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Prediction of Bankruptcy Potential Company of Drinking Water Region

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ABSTRACT.: *This study aims to predict the potential bankruptcy of the Regional Water Company in Indonesia. The research data is the PDAM's financial statements in 2015 and the performance evaluation data of PDAM in 2016. The method used in this research is discriminant method and theory of conditional probability of Bayes. The dependent variable is the category of bankrupt and not bankrupt, while the independent variables are 10 financial ratios such as Net Working Capital to Total Asset, Retained Earning to Total Asset, EBIT to Total Asset, Book Value of Equity to Book Value of Total Debt, Sales to Total Asset, Return On Equity, Operating Ratio, Cash Ratio, and Billing Effectivity. However, for multicollinearity reasons then EBIT to Total Assets and Debt to Asset Ratio is eliminated. The results of the discriminant analysis showed that 8 independent variables can show a significant difference and can form a discriminant function.*
KEYWORDS: *PDAM, discriminant, bankruptcy, financial ratio*

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I. INTRODUCTION

Lately the phenomenon of bankruptcy of a company is a matter that must be observed by every business actor such as owners of capital, management, investors, bank lenders and even by researchers. Although many studies have studied the phenomenon of corporate bankruptcy, but the prediction of bankruptcy is sometimes still less precise or perfect. Many companies are predictably healthy but eventually go bankrupt because of something that has not or can not be predicted before.

Corporate bankruptcies usually begin with a financial distress. The accuracy of a prediction of financial distress or bankruptcy is based on the accuracy and completeness of the data used as a predictor. Usually for companies that have go-public have complete and accurate data, but for companies that have not go-public, the data is a relatively difficult thing. Bankruptcy research on companies in the drinking water sector, especially the Regional Water Company (PDAM) has not been done by many academic / researchers before. PDAM is a company of Regional Owned Enterprises (BUMD) is very unique to be studied, especially for the possibility of default or financial distress.

Some PDAMs in Indonesia have already reached professional and bankable level of companies where the Bank has provided commercial loans to several PDAMs. But there are still many PDAMs that can not yet be said by professional and bankable companies due to unhealthy financial and management conditions. This condition is reflected in several PDAMs that have defaulted on loans, especially loans from the Central Government. The unhealthy financial condition makes the PDAM unable to settle loan repayments either principal or interest. Based on December 2012 data from the Ministry of Finance, out of a total of 187 PDAMs with loans to the Central Government, 110 PDAMs have delinquent status.

PDAM is a company that controls the livelihood of many people in the provision of drinking water so that for the sake of the PDAM's delinquent business, the Government provides loan restructuring program. Improvements in finance and management of PDAM continue to be done so PDAM able to become a professional company. Based on PDAM performance appraisal conducted by the Water Supply System Development Supporting Agency (BPPSPAM), it is stated that there has been no significant change in PDAM health every year. Although the health assessment is not a prediction of bankruptcy but can be used as a reference for financial distress and management professionalism of a PDAM.

Based on PDAM performance evaluation, PDAMs that are categorized as unhealthy or sick have criteria that the PDAM has not been able to generate profit or loss. And some PDAMs that are categorized as healthy if they have a performance value of less than 3 then also have not been said to generate profit or loss despite having a better financial condition. Therefore, it can be concluded that during the year 2013-2016 almost 60% of PDAMs in Indonesia have not produced profit or loss. The disadvantages of PDAMs are generally caused by the selling rate of water that is below the cost of production which is triggered by high levels of water

leakage and inefficient PDAMs. From the phenomenon, it can be seen that the signs of financial distress that can go bankruptcy on the PDAM is very large, especially the persistent losses suffered by PDAM.

The study of the prediction of financial distress or the bankruptcy of a well-known company conducted by Altman (1968,1977, and 2000) with the Altman Z-Score method and its changes. In the Altman Z-Score method used financial ratios that can predict bankruptcy, besides many studies that use additional financial ratios such as solvency ratios, liquidity ratios, rentability ratios and other ratios. Another research which was done by Springate (1978) followed the procedure used by Altman (1968) and Ohlson (1980) using logistic analysis for several financial ratios, Zmijewski (1984) using financial ratio analysis that measures leverage and liquidity performance, and Fulmer (1984) used a step-wise multiple discriminant analysis of financial ratios. As for new financial distress or bankruptcy research also conducted by Moghadas *et al.,* (2014) with logistic regression method for companies in Iran, Bartual *et al.,* (2013) with logistic regression method for companies in Spain, Bredart (2014) by logistic regression method for companies in the United States, Bhandari (2014) with discriminant analysis for companies in the United States, Mraihi (2015) with logistic regression method for companies in Tunisia, Abdullah (2016) with logistic regression for firms in Malaysia, and Mihalovic (2016) with discriminant analysis for companies in Slovakia.

