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Computational of Distribution of Wind Speed as Preliminary Information for Fishers: Case Study in Lombok Sea

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ABSTRACT

Wind speed and direction are two important things needed for safety by fishermen when going for fish in the sea. The shifting season in Indonesia is very visible nowadays, while the fishermen still use traditional techniques in determining the time will be at sea, so there is not a slight accident experienced by fishermen when it is in the middle of the ocean. Therefore, it is the responsibility of the relevant Government to convey early information to the fishermen for their safety. The purpose of this research is to provide alternative information in determining the wind speed and direction using the Artificial Neural Network type Back Propagation (ANN-BP) method. Prediction result with monthly data input for the last 12 years can be used as a reference by the Government to be presented to the fishermen in order to determine when to find fish and more anticipatory in seeing the speed of the wind is influential on the wave speed and height in the sea. The predicted result with the architecture of the 144 layers input, the 10 layers hidden-1, 5 layers hidden-2, and 1 output layer resulted in an average minimum wind speed of 2,996 knots, the average maximum wind speed of 31,500 knots, and the average wind direction of $207{,}824^0$

Key words : Wind Speed, Wind Direction, Preliminary Information, Artificial Neural Network, Back Propagation Method.

1. INTRODUCTION

The wind is a moving air due to the rotation of the earth and the difference in surrounding air pressure [1]. The wind moves to a place that has high air pressure leading to a place that has low air pressure [2], [3]. One of the data recorded by the Meteorology of Climatology and Geophysical Department is called BMKG, which is the wind speed. Wind speed is a fundamental atmospheric quantity caused by the movement of the wind from high pressure to low pressure, usually due to temperature changes [4], [5]. BMKG uses an anemometer to measure wind speed and direction. Other data recorded by BMKG is precipitation, humidity, temperature, and long sunlight.

Generally, the activity of fishers is determined by wind speed and direction that occur in the region [6]. Therefore, the Government should provide early information to fishers to be more cautious when going down to the sea. Because the wind speed is too high will certainly cause a storm that impacts the high sea waves [7]. The welfare of fishers is very influential in their income from catching fish in the sea. The activity of catching fish in the sea depends on the tidal caused by wind speed and direction. So, fishers do not immediately descend into the sea looking for fish without seeing the conditions of the wind that is blowing both from land and from the sea.

Early information would certainly be a positive consideration for fishers to avoid unwanted events. The tools used by BMKG are only capable of measuring the wind speed and direction, but are not able to measure the wind speed for the future. Therefore, a method is required to study the pattern of data spread recorded by the anemometer. Looking at the data recorded by the tool in the form of daily data, monthly, even yearly, then it takes a method capable of doing simulation or prediction with compound data input or matrix $\boldsymbol{m} \times \boldsymbol{n}$, where $\boldsymbol{m}$ and $\boldsymbol{n}$ are the time series of the data. One of the best methods of recognizing data patterns with the size of a compound data is the Artificial Neural Network type Back Propagation (ANN-BP) [8], [9]. This method is able to recognize data patterns; both normal data and data have a high trend [10]. This is because ANN-BP is capable of being medicated by adding more neurons as a signal identifier or input data e.g., with n layer inputs, n layer hidden, and one layer output. In addition, this method has many activation functions and training algorithms to increase the percentage accuracy of the simulated data [11], [12], [13], [14].

The result of the prediction is not the result desired by the research team, but how the prediction result can be used as a reference material by the Government in making the policy and convey it to the fishermen so that the fishermen are also able to read The natural situation even has a better plan for fish-seeking activities in the sea, thus spared the things that would harm and harm them when the sea is fortified.

