Prediction Growth of Company

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Prediction Growth of Company Based on Profitability Factor Using Backpropagation Artificial Neural Network

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Abstract: **Growth of company is a benchmark for the success of a business entity, growth benchmarks can be measured through probitability factors, four profitability factors that affect the growth of the company that is profit margin on sales, profit margin on sales before, basic earning power and return on assets. Four factors are very important for the company for the development of a business entity. Therefore, every business entity tries to know profitability through analysis and prediction. The aim of this research is to apply artificial neural network in prediction system of company growth based on profitability factor. Variables in profitability use profit margin on sales, profit margin on sales before, basic earning power and return on assets. Computational model prediction using sigmoid function that is solved with artificial neural network backpropagation algorithm. The value predicted growth of the company is said decrease if the output value is less than 0, increase if greater than 0 and remain if the value is 0. From the application of artificial neural network backpropagation obtained MAPE results when Training data 0.4% of total 49 data. And MAPE on data that has not been trained 11.1% with an accuracy of 88.9% with very satisfactory results. From the implementation result, backpropagation method can be used to predict company growth based on profitability factor.**

Keywords: **profitability; backpropagation; MAPE; prediction; train.**

1. INTRODUCTION

Market competition increasingly competitive economy in recent years, become very important for companies to balance performance and quality in order to maintain the existence of the company's growth. Due to the company's growth is a measure of the company's success in business processes. The benchmarks the company's growth is a core process of the implementation of an information system (Silva and Costa, 2013). In the increasingly rapid economic development today is causing many companies vying to improve profitability. The company's ability to generate profitability will affect the rate of growth companies (Markunkas and Saboniene, 2015).

Profitability can be measured by financial ratios i.e. Profit Margin On Sales, Basic Earning Power-BEP, Return On Assets-ROA (Brigham and Houston, 2004). And also can be explained on industry factors and the sales approach (Leischnig and Kati, 2016). In this decade profitability have significance for the company, because the profitability is the benchmark whether these enterprises have good growth of what is not in the future. Thus, each entity will always try to determine profitability through analysis and prediction. The predicted results will help determine the pace of the company's policy for determining the profitability generated. The higher level of profitability of a business entity then the survival of these enterprises will be better (Feng and Zhang, 2014).

The prediction model has been used in enterprises, as is the case for companies in the field of stock that is the case study of predictive models random labeling provision. The prediction model will notify the up or down movement in the stock price when the company's stock price position information to be published. Computational methodology used data mining to predict major market stock indexes. Two learning algorithms are linear regression and the Standard Feed Forward Backprop (FFB) is used to test and compare. FFB is an algorithm that produces a good prediction accuracy. Besides traditional knowledge indicates that a period of longer training with the training data more data, could help to design more accurate prediction models (Aghabalaeyan et al., 2011). Profit prediction accuracy is a crucial issue because it can provide an estimate of initial eligibility for future projects (Chang et al., 2013).

In the economic field of artificial neural network models used in the process of predictive modeling earnings cycle that is affected by a decrease in selling prices and competition between companies (Rasanen et al., 2008). Prediction is a tendency for companies to measure the growth of the market, the application displays backpropagation algorithm predictive models used in the measurement of global economic growth in China (Feng and Zhang, 2014). Backpropagation method also used in the prediction of the cost of products and plastic injection mold with the approach of factor analysis and optimization set of particles (Che, 2010). The accuracy of the prediction method selection will affect the accuracy of predicted results. The most accurate prediction method is the method that has the smallest error value (Thomakos and Guerard, 2004). Therefore we need an analysis of election prediction method appropriate to the application of case studies.

Based on the research background, the goal in this research is to build an information system based on the company's growth predictions profitability factors are bridged by the implementing The algorithm backpropagation at a furniture company in Jepara furniture. Data is taken at a furniture company furniture related factors backpropagation profitability by using algorithms and integrated into an information system.

2. THEORETICAL BACKPROPAGATION

The growth of company's can be measured in several ways, including by looking at the sales growth. This measurement can only see growth of corporate marketing aspects (Feng and Zhang, 2014). Another measurement is to look at the growth of the company's profitability. By measuring the company's operating profit, can see the marketing aspect and also the company's efficiency in the utilization of its resources. The next measurement is to measure the net profit growth, net profit growth where the input is the capital, and the output is profit. Last measurement company growth is through the measurement of own capital growth (Sartono, 2001).

