

Resilient method in determining the best architectural model for predicting open unemployment in Indonesia

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Abstract. The resilient method is a method of Artificial Neural Networks which is often used to make predictions, especially in times series data (continuous). This method is able to make predictions by learning from data that has been done before by first forming the right network architecture model. Therefore, this study will discuss the best network architectural models to make predictions using the resilient method. The data used in this study is open unemployment data according to the highest education completed in Indonesia in 2005 to 2018 based on the semester, which was sourced from the National Labor Force Survey (Sakernas) obtained from the website of the Indonesian Central Bureau of Statistics. Based on this data, a network architecture model will be formed that is used with the Bayesian Regulation method, including 12-6-2, 12-12-2, 12-18-2, 12-24-2, 12-12-12-2, 12-12-18-2, 12-18-18-2 and 12-18-24-2. From these 8 models after training and testing, the results show that the best architectural model is 12-18-2 (12 is the input layer, 18 is the number of hidden neurons and 2 is the output layer). The accuracy of the architectural model for semester 1 and semester 2 is 75% with an MSE value of 0,0022135087 and 0,0044974696.

1. Introducing

Unemployment is one of the big problems that is always faced by Indonesian people from year to year besides poverty. Unemployment is now a major problem that must be resolved immediately. The lack of effort by the government and the private sector in creating jobs is one of the triggers for the increasing number of unemployed people in Indonesia, especially accompanied by a low level of community education and inadequate human resources, making the community unable to find work. Unemployment is termed for people who do not work at all, are looking for work, work no more than 2 days a week, or someone who is trying to get a decent job[1]. The cause of unemployment is generally because job seekers or the number of workforces is not comparable with the number of jobs available. Many factors influence the unemployment rate, one of which is inflation, the financial crisis to the low level of public education. Unemployment is often a problem in the economy because, with unemployment, people's productivity and income will decrease so that it can cause poverty and other social problems [2].

In this study, the unemployment that will be discussed is open unemployment in Indonesia according to the highest education completed in each semester (February and August), including No / have never attended school, No / have not finished elementary, elementary, junior high, general high school / High School, Vocational / Vocational High School, Academy / Diploma and University. In recent decades according to the Indonesian Central Bureau of Statistics (BPS), open unemployment in Indonesia according to the highest

education achieved is not stable, sometimes rises and sometimes decreases, especially with the uncertain economic climate in this country potentially growing more unemployment. In BPS data it can be seen that based on junior high school graduates in 2016 in semester 1 (February) there were 1.31 million unemployed and in semester 2 (August) there were 1.29 million. In 2017 in semester 1 (February) the unemployment rate decreased to 1.28 million, down 0.03 million. Whereas in the second semester (August) there were 1.27 million or a decrease of 0.02 million. Whereas based on general/high school graduates in 2016 in the first semester (February) there were 1.54 million unemployed and in the second semester (August) there were 1.95 million. In 2017 in semester 1 (February) the unemployment rate rose to 1.55 million or up 0.01 million. While in the second semester (August) there were 1.91 million or down 0.04 million. Broadly speaking, based on data from BPS, it was concluded that the highest unemployment rate in Indonesia came from general/senior high school education, then vocational/vocational and junior high school senior high school.[3].

Therefore, it is necessary to predict to find out the number of open unemployment in Indonesia according to the highest education completed for the following years, this is done so that the government has references and considerations in determining policies and in making the right steps to overcome this unemployment. But in making predictions it is not easy, it takes data, methods and appropriate steps so that the results of the predictions can be accounted for later. One of the right methods to use is the Resilient backpropagation method. The resilient method is one of the methods of Artificial Neural Networks which is often used to make a prediction, this is because this method is able to predict data based on previous data so that the prediction results are obtained after learning and training based on data that has already occurred[4]–[7]. Therefore, this study will determine the best network architecture model that is used to make predictions later. It is expected that from the results of this study, the number of open unemployment in Indonesia according to the highest education completed for subsequent years in each semester can be predicted so that the Indonesian government can make and determine the right policy to reduce this unemployment rate. In the previous study, a study was conducted to measure the level of open unemployment in Indonesia using the Levenberg-Marquardt algorithm with an accuracy rate of 88%[8]. Further research is conducted to predict the stock exchange in Istanbul Turkey using resilient backpropagation (Rprop). This study produced an accuracy of 86.7% when using backpropagation standards, and 90% when using resilient[9].