2. METHODS

This research is a quantitative descriptive study. Where data is processed in statistic computing to obtain information that is able to be recommended to the Government to be conveyed to fishermen in the form of a policy. The Data used in this study are wind speed and direction over the last 12 years i.e. minimum wind speed (knots), maximum wind speed (knots), and wind direction (degree). Furthermore, to see the accuracy of forecasting used three parameters namely performance (R^2), Mean Square Error (MSE), and Mean Absolute Percentage Error (MAPE) [15]. The training and testing process is explained as follows:

- Designing Graphical User Interface (GUI) using MATLAB software for Back Propagation method with attention to input, calculation process, and output required in the form of the output table, accuracy parameters, and simulation chart data approach Actual and predictive.
- Define training and testing data. In this case, researchers selected the training data for the first ten years and the 11th year to be data testing to see the accuracy of the architecture that was constructed.
- Compile the architecture to be simulated by viewing methods of training, activation function, the number of layers input, hidden, and output. In addition, other parameters such as goal, maximum epoch, learning rate, and step are also specified.
- Choose the training method and activation function with the best prediction result by looking at the smallest error value of MSE and MAPE.
- Make predictions for maximum wind speed data, minimum wind speed, and wind direction for twelve months.
- Determines the average of each data
- Perform an interpretation of the predicted outcome.

3. RESULT AND DISCUSSIONS

Designing a GUI that fits the needs of the Back Propagation method will determine in the process of training and testing done by doing a lot of training options include (1) three types of activation functions namely LOGSIG, TANSIG, and PURELIN; (2) Three types of training algorithms namely TRAINGDA, TRAINGDX, and TRAINRP; (3) The number of inputs on the input layer, hidden, and output; and (4) supporting parameters such as maximum epoch, goal (Error), learning rate, momentum, decrease ratio, increase ratio, and step. Furthermore, determining the output to be displayed includes a table of prediction output, accuracy parameters (MSE and MAPE), as well as graphs of the approach between actual data and predictions. From the results of the training and testing of data, researchers determine the architecture used for the prediction of speed data and wind direction:

Number of Neurons:
- Layer Input : 144 (prediction) and 120 (training & testing)
- Layer Hidden 1 : 10
- Layer Hidden 2 : 5
- Layer Output : 1

Activation Function : LOGSIG, LOGSIG, LOGSIG
Algorithm Training : TRAINRP
Setting Parameter:
- Max. Epoch : 1000
- Error (Goal) : 0,0001
- Learning Rate (LR) : 0,7
- Momentum : 0,9
- Decrease ratio LR : 0,7
- Increase ratio LR : 1,05

Before the above architecture obtained the process of training and testing of data using the last 11 years, while the data of the 12th year is used as a target to track the accuracy of the prediction results. Furthermore, this architecture is used to predict maximum wind speed data, minimum wind speed data, and wind direction. The result of simulated results is obtained according to Table 1 and Table 2 below.

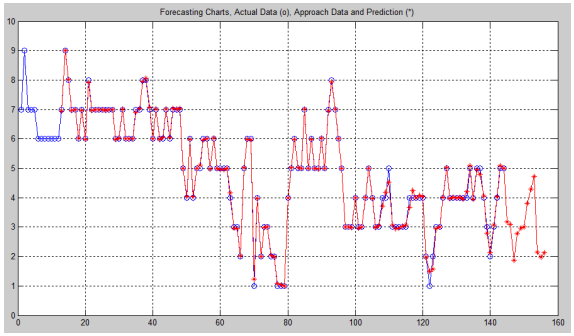
Table 1: Value of Predicted Result Parameters

No	Data	R^2	Iteration	MSE	MAPE	Average
1	Minimum wind speed	0.99843	502	0.00999387	1.8285	2.996 knot
2	Maximum wind speed	0.99886	412	0.212776	2.06538	31.500 knot
3	Wind Direction	0.99898	530	11.8803	1.34546	207.844^0

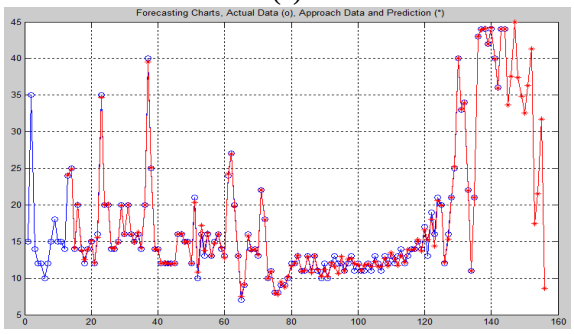
Table 2: Prediction Results of Minimum Wind Speed, Maximum Wind Speed and Wind Direction