New research models used to predict financial distress or bankruptcy are also conducted by researchers in Indonesia such as Kamaludin *et al.,* (2011) with logistic regression method in manufacturing sector at BEI, Utomo *et al.,* (2011) by regression method logistics in the banking sector, Malau *et al.,* (2012) with logistic regression method on trading sector in BEI, Haq *et al.,* (2013) with logistic regression method on banking sector in BEI, Wongsosudono *et al.,* (2013) with logistic regression method in financial sector at BEI, Pane *et al.,* (2013) with discriminant model at manufacture company in BEI, Rahmawati and Pramono (2013) with discriminant model on bankruptcy of food and beverage company in BEI, Kristanti (2014) with logistic regression method at company in BEI, Pujiastuti (2014) with logistic regression method in manufacturing sector at BEI, Yuliana (2015) with discriminant method on mining sector in BEI, Loman *et al.,* (2015) with logistic regression method in manufacturing sector in BEI, and Paramitha (2016) with logistic and discriminant regression method in banking sector in BEI.

However, the phenomenon of the above studies is only done to private companies and even most have go-public so it is less appropriate if applied to local companies such as taps that have different characteristics. In addition, the use of financial ratios in each of the previous studies also varies so differently when applied to PDAMs. Other things found in previous studies have also been carried out at different times to the present conditions so that they will cause improper apabilities to be applied to the company's current conditions. It is therefore necessary to examine the PDAM bankruptcy model with data and information derived from the PDAM as well as the use of financial ratios that affect the bankruptcy of the PDAM and use more updated data.

II. LITERATURE REVIEW

Financial distress is a financial difficulty that may lead to bankruptcy. Bankruptcy is a financial hardship so severe that a company can no longer perform its operations properly. Financial distress can also be interpreted as a broad concept that consists of several situations in which a company faces financial difficulties. Common terms to describe the situation are bankruptcy, failure, inability to pay off debt, and default. The inability to pay off debt shows a negative performance and indicates a liquidity problem. Platt and Platt (2002) define financial distress as a stage of declining financial conditions experienced by a company, which occurred prior to the occurrence of bankruptcy or liquidation. Whitaker (1999) states that a company can already be said to suffer financial difficulties in the first year of cash flow less than long-term liabilities due. According to Siegel and Shim (2000), when viewed from the financial side, the risk of bankruptcy is as a final statement of the inability of a company to continue its operational activities and the obligation to pay the debts.

Based on the understanding of financial distress and bankruptcy above, it can be seen clearly about the relationship of financial distress and bankruptcy. According to Altman (2000), the relationship between financial distress to bankruptcy predictions is that there are many definitions of financial difficulties, economically predicting bankruptcy. Subramanyam and Wild (2012) say the same thing, financial distress is a model of financial difficulties, usually more directed to the predicted model of bankruptcy. At the time the company enters the final stages of failure or bankruptcy, there will be a pattern of corporate financial change. Although bankruptcies can not be predicted with certainty, there are several financial ratios that have proven successful as an immediate indicator of the occurrence of bankruptcy havoc. A study conducted by Altman (1968), developed a statistical model that then succeeded in formulating financial ratios to predict the occurrence of bankruptcy.

There are so many studies that predict the bankruptcy of a company. Each model of research results has different accuracy in predicting bankruptcy. The predicted model of bankruptcy can be made by anyone with any method ever. The predicted corporate bankruptcy models that have been studied can be described as follows:

