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Neural Network Algorithm for Budget Expenditure Prediction in LPP RRI Gorontalo

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Abstract

In this Data Mining research, the researcher uses the Neural Network Algorithm to predict budget expenditures at LPP RRI Gorontalo, the goal is to find out how much cash spending at LPP RRI Gorontalo is on average in each month, so it will make it easier for the Treasurer to control cash disbursements in each month. month. Using 412 Expenditure Records Data from 2013 to 2021, the lowest RMSE value is at Hiden Layer 11, Training Cyle 400, Learning Rate 0.1 and Momentum 0.1 with RMSE 0.142. Prediction results look better because they are closer to Real Data, so Neural Networks can be used to predicting spending at LPP RRI Gorontalo.

Introduction

Financial problems are a very crucial problem for every agency, both government and private agencies, therefore financial management is needed to control financial management. Government Financial Management is financial management carried out by the government on financial sources in the form of state revenues, on state expenditures and financial sources to cover financing deficiencies that may arise (Mikesell, 2013; Finkler et al., 2022). Basically, the finances managed by the government are state finances. In this case, the finances managed by the government are finances sourced from the APBN. State revenue can come from various sources, namely from taxes and non-taxes, which according to laws and regulations are the authority of the government. Government spending is essentially carried out in the context of carrying out its function for the welfare of the community. Meanwhile, financial sources for financing development can come from debt or other sources. The material that will discuss state finances managed by the government which includes the basic concepts of state finances and the basic concepts of the state budget including the implementation of the state budget and accountability for the implementation of the state budget.

State finances, when viewed from a theoretical perspective, may contain several meanings, but the definitions described in this teaching material are limited to those as regulated in the laws and regulations in the field of state finance. In accordance with what is described in the Law on State Finances (Law No. 17 of 2003 concerning State Finances), what is meant by State Finances are all state rights and obligations that can be valued in money, as well as everything - both in the form of money and in the form of goods - that can be made state property in connection with the implementation of these rights and obligations. Then, in the explanation in the Law, the complete formulation of State Finance is described in terms of objects, subjects, processes and objectives, namely: (1) The objects of state finances are all rights and obligations of the state that can be valued in money, including policies and activities in the fiscal and

monetary fields, and the management of separated state assets as well as everything in the form of money or goods that can be used as state property in connection with the exercise of rights. and such obligations; (2). Subjects of state finance are all objects of state finance that are owned and/or controlled by the government and other public legal entities; (3) According to the process, state finances are a whole series of activities for managing all state rights and obligations that can be valued in money starting from policy formulation and decision making to accountability; (4). The objectives of all policies, activities, and legal relations related to the ownership and/or control of state financial objects are intended in the context of administering state government (Rosmilawati, 2017).

Neural Network is an information processing system that has characteristics similar to biological neural networks (Syafarina et al., 2016). Neural Networks have been applied in various fields including pattern recognition, medical diagnostics, signal processing, and forecasting (Meyer-Baese & Schmid, 2014; Sadeeq & Abdulazeez, 2020). Although there are many promising applications that can be carried out by Neural Networks, Neural Networks also have some general limitations, namely the inaccuracy of the results obtained. Neural Network works based on the pattern formed on the input (Fantoni & Mazzola, 1996). In terms of budget expenditures at LPP RRI Gorontalo, researchers conducted a study using the Neural Network algorithm to predict budget expenditures which later aimed at financial management at LPP RRI Gorontalo. Based on the problems that have been described, we raised the title Neural Network Algorithm for Predicting Budget Expenditures at LPP RRI Gorontalo.

Data Mining

(Mandasari et al., 2011) Data mining is a computer science that uses statistical techniques, mathematics, artificial intelligence, and machine learning to extract and identify useful information and related knowledge from large databases. With the use of data mining, it is hoped that the accumulation of data that has been happening so far can be used to dig up important information from a data set that is not known manually.

Prediction

(Santoso, 2015) This forecasting or prediction serves to maintain the continuity of service to the community. This is in line with the notion of prediction or forecasting is a process to estimate how many people's needs in the future which include needs in terms of quantity, quality, time and location needed in order to meet the demand for goods or services.

