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Artificial neural network model for bankruptcy prediction

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Abstract. Bankruptcy is a financial failure in a business where the company fails to generate profits and cannot pay its debts. The impact of bankruptcy is very large for the organization and can be felt by the whole community. Thus, the prediction of a company's financial failure is absolutely necessary to prevent bankruptcy. Prediction can be done with data mining, one of the methods is to use a network model. This study was to obtain the results of the classification of types of companies that went bankrupt and get the performance of the algorithm used. The results obtained are with an accuracy of class recall 99.30% (trueNB) dan 99.07% (trueB). Sedangkan class precision 99.30% (predNB) dan 99.07% (pred.B). Hasil evaluasi kinerja algoritma Naïve Bayesian Classifier pada penelitian ini menunjukkan tingkat akurasi yang cukup tinggi yaitu 99.20%.

1. Introduction

Bankruptcy is a financial failure in business [1], where companies fail to run operations to generate profits and are unable to pay their debts. The impact of bankruptcy is very large for the organization and can be accepted by the community [2-3]. Bankruptcy predictions need to be very important for every organization. Bankruptcy prediction can be done by recognizing the questions that already exist whether the company must approve bankruptcy or not. Prediction can be done with the data mining method using existing data records. Prediction problems can be made using the classification method in data mining [4]. The use of data mining in various fields, including for predictions in the economic field, was carried out for Credit Card Risk Prediction [5]; in the field of health [6-7]. Data mining is a search process, collecting data (big data) in order to get new information from that data [8]. Data mining can be used to extract knowledge from a collection of existing data. One of the data mining activities is classification technique. Classification is the process of finding a model that can distinguish data classes so that it can be used to predict object classes that are not yet known which class labels [9]. The activity in classification is to extract data and then predict the main classification is to predict how the classification value of the data [10]. Artificial Neural Network (ANN) is a part of artificial intelligence that adopts the work of the human nervous system. Artificial Neural Network techniques can be used to conduct training in the classification process. One technique in Artificial Neural Networks, namely the perceptron multi-layer network. This network consists of several layers of neurons (computing units) that are connected hierarchically in a feed forwards. Multilayer perceptron uses several learning techniques, the most popular being back-propagation. The back-propagation neural network architecture is a hierarchical design that contains nodes at each layer that are fully interconnected. Utilization of the multilayer perceptron for grouping in research on the application of the perceptron multilayer for prediction of diabetes mellitus in pregnancy care [11],



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Sleep Stage Classification [12]. In this paper, we will discuss the predictability of forestry using Artificial Neural Networks.

2. Research Methods

This paper discusses bankruptcy predictions using Artificial Neural Network. Model. The research steps undertaken include (1) preprocessing analysis & data, (2) training and testing, and (3) evaluation. The data material used is a bankruptcy dataset, then classifies using the Neural Network model. There are two steps within the classification handle [9], namely the Learning stage, where training data is carried out by a particular classification algorithm, then (b) the classification stage is in the form of testing data based on the classification model that has been generated in the previous step, at this stage the accuracy of classification rules is obtained. If the accuracy is good enough and accepted, then the rules can be applied to classify new data.

2.1. Analysis & data pre-processing

At this stage an analysis of the dataset used was carried out, namely a bankruptcy dataset consisting of 250 samples and consisting of 6 attributes. The data obtained is good and ready for the next process.

2.2. Training and testing

The training was conducted using an Artificial Neural Network model with 6 inputs, 2 hidden layers and 1 output layer. The output consists of 2 labels, namely B (bankruptcy) and NB (non bankruptcy) Sampling type in the training process using stratified sampling and 10-Validation. Research Attributes are shown in Table 1.

Table 1. Research attributes

Name of Attributes	Information
Competitiveness	Ability to compete with similar industries
Credibility	Credibility, good name, company conditions
Financial flexibility	Financial flexibility, the company's financial condition
Industrial risk	Industrial risk
Management risk	Management risk, risk from within the company, or management itself
Operating risk	The inherent risk of a company's operations, the level of operations

2.3. Evaluate algorithm performance

To measure the performance of the algorithm generated using Confusion Matrix and ROC Curve. Confusion Matrix calculates the wrong and correct test records of the predictions that are formed. This evaluation produces a level of recall, precision, accuracy and error rate [13]. The formula used as follow [14]:

$$Accuracy = \frac{\text{Total correct predictions}}{\text{Total correct and incorrect prediction}} \quad (1)$$

$$Error Rate = \frac{\text{Total incorrect predictions}}{\text{Total correct and incorrect prediction}} \quad (2)$$

$$p = \frac{TP}{TP + FP}, \quad r = \frac{TP}{TP + FN} \quad (3)$$

The ROC bend appears exactness and compares classification outwardly. ROC may be a two-dimensional chart with untrue positives as flat lines and genuine positive as vertical lines [15]. The calculation results are visualized with a Receiver Operating Characteristic