1. Altman (1968) in his research produced a formula using 5 (five) financial ratios to predict bankruptcy, which was compiled using the following formula:
   Z-Score = 1,2 X1 + 1,4 X2 + 3,3 X3 + 0,6 X4 + 0,99 X5
   Where: X1 = Working capital of total Assets, X2 = Retained earnings to total Assets, X3 = Earning before interest and taxes to total Assets, X4 = Value of shares to book value of debt, and X5 = Sales to total assets. Later in its development, Altman (1977) adjusted the model and many researchers felt more comfortable with the following formula:
   Z = 1.2X1 + 1.4X2 + 3.3X3 + 0.6X4 + 1.0X5
   Since not all firms go public and do not have market value, Altman (2000) develops a formula for companies that do not go public, thus being transformed into the following:
   Z = 0.717X1 + 0.847X2 + 3,107X3 + 0,420X4 + 0,998X5
   Where for variable X4 = book value of equity / book value of total liabilities.
2. Ohlson (1980) built 3 models, where each model consists of the same variables. Ohlson's built model has 9 variables consisting of several financial ratios. Here is the Ohlson (1980) model:
   O = -1,32-0,407X1 + 6,03X2-1,43X3 + 0,0757X4-2,37X5-1,83X6 + 0,285X7- 1,72X8- 0,521X9
   Where: X1 = Log (total assets / GNP price-level index), X2 = Total liabilities / total assets, X3 = Working capital / total assets, X3 = Working capital / total assets, X6 = Net income / total assets, X6 = Net income / total assets, and X9 = (Nit - Nit-1) / (Nit + Nit-1).
3. Zmijewski (1984) uses a ratio analysis that measures the performance of a firm's leverage and liquidity for its predictive model. Zmijewski used the analytical probit applied to 40 companies that had gone bankrupt and the 800 companies that survived at the time. Successfully developed models are:
   X = -4,3 -4,5X1 + 5,7X2 - 0,004X3
   Where: X1 = ROA (return on asset), X2 = Leverage (debt ratio), and X3 = Liquidity (current ratio).
4. Fulmer (1984) used a step-wise multiple discriminant analysis to evaluate the 40 financial ratios applied to a sample of 60 firms, 30 failures and 30 successes with the average size of the firm's asset being $ 455,000. Fulmer reported an accurate 98% on the company one year before it failed and 81% was accurate over a year before the bankruptcy. The Fulmer model is:
   H = 5,528V1 + 0,212V2 + 0,073V3 + 1,270V4 - 0,120V5 + 2,335V6 + 0,575V7 + 1,083V8 + 0,894V9 - 6,075
   Where: V1 = Retained Earning / Total Assets, V2 = Sales / Total Assets, V3 = EBT / Equity, V4 = Cash Flow / Total Debt, V5 = Debt / Total Assets, V6 = Current Liabilities / Total Assets, V7 = Log Tangible / Total Assets, V7 = Log Tangible / Total Assets, V8 = Working Capital / Total Debt, and V9 = Log EBIT / Interest. If H <0, the company is classified as "fail".
5. The Springate model developed by Springate (1978) follows the procedure used by Altman (1968). Springate uses four of 19 financial ratios and uses multi discriminant analysis using 40 companies as its sample. This model can be used to predict bankruptcy with a level of accuracy of 92.5%. The successful model developed by Springate is:
   S = 1.03A + 3.07B + 0.66C + 0.4D
   Where: A = working capital / total assets, B = net profit before interest and taxes / total assets, C = net profit before taxes / total assets, and D = sales / total assets.

Financial ratios are figures derived from the comparative results of a financial statement post with other posts having relevant and significant relations. This ratio will simplify the information that describes the relationship between a particular post with another post. This simplification allows us to quickly assess the relationship between the post and compare it with other ratios so that information and judgment can be obtained. According to Husnan (1998), in general the various calculated ratios can be grouped into four basic types:

1. Liquidity ratio is to measure the ability of the company for short-term financial obligations. Usually commonly used is the current ratio and quick ratio.
2. Leverage ratio that measures how far the company is funded with debt. Usually commonly used is the debt ratio, debt to equity ratio, and long term debt to equity ratio.
3. The activity ratio, which measures how effectively the company uses its resources. Usually commonly used is turn over assets ratio and turn over inventory ratio.
4. Profitability ratios, which measure overall management effectiveness as indicated by profits generated from sales and investments. Usually commonly used is the operating profit ratio, net profit ratio, return on total assets and return on investment.

In predicting bankruptcy, financial statements are very important data for any method of bankruptcy prediction used. From the financial statements of the company can be seen the company's financial condition through its financial ratios.

III. RESEARCH METHODOLOGY

The research type of this thesis is the ex post facto quantitative research which uses data that has happened in the past. By using this method can be formed a function that serves to explain more deeply about the influence of financial ratios to bankruptcy. The perspective of quantitative research approach from this research is to find the model / function of bankruptcy and the potential percentage of PDAM bankruptcy through discriminant analysis.

The dependent variable used is bankruptcy. While the independent variables consist of Net Working Capital to Total Assets, Retained Earning to Total Assets, EBIT to Total Assets, Book Value of Equity to Book Value of Total Debt, Sales to Total Assets, Return On Equity, Operating Ratio, Cash Ratio, Debt to Asset Ratio, and Billing Effectivity. The reasons for the selection of independent variables are the five independent variables are the financial ratios of the Altman Z-score model for non-go public companies (Net Working Capital to Total Assets, Retained Earning to Total Assets, EBIT to Total Assets, Book Value of Equity to Book Value of Total Debt, and Sales to Total Assets) and 5 independent variables are financial ratios from financial aspect (Return On Equity, Operating Ratio, Cash Ratio, Debt to Asset Ratio, and Billing Effectivity) on PDAM performance evaluation by BPPSPAM. However, due to the multicollinearity problem, EBIT to Total Asset and Debt to Asset Ratio variables must be eliminated.