Neural Network Algorithm

Neural Network (NN) is an attempt to imitate the function of the human brain. The human brain is believed to be made up of millions of tiny processing units, called neurons, that work in parallel. Neurons are connected to each other through neuronal connections (Soriano et al., 2008). Each individual neuron takes input from a set of neurons. It then processes that input and passes the output to a set of neurons. The output is collected by other neurons for further processing (Kurniawan et al., 2018)

Methods

The object of research is a variable or target in the research conducted by the researcher. That is about the Prediction of Budget Expenditures at LPP RRI Gorontalo using the Neural Network Algorithm. The data collection method is a bridge that connects researchers with the social phenomena they study. Through the chosen method, researchers can collect various data needed to answer existing research questions. The data source is an important factor to be considered in determining the data collection method. When viewed from the data source, the data collection can use primary data (primary data) and secondary data (secondary data). In the process of collecting or retrieving data, this study uses two methods including:

Observation

The author collects or collects data by making direct observations of the object to be studied with the relevant agencies to collect data and information related to the existing problems.

Interview

The author collects data and information by interviewing or discussing with the leadership of LPP RRI Gorontalo and users of cash expenditure holders at LPP RRI Gorontalo

Research Stages

Data Collection

In this study, the data used is data obtained from financial data for the 2013 - 2021 Expenditure reporting period at LPP RRI Gorontalo in the form of univariate time series data,

Preprocessing Data

The preprocessing stage of the data carried out in this research is to normalize the data with the aim of grouping the data into a certain range in order to facilitate the data processing. The normalization used in this study is the range (0.1) and the preprocessing process using Microsoft Excel. The calculation formula used can be seen in equation 3.1 and the data to be normalized is in the form of weekly data as shown in solid table 3.2.

The formula for calculating the normalization of the data used is:

X^'=(0,8 (X-b))/((a-b))+0,1……(3.1)

Where

X'= Normalization data

X = Original data/ preliminary data

a= Maximum value of original data

b= Minimum value of original data

The next stage is before testing the Neural Network method, determining the percentage of training data, which is 90% and testing at 10% of the data to be tested.

Data processing stage

From the existing data in the form of univariate data, then data normalization is carried out then from the data that has been normalized the data arrangement is from ascending and then changed to descending

Furthermore, from univariate time series data into multivariate form. then from the existing data first is univariate to multivariate data. The data pattern used

Time series data pattern (Univariate to Multivariate)

Pattern	*Input lag*	*Output/* Target
1	*x1, x2, x3, x4, ..., xp*	*xp+1*
2	*x2, x3, x4, x5,..., xp+1*	*xp+2*
3	*x3, x4, x5, x6,..., xp+2*	*xp+3*
...	...	.....
m-p	*xm-p, xm-p+1, xm-p+2, ..., xm-1*	*xm*

From the data that has been made changes from univariate to multivariate form. This is done to find out the best data pattern that will be processed using the Neural Network algorithm.

Algorithm Testing Stage

At this stage, the proposed algorithm is tested, namely the Neural Network method by determining the percentage of training data that is 90% and testing is 10%. From the results of the data that has been converted to multivariate tested by the Neural Network method. To get the right architecture, the parameters are set, among others:

Neural Network Parameter Determination

The input layer is the amount of data that is entered for learning. In this study, the determination of the input layer is in accordance with the number of variables. The hidden layer in determining the hidden layer parameters can have more than one hidden layer, but if the number of neurons specified is too few it will result in underfitting, and if the neurons are specified too many will result in overfitting. In this study, the determination of the hidden layer was tested with the value of the neuron size. The training cycle or iteration (epoch) is the number of iterations contained in the stages of the algorithm. In determining the training cycle for trials in this study by entering a range value. Learning rate is a parameter used by the Neural Network algorithm in the weight of the neurons. The larger the value to be given will cause faster learning, but if the value given is small it will cause the learning process to be slower. Momentum is used to increase convergence and speed up the learning time process which has value limitations. The output layer is the number of outputs from the results of the Neural Network algorithm process. Number of Validation used is 10.

Model Experimentation and Testing

The dataset used is then processed using a computational processing tool, to test the applied method, namely the Neural Network method, which produces the final result of the data processing in the form of the smallest Root Mean Square Error (RMSE) value to search for the best model.

Evaluation and Testing

At this evaluation stage the value generated from the test is in the form of the Root Mean Square Error (RMSE) value. The value of the Root Mean Square Error is the average square of the difference between the estimated value and the observed value. If the value of the Root Mean Square Error obtained is getting smaller, then the estimation of the model or variable is more valid.

The Root Mean Square Error formula is presented with the following equation:

$$\boldsymbol{RMSE} = \sqrt{\frac{\sum_{t=1}^{n}(X_t - F_t)^2}{n}} \quad \text{.....(3.2)}$$

Where

Xt = Actual value in the tth period

Ft = Forecasting value in the tth period

n = Amount of data.

