivity of the firm's assets, which is a fundamental element in the survival of a firm. Altman (2000) classifies the ratio as a superior measure of profitability that is better than cash flow.
- X4= Market Value of Equity/Book Value of Total Liabilities (MVE/TL). This ratio is the reciprocal of the debt-to-equity ratio, which measures financial leverage. Altman explains that the MVE/TL ratio shows how much a firm's assets can decline in value before the liabilities exceed the assets and the firm becomes insolvent.
- X = 5 Sales/Total Assets (S/TA). This ratio, the standard capital turnover ratio, indicates the sales generating ability of the firm's assets. It is also a measure of management's ability in dealing with competitive conditions. Altman shows that this is the least significant ratio on an individual basis, but it has the second highest discriminating ability due to its unique relationship with the other variables.

The interpretation of Original Altman's Z-score model are the following:

Z > 2.99 -"Safe" Zones
1.81 < Z < 2.99 -"Gray" Zones
Z < 1.81 -"Distress" Zones

2.3. Analysis of Stock Exchange of Thailand (SET) Using Altman's Z-score

Meeampol et. al (2014) studied the Stock Exchange of Thailand (SET) Using Altman's Z-score confirmed that according to their evidence that all the variables should be positive in order to have a higher Z-score; the higher the variables of the Z-score model the higher the Z-Score as resulted the companies will be saved from the financial distress.

Srinammuang, (2015) concluded that liquidity and solvency variables were very important in predicting bankruptcy in the financial sector industry in Thailand base on the SET 100 financial information analyzed. Wherein, liquidity variable measures liquid assets as firm in trouble will usually experience shrinking liquidity or more working capital there is compared to the total assets, the better the liquidity situation while the solvency offers a quick test of how far the company's assets can decline before the firm becomes technically insolvent (i.e. Its liabilities surpass its assets).

3. METHODOLOGY

3.1. Research Process

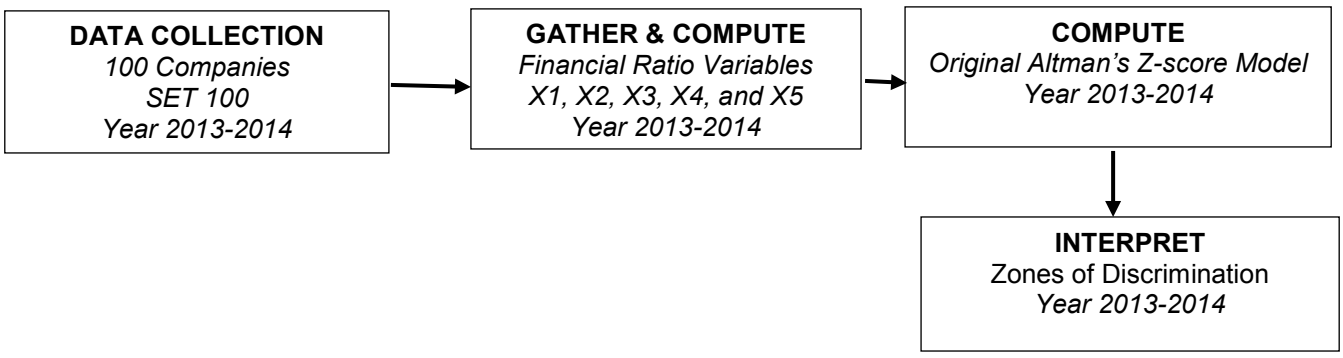
The study utilized the survey method of gathering the financial information of 100 companies listed on SET 100 in the year 2013-2014 using SETSMART database.

Research Process

Picture 1 showed the research process of this study. First, we determined the Original Altman's Z-score with the following steps: (1) the financial information from balance sheet and income statement were gathered from 100 companies listed in SET 100; (2) the particular ratios included in the variables of financial ratio were gathered and computed and as follows: (a) liquidity X1 = Working Capital / Total Assets, (b) profitability X2 = Retained Earnings / Total Assets, (c) leverage X3 = Earnings Before Interest and Taxes / Total Assets, (d) solvency X4 = Market Value of Equity / Total Liabilities, and (e) activity X5 = Sales / Total Assets; (3) the Altman's Z-score were computed using the Original Altman's Z-score model; and (4) the zone of discrimination of each companies were interpreted.