The population of this study are all Regional Water Companies located in Indonesia in 2016 amounting to 371 PDAMs based on PDAM performance evaluation report by BPPSPAM. While the sample research taken from the existing population by using purposive sampling technique, with the following sample criteria:

a. Regional Water Company has been established for at least 2 years or since 2014.
b. The Regional Water Company has and reports the minimum financial report since 2015.
c. Regional Water Company has been included in annual PDAM performance report made by BPPSPAM since at least 2015.

Based on the criteria from the above samples, the authors obtained a sample with 368 PDAMs consisting of 196 healthy PDAMs and 172 less healthy / sick PDAMs. However, the number of samples was reduced to 276 PDAMs comprising 138 healthy PDAMs and 138 poorer / diseased PDAMs due to outlier data and multicolinearity reasons.

Techniques used to analyze data are discriminant analysis and use of model from Bayes Theorem. The discriminant analysis formula as follows:

D = a + v1X1 + v2X2 + + ... VnXn

Where: D = discrimant score, a = constant, v = discriminant coefficients / weights, and n = number of X.

Then after discrimant score model found, it will serve as the basis for calculating the percentage of possible bankruptcy / failure of the Regional Water Company by using Bayes Theorem. The model from Bayes Theorem as follows:

$$P(G_1|D) = \frac{P(D|G_1)P(G_1)}{P(D|G_1)P(G_1) + P(D|G_2)P(G_2)}$$

Where: P (G_1|D) = Potential bankruptcy of PDAM, P (D | G_0) = Opportunity of discriminant value in non-bankruptcy, P (D | G_1) = Opportunity of discriminant value in bankruptcy, P (G_0) = Prior Probability PDAM not bankrupt , and P (G_1) = Prior Probability PDAM bankrupt.

DISCUSSION

Model / Function Discriminant Sign Test. Statistically test the model / discriminant significance test using multivariate test of significan. In the discriminant analysis, the multivariate test uses the Wilk's Lambda test, as can be seen in Table 1.

Table 1. *Wilks' Lambda*

Test of Function(s)	Wilks' Lambda	Chi-square	df	Sig.
1	0.552	160.581	8	0.000

Source: discriminant analysis results with SPSS

Based on table 1. above, the magnitude of Wilk's Lambda is 0.552 or if stated in Chi-square of 160.581 and has a significance value of 0,000 which is smaller than α (0.05), it means that the discriminant function is statistically significant to distinguish both groups of PDAMs (PDAMs go bankrupt and PDAMs do not go bankrupt). These results are consistent with previous studies using discriminant analyzes: Leksrisakul *et al.,* (2005), Yazdanfar (2008), Yuanita (2010), Pane *et al.,* (2015), and Mihalovic (2016).

Each Significance Test of Independent Variables. Significant test results of each independent variable partially (Wilk's Lambda test statistic test) can be seen in Table 2.

Table 2. *Tests of Equality of Group Means*

	Wilks' Lambda	F	df1	df2	Sig.
Net_Working_Capital_to_Total_Asset	0.906	28.338	1	274	0.000
Retained_Earning_to_Total_Asset	0.816	61.777	1	274	0.000
Equity_to_Total_Debt	0.937	18.465	1	274	0.000
Sales_to_Total_Aset	0.944	16.203	1	274	0.000
ROE	0.957	12.380	1	274	0.001
Operating_Ratio	0.787	73.945	1	274	0.000
Cash_Ratio	0.956	12.533	1	274	0.000
Billing_Effectivity_Ratio	0.839	52.604	1	274	0.000

Source: discriminant analysis results with SPSS

Based on Table 2 above, Wilk's Lambda test statistic test shows that the significance value of each independent variable is 0.000 which is smaller than α (0.05). This means that there is a statistically significant influence of each independent variable against bankruptcy. Therefore, all independent variables can be used as predictors of bankruptcy of a PDAM.

Discriminant Functions. The discriminant model / function for PDAMs is not bankrupt and a bankrupt PDAM can be established through SPSS output as in Table 3. on Canonical Discriminant Function Coefficients below.

