Implementation of Multilayer Perceptron Neural Network towards Time Series Based Decision Support System to Classify Micro-Partner Transactional Activity in Social-Enterprise

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Abstract- Economic activities of Indonesia Small and Micro Enterprises are currently increasing day by day. One of the fields is the mobile phone credit sales. A group of credit sellers, in this case are the micro enterprises, is controlled, helped, and partnered by certain bigger enterprise, called social-enterprise, who enhances the quality of micro enterprise. However, some of the micro-partners were unable to have some transactions in a several time ranges. This complicated the officers of the social-enterprise to help the micro-partners wisely. Hence, it is important to predict their active and inactive states. To solve this problem, the popular Multilayer Perceptron Neural Network method, is implemented towards the time series based transactional data to build the decision support system. This yields accuracy of 78,90% in classifying the micro-partners transactional activity. This shows that data mining method can be used as basic of decision support system in case of social-enterprise data.

Index Terms-Social Enterprise, Multilayer Perceptron, Data Mining, Small and Micro Enterprise, phone credit sell

I. Introduction

ONE of the Indonesia society's effort to reduce the poverty in Indonesia is by social enterprise, or named sociopreneurship [1]. This issue, which gives the partners opportunities to establish their own Small and Micro Enterprises (SMEs) or even to grow their already-established business, has emerged as an approach of solution of Indonesia's economic problem towards poverty.

In Indonesia, there are social enterprises who have partnered with a lot of SMEs, one of them is PT. RUMA. PT. RUMA, which was founded in 2009, cooperates with SMEs by the information technology to improve their business [2]. This direct approach benefits the SMEs to gain more customers yet work closely to customers.

However, hundreds of SME partners of PT. RUMA, namely dealers, has difficulty to manage several other partners named agents, whose number is increasing to nearly thousands. Hence, it is difficult to monitor each agent who works successfully or has inability to have transaction. This detection of inactivity of transaction has objective to solve the agent's problem regarding the condition that the agent goes inactive. This inactivity state of the agents can be related to problem toward dealers, technical issues, or even rival companies.

In the other side, in the advantage of growing numbers of agents and dealers, the transaction data becomes large also. This opportunity of the size of transaction data can be explored through data mining. Since the transactional data has the characteristics of time series data, it is possible [3], to detect or even to forecast the next inactive state of an agent.

In that case, the purpose of this research is to apply a data mining towards sociopreneurship transactional data. This result of data mining can be used as a part of decision support system [4], as stated as treatment towards the agents before. A popular method used is Multilayer Perceptron. This algorithm is proved to yield good result in forecasting time series data [5].

The rest of this paper is described as follows: the previous studies on section II, experimental evaluation on section III, conclusion on section IV, and acknowledgement on section V.

II. Previous Studies

This section reviews the main term and method related in this research. They are the sociopreneurship and Multilayer Perceptron Neural Network.

A. Sociopreneurship

Sociopreneurship, which is abbreviated from the term social entrepreneurship, is an approach of entrepreneurship that applies its spirit, business insight, leadership, and non-profit principles into social problem [1]. Sociopreneurship leads a conventional entrepreneurship into society-developing movement yet yields profit to both sociopreneur and developed partners. By implementing information technology in sociopreneurship, happened events can be collected. Thus, it is a great opportunity to explore the advantage data mining toward sociopreneurship.

B. Multilayer Perceptron Neural Network

Neural network which is created from of N input neurons in a layer, M output neurons in a layer, and one or more hidden layers is named Multilayer Perceptron or MLP [6]. Its illustration can be seen in Fig. 1, which inputs represented by x_{ij}, weights by w_{ij}, output value of hidden layer b_{pj}, and sigmoid function transformed output value $\hat{y}_{pk}$. The connection between neurons which used in this model is always feed forward [5].