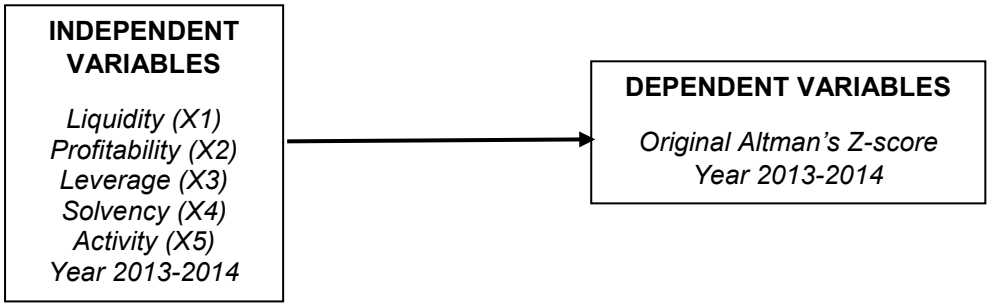
According to the conceptual framework showed in Picture 2, we define liquidity (X1), profitability (X2), leverage (X3), solvency (X4), and activity (X5) in the year 2013-2014 as an independent variables while the dependent variable is Original Altman's Z-score of SET 100 for the year 2013-2014.

Picture 1: Research Process



Source: Author processing, 2016

Picture 2: Conceptual Framework of Variables



Source: Author processing, 2016

3.2. Research Design

The purpose of this study is to analyze the companies listed on SET 100 for the year 2013-2014 using Original Altman's Z-score bankruptcy prediction model and investigate the relationship of Original Altman's Z-score and financial ratio variables (X1, X2, X3, X4, and X5).

In order to successfully achieve the study objective or appropriately test the hypotheses that were proposed in this research, the descriptive, analytical methods, and quantitative analysis techniques were used. The multiple regression was used to allow the relationship of Original Altman's Z-score and financial ratio variables (X1, X2, X3, X4, and X5) for the year 2013-2014. Multiple regression is used when predicting the value of a variable based on the value of two or more other variables (Levine et. al., 2001). This was achieved through the assistance of PHSTAT program. Furthermore, regression and correlation analysis in the data analysis of this study has been used to identify relationships between the dependent and independent variable. The PHSTAT program will give the outcome of ANOVA summary which is significant in rejecting the hypothesis stated in this study.

3.3. Hypotheses

According to the dependent and independent variables shown in Picture 1, we proposed the following hypotheses:

H1 liquidity (X1) financial ratio variables affects the Original Altman's Z-score.
H2 profitability (X2) financial ratio variables affects the Original Altman's Z-score.
H3 leverage (X3) financial ratio variables affects the Original Altman's Z-score.
H4 solvency (X4) financial ratio variables affects the Original Altman's Z-score.
H5 activity (X5) financial ratio variables affects the Original Altman's Z-score.

4. DATA ANALYSIS AND EMPIRICAL RESULTS

4.1. Analysis of SET 100 Using Original Altman's Z-score Model

The study utilized the survey method wherein 100 companies listed on SET 100 were analyzed. The distribution of sample size (N=100) according to industry classification are as follows and rank according to the highest frequency: 1st-services (29), 2nd - property and construction (26), 3rd-resources (14), 4th - financial (13), 5th - technology (10), and 6th - industrial (8). According to Table 1 the Original Altman's Z-score mean for both years 2013 and 2014 were above 2.99 it indicates that majority of industries were in the "Safe Zones" for bankruptcy. The lowest Original Altman's Z-score mean was industrial industry for both years, and also had the lowest frequency distribution (8) this revelation suggests that industrial industry is risky, or it appears to be more resilient to bankruptcy risk, among other industries.

Table 1: Descriptive statistics of SET 100 according to industry classification.

INDUSTRY	Frequency	Original Altman's Z-score Mean	
YEAR		*2013*	*2014*

Financial	13	7.04	6.22
Industrial	8	5.58	5.71
Property and Construction	26	11.95	11.95
Resources	14	15.14	13.29
Services	29	6.42	7.31
Technology	10	13.3	13.03
TOTAL N=	**100**		

Source: Author processing, 2016
Note: Zones of Discrimination:
Z > 2.99 -"Safe" Zone; 1.81 < Z < 2.99 -"Gray" Zone, and Z < 1.81 -"Distress" Zone

Table 2 shows the descriptive statistics of Original Altman's Z-score for the year 2013 and 2014. There were 100 samples of companies listed on SET 100. It was reflected that the mean of Original Z-score for both years 8.95 (2013) and 9.03 (2014) were above 2.99 and interpreted as "Safe Zones" for bankruptcy. The standard deviation for both years 19.31 (2013) and 21.18 (2014) were adjacent to each other with a slight difference. The maximum value for both years were: 283.53 (2013), and 201.04 (2014), while the minimum value were -0.57 (2013), and 0.25 (2014).

Table 2: Descriptive statistics of Altman's Z-score of 2013 and 2014.