Results and Discussion

This study aims to predict budget expenditures using the Neural Network Algorithm at LPP RRI Gorontalo. The data used in this study is data obtained from financial data for the 2013 to 2021 Expenditure reporting period at LPP RRI Gorontalo in the form of univariate time series data. The amount of data from 2013 to 2021 is 412. In the initial data processing the researchers used several stages, namely times series data, data normalization, Neural Network analysis, and denormalization. For the stages of times series, normalization, and denormalization of data in this study using Microsoft excel. As for the Neural Network stage using the tools available

in RapidMiner. Data processing is the manipulation of data into a more useful form. Because the predictions use times series data, the researchers changed the financial statements from monthly to weekly reports. It generates 412 data records for the overall data. The data are as follows:

Table 2. Times Series Data

No.	Month	Sunday	Expense
1	January 2013	1	19,230,000
2		2	19,080,300
3		3	23,267,000
4		4	19,002,300
5	February 2013	5	21,530,000
6		6	21,789,000
7		7	23,760,700
8		8	25,083,000
9	March 2013	9	19,980,000
10		10	25,667,000
11		11	23,606,700
12		12	21,789,000
13	Apr-13	13	23,267,000
14		14	19,002,300
15		15	19,980,000
16		16	26,177,000
17	May 2013	17	21,789,000
18		18	24,980,000
19		19	24,980,000
20		20	19,980,000
.....	.....	.....	.....
.....	.....	.....	.....
397	Apr-21	397	23,267,000
398		398	21,530,000
399		399	23,608,300
400		400	23,267,000
401	May 2021	401	21,989,000
402		402	25,667,000
403		403	23,267,000
404		404	24,660,700
405	June 2021	405	21,549,000
406		406	23,106,700
407		407	23,240,000
408		408	19,180,300
409	July 2021	409	22,038,900
410		410	25,667,000
411		411	23,606,700
412		412	23,230,300

From the data normalization formula that has been described in Chapter III, using the initial data is done normalization of data in the following ways:

X (Sunday)1 = 0.8 (19230000 – 14720800) / (28177000 – 14720800) + 0.1

= 0. 368

X (Sunday)2 = 0.8 (19080300 – 14720800) / (28177000 – 14720800) + 0.1

= 0. 369

X (Sunday)3 = 0.8 (23267000 – 14720800) / (28177000 – 14720800) + 0.1

= 0. 608

X (Sunday)4 = 0.8 (19002300 – 14720800) / (28177000 – 14720800) + 0.1

= 0. 355

X (Sunday)5 = 0.8 (21530000 – 14720800) / (28177000 – 14720800) + 0.1

= 0. 505

X (Sunday)6 = 0.8 (21789000 – 14720800) / (28177000 – 14720800) + 0.1

= 0. 520

X (Sunday)7 = 0.8 (23760700 – 14720800) / (28177000 – 14720800) + 0.1

= 0. 637

X (Sunday)8 = 0.8 (25083000 – 14720800) / (28177000 – 14720800) + 0.1

= 0. 716

X (Sunday)9 = 0.8 (1998000 – 14720800) / (28177000 – 14720800) + 0.1

= 0. 413

X (Sunday)10 = 0.8 (25667000 – 14720800) / (28177000 – 14720800) + 0.1

= 0.751

Prediction Result

As previously explained, in making predictions, the researcher uses RapidMiner and Microsoft Excel as tools in managing the data. The process in RapidMiner to make predictions is the same as the process of determining NN Parameters. The difference is in this process, the results in the first process (parameters generated in the first process) are the parameters in this process.

The best period result data is entered in RapidMiner for validation. This process produces NN parameters that will be used in predicting Budget Expenditures which will ultimately produce Budget Expenditure predictions at LPP RRI Gorontalo.

Conclusion

Based on the results and discussion of this research, conclusions can be drawn regarding the prediction of Budget Expenditures at RRI Gorontalo by using the Neural Network Algorithm that the accuracy of the Neural Network Algorithm includes (1) Using 412 Expenditure Records Data from 2013 to 2021 The lowest RMSE value is in the Hidden Layer 11 , Training Cyle 400, Learning Rate 0.1 and Momentum 0.1 with an RMSE value of 0.142. (2) Prediction results look better because they are close to Real Data, so the Neural Network can be used to predict spending at LPP RRI Gorontalo. Presumably we can do testing with other algorithms to predict other data or can also compare with other algorithms, so that maximum results can be found, or can also use larger data.

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