Profitability is a description of management's performance in managing the company. The size of the company's profitability can be various kinds such as operating income, net income, return on invetasi / assets, and return on equity owner. Profitability ratios or profitability ratio shows the company's success in generating profits. Among the ways to measure the ratio profitabilatas is to calculate Gross Profit Margin (GPM) Gross Profit Margin (GPM) is used to measure the rate of return on gross profit to net sales (Robert, 1997).

According to Brigham and Houston (2004), profitability can be measured by financial ratios, namely:

A. The profit margin on sales (Profit Margin On Sales-PMS), calculated with net income and tax expenses are paid by the company.

B. The basic ability to generate profit (Basic Earning Power-BEP), calculated by dividing the profit (profit) before interest and taxes to total assets.

C. The return on total assets (Return On Assets-ROA), to measure the rate of return on total assets using the ratio of net income to total assets net of tax burden and the company.

From the above theory can be made to the notion that financial ratios affect the growth of the company, as given in Figure1.

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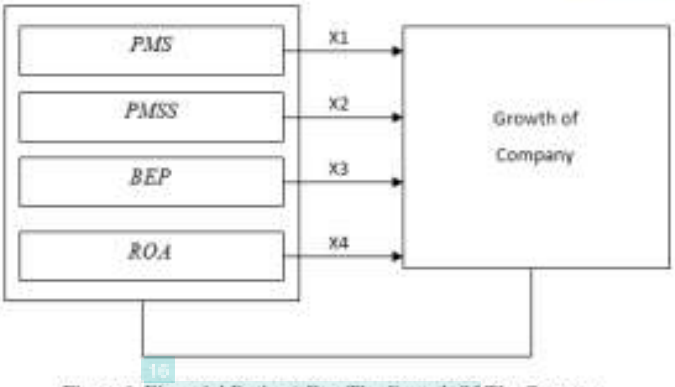

Figure 1: Financial Ratios Affect The Growth Of The Company.

X1: The profit margin on sales (PMS) The effect on the growth of the company. This ratio is influenced by the gain on sale.

X2: Represents the value of the profit margin on the sale of previously (PMSS) that influential in the prediction calculation process of growth of the company.

X3: basic ability to generate profit (BEP) The effect on the growth of the company. This ratio is influenced sales profit and total assets.

X4: The rate of return on total assets (ROA) The effect on the growth of the company. This ratio is influenced by income, total assets and the level of tax burden and the company.

Predictive process flow growth of the company has an input, wherein the input system is derived from a form filled out by user ratings (Cheng et al., 2016). Indicators assessing the data in the company asked the experts to get the data.

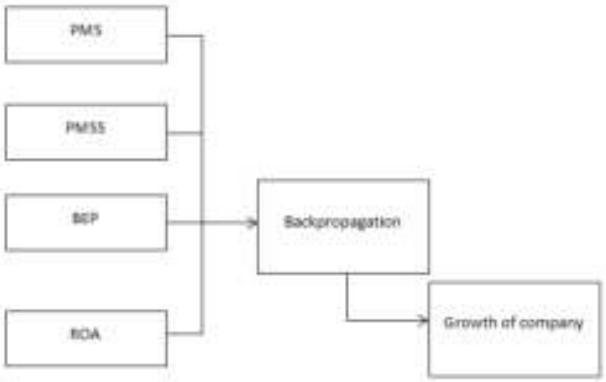

Figure 2: Schema Of Predict Growth Of Company With Backpropagation.

Backpropagation is a method used to bridge the predicted growth of the company, where it's an artificial neural network that need the data later using supervised learning algorithm and used by Perceptron with many layers of the screen to change the existing weights in the hidden layer. The training method is a type of training supervised backpropagation which uses weighting adjustment patterns to achieve the minimum error between the output of the prediction results with real output (Cheng et al., 2016).