	Original Altman's Z-score	
Descriptive Statistics	*2013*	*2014*
N=100		
Standard Deviation	19.31	21.18
Mean	8.95	9.03
Maximum	283.53	201.04
Minimum	-0.57	-0.25

Source: Author processing, 2016
Note: Zones of Discrimination:
Z > 2.99 -"Safe" Zone; 1.81 < Z < 2.99 -"Gray" Zone, and Z < 1.81 -"Distress" Zone

Table 3 shows the percentage and frequency distribution of zone of interpretation for 2013-2014. According to Table 3, the safe zone constituted the most numbers. Sixty or 60% (2013) and fifty-six or 56% (2014).

Table 3: Percentage and Frequency Distribution of Zone of Interpretation for 2013-2014.

Zone of Interpretation	**Frequency 2013**	**Percentage**	**Frequency 2014**	**Percentage**
Safe Zone	60	60%	56	56%
Gray Zone	19	19%	20	20%
Distress Zone	21	21%	24	24%
TOTAL N =	**100**	**100%**	**100**	**100%**

Source: Author processing, 2016
Note: Zones of Discrimination:
Z > 2.99 -"Safe" Zone; 1.81 < Z < 2.99 -"Gray" Zone, and Z < 1.81 -"Distress" Zone

Table 4 presents the descriptive statistics of Original Altman's Z-score and financial ratio variables, it revealed a large difference in each variable between 2013 and 2014. The solvency (X4) variable has

the highest maximum value for both years with the value of 304.78 (2013) and 332.77 (2014). The profitability (X2) and leverage (X3) variable has the lowest and has the same minimum value of -0.62 (2013) while liquidity (X1) variable has the lowest minimum value of -1.77 (2014). In terms of standard deviation of the given variables, the solvency (X4) variable has the highest value for both years with the value of 31.92 (2013) and 34.73 (2014) respectively. This result indicates that solvency (X4) variable is high volatile among the given variables.

Table 4: Descriptive Statistics of Original Altman's Z-score and Financial Ratio Variables

Variables and Years	Minimum	Maximum	Mean	Standard Deviation
2013				
X1	-0.4119108	28.5180983	0.6311975	2.9631
X2	-0.6240562	7.4099456	0.2816039	0.7465
X3	-0.6240562	7.4099456	0.3427666	2.9631
X4	0.00104022	304.78431	10.277678	31.9226
X5	0.0004782	192.922563	3.3084038	19.4654
2014				
X1	-1.7693433	5.617293	0.3925386	1.024
X2	-0.7137912	12.3802074	0.3362006	1.2347
X3	-0.2029693	7.29674527	0.2438156	0.897
X4	0.0041792	332.773938	10.438685	34.7395
X5	0.00016561	21.4970942	0.9971893	2.4379

Source: Author processing, 2016

4.2. Analysis of SET 100 Using Multiple Regression

Table 5 presents the Model Summary of regression statistics for the year 2013 and 2014. It was revealed that both years 2013 and 2014 the R squared were related or similar to each other which has a score of 0.9989 or 99% (2013) and 0.9999 or 99% (2014) respectively. This result indicates that 99% of the variations in Original Altman's Z-score can be explained by the variation of liquidity (X1), profitability (X2), leverage (X3), solvency (X4), and activity (X5). Also, the Adjusted R Square score for both years were similar, indicating that 99% capability of the variations in Original Altman's Z-score can be explained by the multiple regression model, as adjusted for the number of predictors and sample size.

Table 5: Model Summary for the year 2013 and 2014

Regression Statistics	2013	2014
Multiple R	0.9994	1.0000
R Square	0.9989	0.9999
Adjusted R Square	0.9988	0.9999
Standard Error	1.1544	0.1547
Observations	100	100

a. Predictors: (Constant), Liquidity (X1), Profitability (X2), Leverage (X3), Solvency (X4), Activity (X5)
b. Dependent Variable: Original Altman's Z-Score - criterion variable
Source: Author processing, 2016

According to the table of coefficients showed in Table 6 for the year 2013, we found the P-value of five independent variables: liquidity X1 (0.237), profitability X2 (0.000), leverage X3 (0.000), solvency X4

(0.000), and activity X5 (0.000) were significantly related to Original Altman's Z-score. The scale variable and the interceptor were significant at the 5 % level of significance as the P-value is lower than 0.05. VIF value of four independent variables: profitability (X2), leverage (X3), solvency (X4), and activity (X5) was less than 10 (VIF<10) which means there is no collinearity. However, liquidity (X1) variable has too much correlation which have 11.87, the VIF is greater than 10 (VIF>10) this indicates that independent variable liquidity (X1) should be handled with extreme caution.