III. Experimental Evaluation

A. Dataset and Preprocess

The dataset which used in this research consisted of 3 months agent transactions of PT. RUMA. This dataset is preprocessed first into a single row which indicates the number of transaction that done by an agent in a day. This

preprocess produces the training set for this method. The next day by a desired time range is then used by test set, which is also preprocessed using the same day-grouping process.

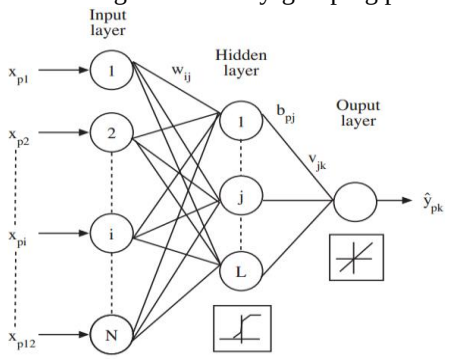

Fig. 1. Multilayer Perceptron Illustration

B. Implementation Setup

The implementation of this research is made by the help of software WEKA 3.7 and its separated package time series analysis library [7] and customized with JAVA programming language. As a comparison algorithm, the Sequential Minimal Optimization (SMO) algorithm is used. Both MLP and SMO are taken from the WEKA time series analysis library. After getting the result of both algorithm, another experiment regarding of MLP the performance of several trained and tested time range will be displayed.

C. Result and Discussion

The two experiments, which objective are as follows: comparing the results of MLP and SMO, and observing the performance by the time range, are displayed in TABLE I and TABLE II. Accuracy is used to evaluate that the predicted states (active or inactive) of the next time range are correct. The bigger the value means the more states are correctly predicted.

TABLE I
CLASSIFICATION RESULT OF COMPARED SMO AND MLP PERFORMANCE

Algorithm	Accuracy (%)
SMO	42,95-60,82
MLP	75,65-78,90

TABLE II
CLASSIFICATION RESULT OF MLP ALGORITHM USING DIFFERENT TIME RANGE IN TRAINING AND TESTING

Training Time Range (Days)	Testing Time Range (Days)	Accuracy (%)
$60^{th} - 68^{th}$	$69^{th} - 72^{nd}$	75,65
$73^{rd} - 79^{th}$	$80^{th} - 84^{th}$	78,90
$85^{th} - 91^{st}$	$92^{nd} - 96^{th}$	77,20

From TABLE I, it can be inferred that MLP is better than SMO in this case, by accuracy of 75,65% until 78,90%. Accuracy values which presented by TABLE I is returned by the several experiments regarding different number of agents. The number of agents that used in this experiment reaches up to nearly 14000.

The stable result is given by the values representation of TABLE II. Accuracy evaluation differs between 75,65% and 78,90% implies that the algorithm MLP can be categorized as stable approach by the different training and testing data sets.

Moreover, there could be some improvement regarding the information that can be extracted through the dataset and the method itself. The dataset scope only captured the number of transactions held by an agent in a day. It can be improved by extra characteristic such as the category of product or the location of the agent. In other case of dataset, the day-grouping defined is based on assumption based on business processes (frequent time range that an agent reloads his/her transaction). Hence, it can be a better approach by analyzing how long an agent should recharge his/her source by the data.

Some other neural network algorithm also has some better evaluation than MLP [5], which named Radial Basis Function. So that, it could be interesting to test the method into this case.

IV. CONCLUSION

A sociopreneurship case is considered as a new initiative and approach to solve economic problems in Indonesia. Then, it is interesting to explore the characteristic of sociopreneurship data to enrich this initiative.

Using the dataset provided by PT. RUMA, a sociopreneurship company, it is proved that the data mining technique can be used as an information extractor toward decision support system. By its maximum value of 78,90% accuracy and stable classification results, Multilayer Perceptron Neural Network can be regarded as a good option to predict the unseen agent's state of active or inactive in case of transaction making.

In the other case, it is important to know that the dataset can be explored more by adding extra attributes, such as locations, and using various time ranges. From the method, the other data mining prediction method can also be considered as another approach to improve the extracted information.

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