2. Methodology

2.1. Research Methods

The research method used is an Artificial Neural Network with a resilient method. This method is able to make predictions based on past data. Resilient is the result of the development of backpropagation. The change in weight in backpropagation is influenced by the learning rate and depends on the slope of the error curve ($\partial E / \partial W_{ij}$). The smaller the learning rate used, the learning will take longer. While the greater the level of learning, the weighting value will be far from the minimum weight. To overcome this, a new method is developed, namely Rprop (Resilient Backpropagation). This method uses a sign (positive or negative) of the gradient to indicate the direction of weight adjustment. While the size of the change in weight is determined by the adjustment in value (Δ_0). The resilient method changes the weight and bias network with a direct adaptation process from weighting based on local gradient information from the learning iterations so that the number of iterations needed to reach the target[10].

2.2. Data Source

The dataset used in this study is the dataset of Open Unemployment according to the highest education completed in 2005-2018 (Table 1), which is sourced from the website of the Indonesian Statistics Agency[3].

Table 1. Open Unemployment by Education

No	Highest Education The one who was finished	2005		...	2018	
		February	August		February	August
1	No / never been to school	342.656	264.458	...	42.039	31.774
2	No / haven't graduated from elementary school	670.055	673.527	...	446.812	326.962
3	SD	2.540.977	2.729.915	...	967.630	898.145
4	SLTP	2.680.810	3.151.231	...	1.249.761	1.131.214
5	SLTA Umum/SMU	2.680.752	3.069.305	...	1.650.636	1.930.320
6	SLTA Kejuruan/SMK	1.230.750	1.306.770	...	1.424.428	1.731.743
7	Akademi/Diploma	322.836	308.522	...	300.845	220.932
8	Universitas	385.418	395.538	...	789.113	729.601
Total		10.854.254	11.899.266	...	6.871.264	7.000.691

2.3. Research Flow

The first thing to do is to collect datasets. The dataset used is data Open unemployment according to the highest education completed. Next is the pre-processing stage and dividing the data into several parts, namely data used for training and data used for testing. Then determine the network architecture model that will be used for the training process and testing process, after all, is done, results will be obtained based on the architectural model used. Furthermore, some of the best architectural models used are chosen.

2.4. Research Variable

The research variables used in this article are 2 parts, namely input variables, and output variables. There are 12 input variables, namely the number of open unemployment in semester 1 (February) and Semester 2 (August) based on years from training and testing input data. While the output variable is 2, namely the number of open unemployment in semester 1 (February) and Semester 2 (August) which is the target of training and testing input data. While the criteria used are 8, among others: No / never been to school, No / graduated from elementary school, elementary school, junior high school, General / Senior High School, Vocational High School / Vocational School, Academy / Diploma and University.

2.5. Normalization

Based on table 1 data, the data is first divided into 2 parts. The 2005-2010 data with the 2011 target was used as training data, while the 2012-2017 data with the 2018 target were used as testing data. Then the data that has been divided into two is normalized using the equation (1) [11]–[13].

$$x' = \frac{0.8(x-a)}{b-a} + 0.1 \quad (1)$$

Explanation: x' is the result of normalization, x is data that will be normalized, a is the lowest data and b is the highest data from the dataset.

3. Results and Discussion

3.1. Results of Normalization Data

Table 2 below is the result of the normalization of training data used in each semester 2005 to

2010 with 2011 as the target. While Table 3 is the result of normalization of test data used in each semester of 2012 - 2017 with a target in 2018. This data is taken based on table 1. This data is normalized using the sigmoid function as written in the equation (1).

Table 2. Normalization of training data

Data	Highest Education					Target	
	The one who was finished						
	2005		...	2010		2011	
	Feb	Aug		Feb	Aug	Feb	Aug
1	0,1734	0,1531	...	0,1000	0,1255	0,1090	0,1379
2	0,2581	0,2590	...	0,2263	0,2400	0,2295	0,2756
3	0,7421	0,7910	...	0,4786	0,4477	0,4189	0,4060
4	0,7783	0,9000	...	0,5135	0,5146	0,5594	0,6381
5	0,7783	0,8788	...	0,6309	0,6407	0,7020	0,6995
6	0,4031	0,4228	...	0,4306	0,3939	0,3718	0,3852
7	0,1682	0,1645	...	0,2240	0,1994	0,2061	0,1563
8	0,1844	0,1871	...	0,2969	0,2684	0,2491	0,2253