Month	A_{min}	A_{max}	Wind Direction
January	3.182	33.656	264.844
February	3.086	37.609	166.485
March	1.870	44.995	258.454
April	2.765	37.371	207.107
May	2.955	34.892	235.649
June	3.018	32.529	197.515
July	3.794	36.310	167.552
August	4.295	41.309	220.860
September	4.725	17.416	156.545
October	2.152	21.559	207.980
November	1.975	31.750	260.912
December	2.139	8.608	149.985
Average	2.996	31.500	207.824
Maximum	4.725	44.995	264.844
Minimum	1.870	8.608	149.985

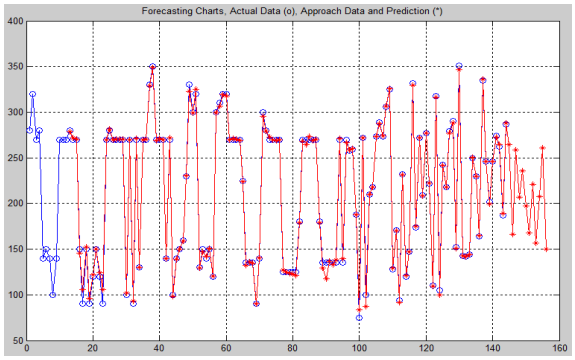
Table 1 show that the number of iterations ranges from 500 to 1000 targeted iterations of the iteration. This has resulted in an average performance level of 0.999, or in other words; the accuracy rate reaches 99.75% with an average of MSE and MAPE of 4.034 and 1.746. In addition, in Table 2 it appears that the average minimum wind speed is 2.996 knots, with the lowest value occurring in March at the rate of. Meanwhile, the average maximum wind speed was 31,500 knots, with the highest value occurring in March of 44.995 knots. Subsequently, the average wind direction prediction of 207.824. The pattern of the predicted distribution of each data can be seen in Figure 1 below.



(a)



(b)



(c)

Figure 1: Prediction Result of (a) Minimum Wind Speed, (b) Maximum Wind Speed, (c) Wind Direction

Predictions are not absolute but can be used as a reference in making policies to be published to the public to be more alert to natural symptoms, in particular, the impact posed by the wind speed and direction conditions [16]. The two symptoms of this nature are of mutual effect with other natural symptoms such as rainfall, temperature, and humidity. Where the wind brings the clouds to a certain area into a rain either low, normal or high. In addition, wind speed and direction become the determining wave condition in the sea as the first benchmark that must be observed or studied by fishermen before going to the sea as well as by the officials in the voyage of the Marine transportation system. Too high waves or waves are certainly caused by high wind speeds. The standard for small boats should be wary of the maximum wind speed of 16 knots, while a large boat with a type of Ferry must be wary of the maximum wind speed of 21 knots. While on Table 2 it looks average wind speed is very high, reaching 31.500 knots. Of course, this is very worrying about the safety of fishers, including sea transportation.

Furthermore, wind direction conditions also need to be noticed by the fishermen so that the purpose of the cruise does not contradict wind direction. Based on Table 2, the average wind direction of 207.824, it is explained that the direction of the wind is always blowing towards the southwest (between the south and the West). This wind direction explains the condition of the clouds always pointing southwest. It is also very low in the rainfall occurring in the eastern region of West Nusa Tenggara province. The intensity of rainfall in the southern and western regions is very high, while the eastern and northern regions are very minimal. This is one of the factors of drought in the area.

Such analysis needs to be significantly conveyed to the community through policies by the Government or related agencies so that fishers or farmers take action to avoid or reduce the risk of loss in Daily activities because the traditional methods that just fall in time cycles are certainly not always true, due to the uncertain natural conditions resulting in seasonal shifts and other natural symptoms.

4. CONCLUSION

Forecasting is imperative by looking at the pattern of distribution and trend of data that has been recorded in the government database. This is because the predicted result can be used as a reference in deciding the conclusion to give birth to policies that need to be conveyed to the community. Result prediction using Artificial Neural Networks (ANN), especially Back Propagation method, is able to provide good output. This is because this method has many training methods and activation functions that can be selected based on input data characters. One of them is the prediction of wind speed and wind direction in this case. Data simulation results provide an accuracy rate of up to 99.9% with the data count architecture specifying the number of input layers, two hidden layers, and one layer output.

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