Table 6: Coefficients for the year 2013

	Coefficients	**Standard Error**	**t Stat**	**P-value**	**VIF**
	2013	*2013*	*2013*	*2013*	*2013*
Intercept	-0.157	0.132	-1.190	0.237	
X1	1.496	0.135	11.092	0.000	11.865
X2	1.322	0.159	8.339	0.000	1.092
X3	3.342	0.241	13.839	0.000	8.160
X4	0.601	0.004	165.153	0.000	1.001
X5	0.951	0.017	55.842	0.000	8.164

Source: Author processing, 2016

Table 7 shows the coefficient for the year 2014, we found the P-value of five independent variables: liquidity X1 (0.256), profitability X2 (0.000), leverage X3 (0.000), solvency X4 (0.000), and activity X5 (0.000) were significantly related to Original Altman's Z-score. The scale variable and the interceptor were significant at the 5 % level of significance as the P-value is lower than 0.05. The VIF value of all those variables was less than 10 (VIF<10) which means there is no collinearity.

Table 7: Coefficients for the year 2014

	Coefficients	**Standard Error**	**t Stat**	**P-value**	**VIF**
	2014	*2014*	*2014*	*2014*	*2014*
Intercept	0.022	0.019	1.144	0.256	
X1	1.197	0.019	63.614	0.000	1.534
X2	1.399	0.013	110.885	0.000	1.003
X3	3.297	0.021	153.747	0.000	1.530
X4	0.600	0.000	1336.275	0.000	1.006
X5	1.002	0.006	156.236	0.000	1.011

Source: Author processing, 2016

Table 8 presents the ANOVA test, for the year 2013 it was revealed that the F test value is 595.298 and the P value (0.000) is less than 0.05 (P<0.05) which means the variables are significantly related and the model is acceptable. For the year, 2014 it was revealed that the F test value is 371068.786 and the P value (0.00) is less than 0.05 (P<0.05) which means the variables are significantly related and the model is acceptable.

The revelation of the ANOVA test indicates that proposed hypotheses is accepted and that H1 liquidity (X1), H2 profitability (X2), H3 leverage (X3), H4 solvency (X4), and H5 activity (X5) financial ratio variables affects the Original Altman's Z-score.

Table 8: ANOVA

ANOVA	***2013***				
	df	**SS**	**MS**	**F**	**Significance F**
Regression	4	107304.080	26826.0200	595.298	0.000

Residual	95	4281.005	45.0632		
Total	99	111585.085			
	2014				
Regression	5	44422.136	8884.4274	371068.786	0.000
Residual	94	2.251	0.0239		
Total	99	44424.388			

a. Predictors: (Constant), Liquidity (X1), Profitability (X2), Leverage (X3), Solvency (X4), Activity (X5)
b. Dependent Variable: Original Altman's Z-Score - criterion variable
Source: Author processing, 2016

5. CONCLUSION

The study analyzed the companies listed on SET 100 for the year 2013-2014 using Original Altman's Z-score bankruptcy prediction model and investigate the relationship of Altman's Z-score among given financial ratio variables: liquidity (X1), profitability (X2), leverage (X3), solvency (X4), and activity (X5). The paper found out that the majority of the 100 samples of companies listed on SET 100 were most likely in the "Safe Zones" for bankruptcy based on the analyzed financial data. The industrial industry appears to be more resilient to bankruptcy risk among other industry. Negligence, fraud, economic recessions, and other factors may cause an unexpected problem.
The solvency (X4) variable is high volatile for both years among the variables since the elements of this ratio (market value of equity) depends on the company's current stock price which is subject to volatility multiply by its number of outstanding shares. Thus, we concluded that monitoring of solvency variable is important before the liabilities surpass the assets and the firm becomes bankrupt.

Based on the regression statistics results we found out that 99% of the variations in Original Altman's Z-score can be explained by the variation of: liquidity (X1), profitability (X2), leverage (X3), solvency (X4), and activity (X5), thus this model fits in predicting the companies listed in SET 100 for the year 2013-2014.

For the year 2013 and 2014 the ANOVA test indicates that proposed hypotheses is accepted that: H1 liquidity (X1), H2 profitability (X2), H3 leverage (X3), H4 solvency (X4), and H5 activity (X5) financial ratio variables affects the Original Altman's Z-score. However, in the year 2013 the liquidity (X1) variable has too much correlation indicating that liquidity (X1) should be handled with extreme caution since this variable is significant because it reflects whether a business will be able to pay off its short term debt.

Finally, we concluded that Original Altman's Z-score model fits in analyzing the companies listed on SET 100 for the year 2013-2014. Each five variables affect the Altman's Z-score wherein they are very significant in predicting bankruptcy that gives an early warning system for the management and investors improved disclosure of trouble ahead.

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