Table 3. ***Canonical Discriminant Function Coefficients***

	Function
	1
Net_Working_Capital_to_Total_Asset	1.005
Retained_Earning_to_Total_Asset	4.363
Equity_to_Total_Debt	-0.008
Sales_to_Total_Aset	0.554
ROE	0.671
Operating_Ratio	-0.711
Cash_Ratio	0.042
Billing_Effectivity_Ratio	3.744
(Constant)	-2.539

Source: discriminant analysis results with SPSS

According to Table 3. above, the discriminant function is obtained to obtain D-score. The discriminant function can be written in the following equation:

D = -2,539 + 1,005 Net Working Capital to Total Asset + 4,363 Retained Earning to Total Asset - 0,008 Book Value of Equity to Book Value of Total Debt + 0.554 Sales to Total Asset + 0.671 Return On Equity - 0.711 Operating Ratio + 0.042 Cash Ratio + 3,744 Billing Effectivity

Variables that have a positive influence on the value of discriminant or company health are Net Working Capital to Total Asset, Retained Earning to Total Asset, Sales to Total Asset, Return On Equity, Cash Ratio, and Billing Effectivity. While the variables that have a negative influence on the value of discriminant or company health is Book Value of Equity to Book Value of Total Debt and Operating Ratio.

These results are appropriate and different when compared to previous studies such as: (1) For Net Working Capital to Total Asset variables according to Altman's research (1968, 1977, and 2000), Springate (1978), Leksrisakul *et al.,* (2005), and Yuliana (2016), but unlike Mihalovic's (2016) research; (2) Variable Retained Earning to Total Assets according to the study of Altman (1968, 1977, and 2000), Fulmer (1984), Leksrisakul *et al.,* (2005), and Yuliana (2016); (3) Book Value of Equity to Book Value of Total Debt variable in accordance with Rifqi *et al.,* (2016), but different from Altman's research (1968, 1977, and 2000) and Yuliana (2016); (4) Variable Sales to Total Assets according to Altman's research (1968, 1977, and 2000), Springate (1978), Fulmer (1984), Haddad et al., (2003), Leksrisakul *et al.,* (2005), and Yuliana (2016), but different from Malau *et al.,* (2012); (5) Vaiabel Return On Equity in accordance with the research of Haq *et al.,* (2013) and Affes *et al.,* (2016); (6) Variable Operating Ratio in accordance with research Purbayati (2010), and Wibowo *et al.,* (2015); (7) Cash Ratio variables according to Haddad *et al.,* (2003), Yazdanfar and Matias (2008), Bhandari (2014), and Wibowo *et al.,* (2015); (8) Variable Billing Effectivity is different from research from Wibowo *et al.,* (2015).

Square Canonical Correlation (CR2). The calculation result of Canonical Correlation Square Value (CR2) can be calculated from Canonical Correlation (CR) value on eigenvalues as Table 4.

Table 4. ***Eigenvalues***

Function	Eigenvalue	% of Variance	Cumulative %	Canonical Correlation
1	,813a	100.0	100.0	0.670

a. First 1 canonical discriminant functions were used in the analysis.

Source: discriminant analysis results with SPSS

The value of Canonical Correlation Square (CR2) of 0.448 indicates that 44.8% of the PDAM group variation is bankrupt and the PDAM is not bankrupt can be explained by the independent variables such as Net Working Capital to Total Asset, Retained Earning to Total Asset, Book Value of Equity to Book Value of Total Debt, Sales to Total Asset, Return On Equity, Operating Ratio, Cash Ratio, and Billing Effectivity.

Important Roles between Independent Variables. The level of roles of each independent variable against bankruptcy can be seen in Table 5. on the Standardized Canonical Discriminant Function Coefficients below.

Table 5. ***Standardized Canonical Discriminant Function Coefficients***

	Function
Net_Working_Capital_to_Total_Asset	0.483
Retained_Earning_to_Total_Asset	0.422
Equity_to_Total_Debt	-0.410
Sales_to_Total_Aset	0.159
ROE	0.138
Operating_Ratio	-0.252
Cash_Ratio	0.244
Billing_Effectivity_Ratio	0.430

Source: discriminant analysis results with SPSS

In Table 5. above it is shown that the variable that has the largest coefficient value is its most important role from other independent vaiabel. Sequentially independent variables from which have important role to bankruptcy from high to low that is variable of Net Working Capital to Total Asset, Billing Effectivity, Retained Earning to Total Asset, Book Value of Equity to Book Value of Total Debt, Operating Ratio, Cash Ratio, Sales to Total Assets, and Return On Equity.

Structure Matrix (Discriminant Loading). The loading value of the structure matrix can be used to interpret the contribution of each variable in forming a discriminant function. To know the contribution of independent vaiabel can be seen in Table 6. below.