(ROC) atau Area Under Curve (AUC). If the value is close to one, then the model obtained is more accurate. AUC formula as follow:

$$AUC = \frac{\sum_{i=1}^{n^+} \sum_{j=1}^{n^-} 1 f(x_i^+) f(x_j^-)}{n^+ n^-}$$

Information:

$f(.)$ = value of a function

x^+ dan x^- = positive and negative samples

n^+ dan n^- = number of positive and negative samples

(Brefeld, 2005)

3. Result and Discussion

The data used in this research was obtained from the UCI machine learning repository using qualitative bankruptcy dataset, which contain 250 instances and 7 attributes [4]. The results of this study are to predict bankruptcy using an artificial neural network model. The network architecture is obtained with 6 inputs, 2 hidden layers consisting of 6 nodes and 4 nodes, and 1 output layer. Figure 1 shown the results of Network architecture.

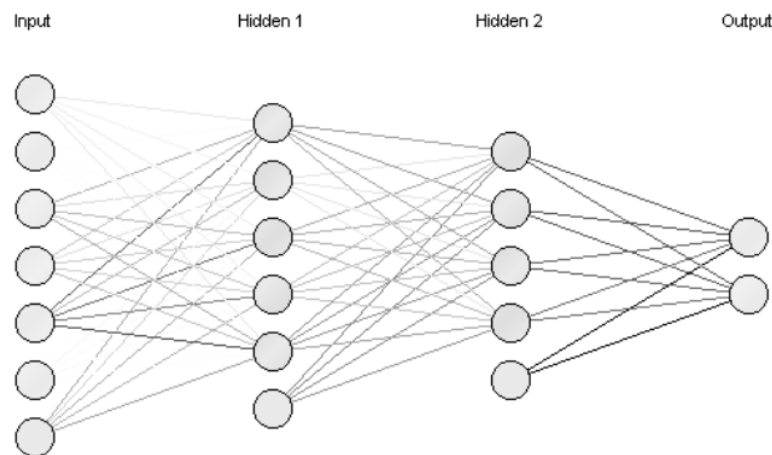


Figure 1. The Neural network architecture

Based on the modelling, a method evaluation was performed using a confusion matrix which accuracy of 99.20% (Table 2). Table 2 show the results of class recall and class precision [14].

Table 2. The Performance of algorithm

	true NB	true B	class precision
pred. NB	142	1	99.30%
pred. B	1	106	99.07%
class recall	99.30%	99.07%	

The AUC curve and the ROC curve are shown in Figure 2.

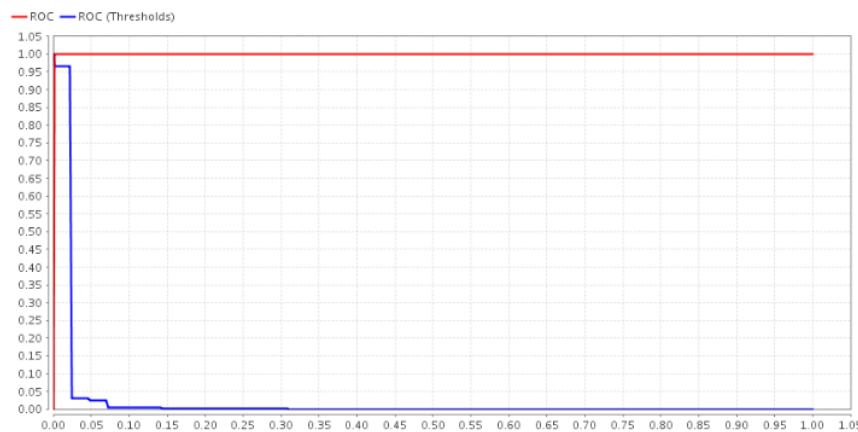


Figure 2. AUC curve and the ROC curve

4. Conclusion

The results of the analysis through training and testing using Neural Network models obtained on the prediction of bankruptcy companies with a recall class level of 99.30% (trueNB) and 99.07% (trueB). While the precision classes are 99.30% (predNB) and 99.07% (pred.B). Naïve Bayesian Classifier algorithm performance evaluation results in this study showed a fairly high level of accuracy, namely 99.20%, so it can be used to predict bankruptcy of a company based on the six appropriate attributes used in this study.

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