Backpropagation algorithm using Error Output to change the value of the weight-weight in a backward direction (Backward). To get this error, advanced propagation phase (Forward Propagation) must be done first. At the time of forward propagation, neurons activated by using sigmoid activation function that has data patterns 0-1 (Che, 2010). In the company's growth predictions apply sigmoid functions (2):

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$$f(x) = \frac{1}{1+e^{-\sigma x}} \quad (1)$$

Where,

$$f'(x) = \sigma f(x)[1 - f(x)] \quad (2)$$

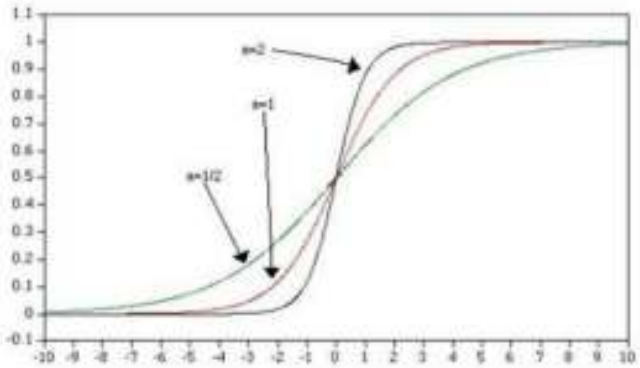

Figure 3: Sigmoid Function

Steps of implementation Backpropagation with sigmoid function for the prediction growth of the company as follows:

1. Initialize weights (download the initial weights with random values are quite small).then do the following steps until the stop condition.For each pair of elements that will be carried feedforward learning follows:

a. Each unit of input (xi, i = 1,2,3, ..., n) receives the signal xi and forwards the signal to all units on top of the existing layer (hidden layer) . Each hidden unit (Zi, j = 1,2,3, ..., p) summing the weighted input signals.

$$Z_j = v_{0j} + \sum_{i=1}^{n} x_i v_{ij} \quad (3)$$

Using the activation function to calculate the output signal:

$$Z_j = f(z\_in_j) \quad (4)$$

And the signal is sent to all units layers (unit layers of output).

b. Unit of output (Yk, k = 1,2,3, ..., M) summing the weighted input signals.

$$y_k = w_{0k} + \sum_{j=1}^{p} z_j w_{jk} \quad (5)$$

Implementaion activation function to calculate the output signal:

$$y_k = f(z\_in_k) \quad (6)$$

Sends those signals to all upper layer of units (units of output)

c. Output (Yk, k = 1,2,3, ..., M) receives the target pattern is associated with learning input patterns, and calculated error.

$$\delta_k = (t_k - y_k) f'(y_{in_k}) \quad (7)$$

Calculated correction weights (which will be used to correct the value w_{jk}):

$$\Delta w_{jk} = \alpha \delta_k z_j \quad (8)$$

Calculated bias correction (which will be used to correct the value w_{0k})

$$\Delta w_{0k} = \alpha \delta_k \quad (9)$$

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Sent δ_k it to the existing units under- neath.

d. Hidden unit (Zi, j = 1,2,3, ..., p) delta summing inputs (from the units that are in the top layer):

$$\delta\_in_j = \sum_{k=1}^{m} \delta_j w_{jk} \quad (10)$$

Multiply the value of the derivative of the activation function to calculate the error information:

$$\delta_j = \delta\_in_j f'\left(z_{in_j}\right) \quad (11)$$

Calculated correction weights (which will be used to correct the value V_{ij}):

$$\Delta v_{jk} = \alpha \delta_j x_i \quad (12)$$

Calculated bias correction (which will be used to correct the value V_{0j}):

$$\Delta v_{0j} = \alpha \delta_j \quad (13)$$

e. Output (Yk, k = 1,2,3, ..., M) fix bias and weight (J = 0,1,2,3, ..., P):

$$w_k(new) = w_k(old) + \Delta w_k \quad (14)$$

each hidden unit (Zi, j = 1,2,3, ..., p) fix bias and weight (i = 1,2,3, ..., n_i

$$v_{ij}(new) = v_{ij}(old) + \Delta v_{ij} \quad (15)$$

3. Loop until the condition error 0,1 or epoch = maximum epoch (Fausset, 1994).

Steps backpropagation implemented to predict the growth of companies such as Figure 4

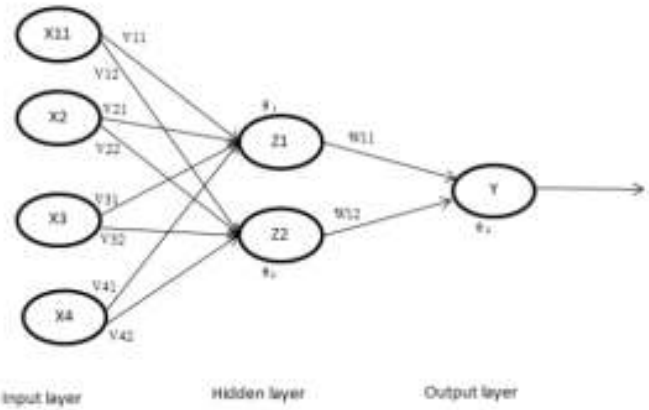

Figure 4: Network Architecture Prediction Growth of Company With Backpropagation

Of the network architecture in Figure 4. can be formulated coating and the following variables:

1. Layer input layer is a layer that affect the output (Y) with a layer consisting of three vertices which X1, X2, X3 where:

X1 = Profit margin on sales (PMS)

X2 = Profit margin on sales before (PMSS)

X3 = Basic Earning Power (BEP)

X4 = Return on Assets (ROA).

2. Z1, Z2 is the hidden layer

3. The initial weight input to the hidden layer (V).

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4. The initial weight hidden layer to the output (W).
5. Symbol (θ1, θ2, θ3) is the weight bias in the hidden layer and output layer
6. Layer output (Y) is a result of growth of company.

Results of the detection output is a predicted value of the company's growth. Down if the output value <0, Fixed if the output value is 0 and Up If the output value is worth the ride> 0. While formulations for the company's growth prediction system with the following formula:

$$y_k = w_{0k} + \sum_{j=1}^{p} z_j w_{jk} \qquad (16)$$

Where,

$$Z_j = v_{0j} + \sum_{i=1}^{n} x_i v_{ij} \qquad (17)$$

The results then calculate the prediction error value by using MAPE (Mean Absolute Percentage Error). If MAPE <25%, the simulation results can be received satisfactorily, otherwise if MAPE> 25%, the simulation results are less satisfactory (Markridakii et al., 1983).

$$MAPE = \frac{\sum_{k=1}^{M} \frac{|Yk - Ak|}{Ak} x\ 100\%}{M} \qquad (18)$$

Information :

Y_k = Result data k

A_k = Actual data on k

M = number of observation data.

3. RESULT AND DISCUSSION

3.1 Implementation of Backpropagation Networks:

Application of backpropagation network is currently in train displays network forms, such as 4 x input variables to the symbol used, 9 hidden layer with z and 1 output symbols to the symbol y. Figure 4.1 shows the network back propagation formed.

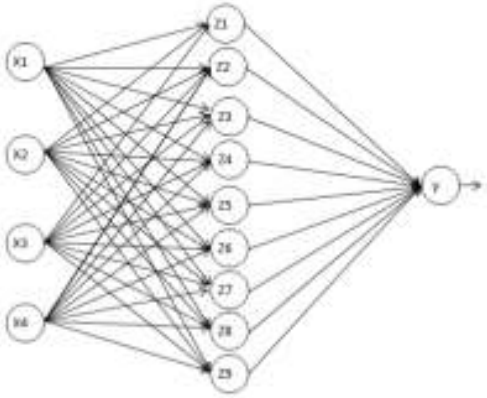

Figure 5: Application of Network Backpropagation

Once the network is formed obtained the progress of training, progress of traning obtained after propagation in computing. of the network produced progress that epoch iteration stops at 93 of a total of 5000 iterations in 1 second and validation waktuk 6, the training results in attachment 2.

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3.2 Graph Network Train:

At the time of training to show the form of graphs which chart contains data on the target (actual growth rate) and output (result growth rate prediction). the blue line is the target while the red line is the output produced to meet the target, said to be good if the network graph and the output target line parallel to the meeting together. Fig. 7 shows the graph between the target and the output from the training

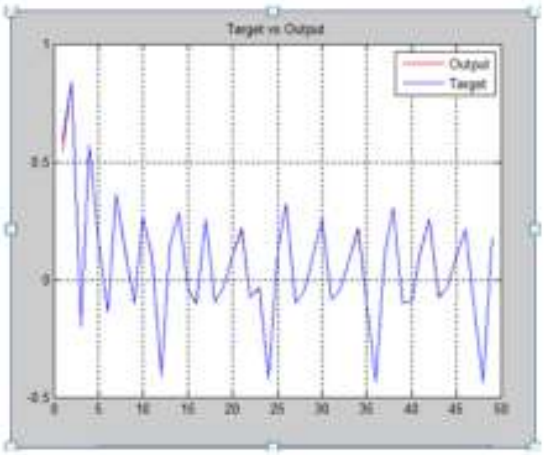

Figure 6: Graph Between the Actual Growth Rate and the Growth Rate Predicted Results

From the graph of the network between the target and the output value can be formulated into table form so they can know the difference between the target and the output value where the highest error margin value = 0.003305162 and the value of the lowest error = -0.010509638.