Table 6. ***Structure Matrix***

	Function
Operating_Ratio	-0.576
Retained_Earning_to_Total_Asset	0.527
Billing_Effectivity_Ratio	0.486
Net_Working_Capital_to_Total_Asset	0.357
Equity_to_Total_Debt	-0.288
Sales_to_Total_Aset	0.270
Cash_Ratio	0.237
ROE	0.236

Source: discriminant analysis results with SPSS

According to Ghozali (2016) the value of loading independent variables ranges between +1 and -1. If the loading value is close to 1 (absolute), then the higher the value of communality between the independent variable and the discriminant function. Based on Table 6. on Structure Matrix, it can be seen that independent variables have high loading value from Operating Ratio (0.576), Retained Earning to Total Asset (0,527), and Billing Effectivity (0,486).

Hit Ratio. The overall level of PDAM bankruptcy classification accuracy of the discriminant model generated from this study is 82.2%. The summary of PDAM classification results can be seen in Table 7. below.

Table 7. Classification Matrix

Z			Predicted Group Membership		Total
			0	1	
Original	Count	0	121	17	138
		1	32	106	138
	%	0	87.7	12.3	100.0
		1	23.2	76.8	100.0

Source: discriminant analysis results with SPSS

Based on table 7. above, it can be seen that from 276 PDAM there are 49 predicted error PDAM (17,75%) with details for 138 PDAM bankrupt prediction error happened 32 PDAM (23,19%) and for 138 PDAM not bankrupt happened error predicted as much as 17 PDAM (12,31%).

Accuracy of the resulting discriminant function can be said to be good. It is based on the hit ratio value greater than the chance of classification. According to Maholtra (1985) stated that the chance of classification for groups of the same size is 1 divided by the number of groups. In this study the number of groups consists of 2 so that the chance of classification is 1 divided by 2 is 0.5 (50%). Based on that, the hit ratio is 82.25% greater than the 50% chance of classification so it can be concluded that the discriminant function has high accuracy. While Hair *et al.*, (1979) states that a good hit ratio criterion is if the value is equal to or exceeds the chance of classification plus a quarter. Opportunity classification in this research is 50%, hence minimum limit of hit ratio as follows:

Bound hit ratio = 50% + (25%) (50%) = 62,5%

Based on this, the hit ratio of 82.25% is still greater than the minimum hit ratio, it can be said that the discriminant function has high accuracy.

Furthermore, it is necessary to test statistically whether the classification using the discriminant function has accuracy or not. In the case of this test used Press's Q Statistic test. The Press's Q Statistic formula can be written as follows:

$$Press's\ Q = {[N - (nK)^2]}/{N\ (K - 1)}$$

Where: N: total sample size, n: number of PDAMs classified appropriately, and K: number of PDAM groups. Based on the formula obtained the calculation of sample research as follows:

$$Press's\ Q = {[276 - (226\ x\ 2)^2]}/{276\ (2 - 1)} = 73{,}709$$

With α = 0.05, df = 1, and the value of x2 (chi-square) of 3.841, the value of Press's Q is 73.709 greater than the critical value of chi-square. Therefore it can be concluded statistically the resulting discriminant function is stable and accurate. This result is in accordance with previous research from Yuliana (2015) which tested the accuracy of the discriminant model with Press's Q Statistic.

Cut Off value. To determine whether PDAMs belong to the PDAM group are not bankrupt or the PDAM is bankrupt, it is necessary to compare the discriminant (D-score) value with the cut off value. If the discriminant value (D-score) is smaller than the cut off value, then the PDAM is categorized in a bankrupt tank and vice versa. the cut off value formula below is due to having the same number of samples for each PDAM group, as for the formula:

$$Cut\ Off\ Value = ((Z0 + Z1))\ /\ 2$$

Where: Z0: value of group centroid 0 and Z1: the value of group centroid 1.

Centroid values can be seen in the SPSS output for discriminant analysis as in Table 8.

Table 8. ***Functions at Group Centroids***

Z	Function
0	0.898
1	-0.898

Source: discriminant analysis results with SPSS

Based on Table 8. above, if included in the calculation formula cut off it will get cut off value as follows:

$$Cut\ Off\ Value = (0{,}898 + -0{,}898)\ /\ 2 = 0$$

In the above calculation, the value of cut-off is zero, which means that if the PDAM (D-score) discriminant value is below zero then the PDAM is categorized into a bankrupt tank. Whereas if the discriminant value (D-score) of PDAM is above zero then PDAM is categorized in PDAM not bankrupt.