Table 3. Normalization of test data

Data	Highest Education					Target	
	The one who was finished						
	2012		...	2017		2018	
	Feb	Aug		Feb	Aug	Feb	Aug
1	0,1339	0,1191	...	0,1215	0,1111	0,1037	0,1000
2	0,3028	0,2709	...	0,2833	0,2326	0,2477	0,2050
3	0,5935	0,6054	...	0,5485	0,4106	0,4330	0,4083
4	0,7067	0,6989	...	0,5446	0,5422	0,5334	0,4912
5	0,8159	0,7533	...	0,6413	0,7686	0,6760	0,7756
6	0,4511	0,4684	...	0,5808	0,6656	0,5956	0,7049
7	0,1806	0,1599	...	0,1775	0,1751	0,1957	0,1673
8	0,2855	0,2473	...	0,3047	0,3089	0,3695	0,3483

Data processing is assisted by Matlab 2011b tools in determining the best architectural model with resilient. The architecture used is 8 models, namely: 12-6-2, 12-12-2, 12-18-2, 12-24-2, 12-12-12-2, 12-12-18-2, 12 -18-18-2 and 12-18-24-2. The way to determine the best architectural model with the resilient method is to determine the minimum error from the training and testing process carried out. The error rate used is 0.02 with a learning rate of 0.01. In this study, the code parameters used were analyzed using the Matlab 2011b application.

3.2. Best Model Training and Testing

Of the 8 architectural models used in this study, the 12-18-2 architectural model is the best model. The results of the training using the architectural model 12-18-2 can be seen in figure 1 below.

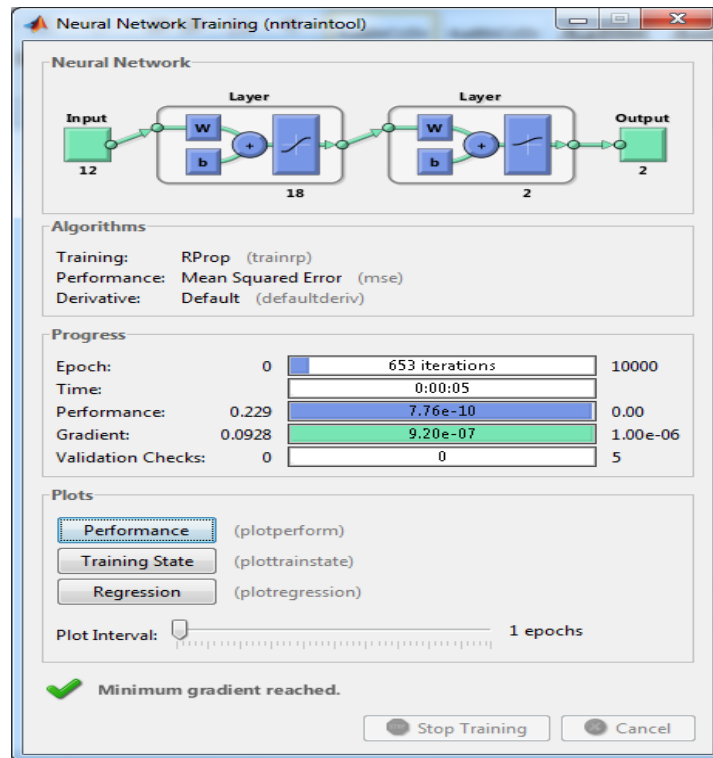


Figure 1. Training with models 12-18-2

In figure 1, it can be explained that the results of the training using the 12-18-2 architectural model produced an epoch of 653 iterations, completing the training for 5 seconds which would later produce training MSE of 0.0000000006 and 0.00000017. The complete results of training and testing data with the 12-18-2 architecture can be seen in the following tables 4 and 5:

Table 4. Model training data 12-8-2

Data	Target		Output		Error		SSE	
	Feb	Aug	Feb	Aug	Feb	Aug	Feb	Aug
1	0,1090	0,1379	0,1090	0,1378	0,000027	0,000056	0,0000000007	0,0000000032
2	0,2295	0,2756	0,2295	0,2756	0,000013	-0,000048	0,0000000002	0,0000000023
3	0,4189	0,4060	0,4189	0,4060	0,000014	0,000016	0,0000000002	0,0000000003
4	0,5594	0,6381	0,5594	0,6381	-0,000028	-0,000018	0,0000000008	0,0000000003
5	0,7020	0,6995	0,7020	0,6995	0,000005	-0,000001	0,0000000000	0,0000000000
6	0,3718	0,3852	0,3718	0,3852	-0,000031	-0,000016	0,0000000009	0,0000000002
7	0,2061	0,1563	0,2061	0,1564	-0,000040	-0,000064	0,0000000016	0,0000000041
8	0,2491	0,2253	0,2491	0,2252	0,000019	0,000059	0,0000000004	0,0000000034
Sum SSE							0,0000000048	0,0000000138
MSE							0,0000000006	0,0000000017