The difference between the target and the output can be saved in Exel format by pressing the save button to E. Meanwhile, to save network file containing the input weight value. The result of the error (Error) of the total amount of data 0.38763% calculated using MAPE (Mean Absolute Percentage Error).

3.3 Training Network

Selection of the current network architecture training (training) data based on the best results and the variations given. Variations in question is the distinction of the number of hidden layer neurons during the training data. From all variations of the number of hidden layer will have a variation that gives the value of MAPE (Mean Absolute Percentage Error) the minimum and the value of the correlation coefficient approaches a value of 1. Table 1 shows the variation of the training network.

Table 1: Training network

Number of variables	Number of hidden layers	Value of corelation	MAPE	Result
4	5	0.99562	31.98	Less than optimal
4	9	1	0.38763	Very optimal
4	15	1	1.5159	Optimal
4	25	1	23.4036	Optimal
4	50	1	11.4087	Optimal
4	100	0.99853	165.032	Not optimal

Variations in the number of hidden layer will be used to determine the best training network architecture with a parameter value of MAPE (Mean Absolute Percentage Error) are near zero and has a correlation coefficient (R) which is close to the value 1. With regard to the value of MAPE and the value it will show the correlation coefficients architecture the most optimal but keep in mind the greater number of hidden layer neurons in the longer process of training and testing. From

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the results obtained training variations are not optimal value is to 4variabel input, hidden layer 100 with a correlation coefficient of 0.99853 produce 165 032% error is not very optimal results when used to test the data when the network is used for testing will menghasil inaccurate results , While the results are highly optimized, namely with 4variabel inputs, 9 hidden layer with a correlation coefficient = 1 and error 0.38763% is optimal when used to test the data in order to predict the growth of the company to obtain an accurate prediction results. Highly optimized variation results can be stored in the form of matlab file and can be used to test the data that has never been done variations and training.

3.4 Data Validation:

Validation data that has not been trained are as much as 10 data. Data is data BEP tested, ROA, PMS and PMSS which the data has not been done the training. Of any variation in training with the difference in the number of neurons in the hidden layer will show the value of the accuracy of the network as shown in Table 1 which contains the results of varying the amount of each hidden layer. The results of the optimal training variations used to test the data that has never been tested below Table 3 shows of the validation results.

Table 2: Result validation

Actual data	Growth actual	Data prediction	Growth prediction	Residual (%)	Validation
0,294	Up	-0,084	Down	128,65	invalid
-0,045	Down	-0,045	Down	0,01	valid
0,083	Up	0,083	Up	0,00	valid
0,215	Up	0,213	Up	0,93	valid
-0,092	Down	-0,092	Down	0,00	valid
-0,432	Down	-0,429	Down	0,76	valid
0,122	Up	0,122	Up	0,00	valid
0,306	Up	0,306	Up	0,00	valid
-0,096	Down	-0,097	Down	0,17	valid

Table 2 shows the results of the results of data that has never been trained, using 25% residual error shows 1 invalid data and 8 valid data from the predicted growth of the company. From the test data that has not been trained to get 1/9x100 = 11.1% error with honesty 8/9x100 = 88.9%. From the results of these accreditations then the artificial neutral backpropagation can be used to predict company growth based on profitability factor with very satisfactory results.

4. CONCLUSION

From the research and analyze implementation of the Backpropagation at the company furniture in Jepara by a factor of profitability can be concluded that the method backpropagation can be used to predict a growth of company's by a factor of profitability that PMS, PMSS, ROA and BEP of the results of applying the Backpropagation method to predict a growth of company's by a factor of profitability produce MAPE 0,4% of the total 49 training data and the accuracy of the data against data that has not been trained to 88,9% accurate and 11,1% inaccurate than 10 data, while in the process experimental predictions of training with 9 hidden layer is better than training with 10 hidden layer in terms of error produced and of the results of tests that trained more data will produce better predictions network.

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PAGE 1

PAGE 2

PAGE 3

PAGE 4

PAGE 5

PAGE 6

PAGE 7

PAGE 8

PAGE 9