These results are consistent with research from Altman (1968, 1977, and 2000) that divide the cut off value into 3 categories where the greater the Z-score the more healthy the company will be. Other suitable studies were Yuliana (2015) with a cut off of 0.681, Leksrisakul et al. (2005) with cut off -0.434, Bhandari (2014) with cut off 0.019, and Haryetti (2010) with cut off 0.44.

Predicted potential of PDAM bankruptcy. Based on the discriminant value (D-score) generated from the discriminant function mentioned above, the writer uses the discriminant value to find out what percentage of probability a PDAM will be bankrupt / financial distress (PDAM bankrupt). The percentage value of the possibility of bankruptcy can be displayed on some of the SPSS output results as mentioned in Table 9. below.

Table. 9 Predicted Bankruptcy Results of PDAM

Case Number		Actual Group	Highest Group					Second Highest Group			Discriminant Scores
			Predicted Group	P(D>d | G=g)		P(G=g | D=d)	Squared Mahalanobis Distance to Centroid	Group	P(G=g | D=d)	Squared Mahalanobis Distance to Centroid	Function 1
				p	df						
1	1	1	1	0.080	1	0.991	3.063	0	0.009	12.577	-2.648
	4	1	0**	0.403	1	0.528	0.698	1	0.472	0.923	0.063
	139	0	0	0.647	1	0.920	0.210	1	0.080	5.082	1.356
	145	0	1**	0.517	1	0.610	0.420	0	0.390	1.318	-0.250

Source: discriminant analysis results with SPSS

Based on Table 9 above, several examples of PDAMs have predicted bankruptcy opportunities by SPSS software based on discriminant values. The explanation of the results of research is as follows:

1. At first observation, PDAM has actual condition is bankrupt then research result also predicted bankrupt with discriminant value -2,648 and have bankruptcy probability equal to 99,1% (0,991).
2. At the 4th observation, PDAM has actual condition is bankrupt then the result of predicting research to not go bankrupt with discriminant value 0,063 and have bankruptcy probability equal to 40,3% (0,403).
3. At 139th observation, PDAM has actual condition is not bankrupt then research result also predict not bankrupt with discriminant value 1,356 and have bankruptcy opportunity equal to 92% (0,920).
4. At 145th observation, PDAM has actual condition is not bankrupt then result of research predict to be bankrupt with discriminant value equal to -0,250 and have bankruptcy probability equal to 51,7% (0,517).

Based on the discriminant value and opportunity value of the PDAM's bankruptcy, the authors match the PDAM bankruptcy opportunity value generated by discriminant analysis results with manual calculations with the Bayes theorem. Bayes's theorem is used to calculate the probability of occurrence of an event, based on the effects of previous observations. Stockburger (2016) argues that Bayes's theorem provides a means of converting previous probabilities into posterior probabilities. In the case of discriminant function analysis, the prior probability P (G) is transformed into a posterior probability of group membership given a particular P (G / D) score using information about discriminatory variables. Based on the Bayes theorem formula, it can be illustrated that the probability of bankruptcy (G1) after the discriminant value (D) of a PDAM is known.

Then, Bayes's theorem is applied based on the results of the study in Table 10. by combining with the probability formula in normal distribution via microssof excel (= norm.dist (D_score; mean; std_deviation; false)). The authors use the values of the results of this study that are required in the Bayes theorem calculation chances are:

- Prior Probability PDAM is not bankrupt (P (G_0)) = 0,5
- Prior Probabilty PDAM bankrupt (P (G_1)) = 0.5
- Centroid PDAM is not bankrupt = 0,898
- Centroid PDAM bankrupt = -0.898
- PDAM deviation standard is not bankrupt = 0.816
- Standard deviation of PDAM bankrupt = 1.155

Then the values are applied for each observation. as follows:

1. On the 1st observation that has actual condition and predicted result is bankrupt and discriminant value (D) equal to -2,648 and bankruptcy opportunity 99,1%, then Bayes's theorem calculation as follows:

   - $P\ (D|G_1)$ = 0,1096 dan $P\ (D|G_0)$ = 0,0001
   - $P\ (G_1|D) = \frac{0{,}1096\ x\ 0{,}5}{(0{,}1096\ x\ 0{,}5)+(0{,}0001\ x\ 0{,}5)} = 0{,}9982$

The bankruptcy probability value generated based on Bayes's theorem is 99.82% (0.9982), while the probability of bankruptcy of SPSS output yield is 99.1%. The probability of bankruptcy probability from Bayes theorem and SPSS output can be said to be relatively equal because only 0.72% difference.

2. On the 2nd observation that has actual condition of bankrupt but the result of research prediction is not bangrut with discriminant value equal to 0,063 and bankruptcy opportunity 52,8%, hence calculation with Bayes theorema as follows:

- $P\ (D|G_1)$ = 0,2444 dan $P\ (D|G_0)$ = 0,2894
- $P\ (G_1|D) = \frac{0{,}2444\ x\ 0{,}5}{(0{,}2444\ x\ 0{,}5)+(0{,}2894\ x\ 0{,}5)} = 0{,}4578$

Bankruptcy probability value generated based on Bayes theorem is 45,78% (0,4578), while opportunity bankruptcy result of output of SPSS equal to 52,8%. The probability of bankruptcy probability from Bayes theorem and SPSS output is 7%.

3. At the 3rd observation that has actual condition and prediction result of research not bankrupt with discriminant value equal to 1,356 and chance bankruptcy 8%, then calculation with Bayes theorema as follows:

- $P\ (D|G_1) = 0{,}0514$ dan $P\ (D|G_0) = 0{,}4176$
- $P\ (G_1|D) = \frac{0{,}0514\ x\ 0{,}5}{(0{,}0514\ x\ 0{,}5)+(0{,}4176\ x\ 0{,}5)} = 0{,}1096$

The bankruptcy probability value generated based on Bayes theorem is 10.96% (0.1096), whereas the chance of bankruptcy of SPSS output yield is 8%. The probability of bankruptcy probability from Bayes theorem and SPSS output is 2.96% difference so that it can be said to be relatively the same.

4. On the 4th observation that has actual condition not bankrupt but the prediction result of research become bankrupt with discriminant value equal to -0,250 and opportunity bankruptcy 61%, then calculation with Bayes theorem as follows:

- $P\ (D|G_1) = 0{,}2951$ dan $P\ (D|G_0) = 0{,}1817$
- $P\ (G_1|D) = \frac{02951\ x\ 0{,}5}{(0{,}2951\ x\ 0{,}5)+(0{,}1817\ x\ 0{,}5)} = 0{,}6189$

The bankruptcy probability value generated based on the Bayes theorem is 61.89% (0.6189), whereas the probability of bankruptcy of SPSS output yield is 61 %%. The probability of bankruptcy probability from the Bayes theorem and the SPSS output is 0.9% difference so it can be said to be relatively the same.

This is also in accordance with previous research from Wibowo *et al.*, (2015) using Bayes's theorem to predict bankruptcy with corporate discriminant values.

IV. CONCLUSION

Based on the results of research on PDAM bankruptcy prediction by using discriminant analysis, the following conclusions can be drawn: (1) The resulting discriminant model / function is statistically significant so it can be used to predict the bankruptcy of the PDAM; (2) After the basic assumption test is performed before discriminant analysis, independent variables such as EBIT to Total Asset and Debt to Asset Ratio must be eliminated due to multicollinearity. Therefore, only 8 independent variables are used to form the discriminant function of Net Working Capital to Total Asset, Retained Earning to Total Asset, Book Value of Equity to Book Value of Total Debt, Sales to Total Asset, Return On Equity, Operating Ratio, Cash Ratio, and Billing Effectivity. Partially 8 independent variables have a significant influence on bankruptcy so that it can be used as a predictor of PDAM bankruptcy; (3) The discriminant function generated by the research has CR2 value of 44.8% which means that the financial ratio as independent variable can explain bankruptcy of 44.8%. The resulting discriminant function has a high PDAM bankruptcy classification accuracy of 82.2% and based on Press's Q Statistic test, the discriminant function is accurate; (4) Discriminant value and probability of bankruptcy of research result can be used to determine the percentage of potential bankruptcy of PDAM and bankruptcy probability value relative to calculation using Bayes's theorem. Opportunities for bankruptcy are in accordance with the conditions of PDAM where PDAM is considered healthy will have a small percentage of bankruptcy and vice versa.

Suggestions that can be given for further research as well as for PDAM as follows: (1) PDAM grouping into healthy PDAM category (not bankrupt) and PDAM financial distress (bankruptcy) can be done by other methods such as grouping based on PDAM profit and PDAM loss to obtain function better discriminant; (2) Independent variables need to be changed or added in order to obtain greater Canonical Correlation (CR2) Square values from this study or increase the accuracy of discriminant function classification results; (3) Discriminant analysis methods may be replaced by other statistical methods to obtain better discriminant function or as a comparison in determining the financial distress / bankruptcy of the PDAM; (4) Methods of data collection need to be expanded and more than just financial statements such as by direct survey to PDAM to get a more accurate picture of the state of the PDAM; (5) For PDAMs experiencing good financial condition and having a good discriminant value to be maintained or even improved. As for PDAMs that have poor financial condition and have low discriminant value in order to be improved performance.

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