Table 5. Model testing data 12-8-2

Data	Target		Output		Error		SSE		Hasil	
	Feb	Aug	Feb	Aug	Feb	Aug	Feb	Aug	Feb	Aug
1	0,1037	0,1000	0,1260	0,1066	-0,022347	-0,006600	0,0004994058	0,0000435600	1	1
2	0,2477	0,2050	0,2387	0,2299	0,008984	-0,024863	0,0000807051	0,0006181590	1	1
3	0,4330	0,4083	0,4565	0,4486	-0,023493	-0,040318	0,0005519180	0,0016255321	1	1

Data	Target		Output		Error		SSE		Hasil	
	Feb	Aug	Feb	Aug	Feb	Aug	Feb	Aug	Feb	Aug
4	0,5334	0,4912	0,5423	0,5802	-0,008902	-0,088985	0,0000792426	0,0079182574	1	1
5	0,6760	0,7756	0,7153	0,6415	-0,039258	0,134063	0,0015411803	0,0179727577	1	0
6	0,5956	0,7049	0,6344	0,6927	-0,038850	0,012203	0,0015093075	0,0001489024	1	1
7	0,1957	0,1673	0,1635	0,1550	0,032244	0,012308	0,0010396719	0,0001514962	0	1
8	0,3695	0,3483	0,2581	0,2617	0,111385	0,086609	0,0124066382	0,0075010919	0	0
Sum SSE							0,0177080694	0,0359797567	75% 75%	
MSE							0,0005208256	0,0010582281		

In tables 4 and 5 it can be explained that there are 8 data (No / never been to school, No graduated from elementary school, elementary, junior high, high school general / high school, vocational/vocational high school, academy/diploma and university). Training targets were obtained from normalized Targets 2011 (February and August) (can be seen in table 2), while testing targets were obtained from normalized Targets 2018 (February and August) (can be seen in table 3). The training and testing output was obtained from calculations using Matlab 2011b based on the 12-8-2 architectural model. Error obtained from target - output. SSE is obtained from Error^2 . The results are obtained from the formula: IF (error \leq 0.02; 1; 0). Value 1 means true, while 0 means wrong. The number of SSE is obtained from the total SSE as a whole. MSE is obtained from Total SSE / 8 (amount of data). While accuracy is obtained from the correct amount of data / 8 * 100, resulting in 75% accuracy.

3.3. Comparison of Architectural Models

In table 5 below, we will see a comparison of the 8 architectural models.

Table 5. Comparison of Architectural Models

No Architecture		Training					Testing			
		Epoch Times		MSE		Function	MSE		Accuracy	
				February	August		February	August	Feb	Aug
1	12-6-2	1721	00.12	0,0000000016	0,0000000097	tansig, logsig	0,0077261882	0,0367969373	38%	63%
2	12-12-2	3828	00.25	0,0000000022	0,0000000044	tansig, logsig	0,0145236130	0,0219917286	50%	50%
3	12-18-2	653	00.05	0,0000000006	0,0000000017	tansig, logsig	0,0022135087	0,0044974696	75%	75%
4	12-24-2	466	00.03	0,0000000006	0,0000000011	tansig, purelin, logsig	0,0079475406	0,0269124436	50%	38%
5	12-12-12-2	2074	00.15	0,0000000006	0,0000000016	tansig, purelin, logsig	0,0074304950	0,0202662022	75%	50%
6	12-12-18-2	1785	00.13	0,0000000006	0,0000000016	tansig, purelin, logsig	0,0097445998	0,0055817166	38%	38%
7	12-18-18-2	4123	00.30	0,0000000006	0,0000000018	tansig, purelin, logsig	0,0238099467	0,0448071071	75%	75%
8	12-18-24-2	3027	00.23	0,0000000006	0,0000000011	tansig, purelin, logsig	0,0258659672	0,0406906660	75%	50%

4. Conclusion

The resilient backpropagation algorithm can be used to predict the level of open unemployment in Indonesia as an effort to assist the government in reducing poverty in the future. Based on the 8 architectural models used in the study (12-6-2, 12-12-2, 12-18-2, 12-24-2, 12-12-12-2, 12-12-18-2, 12-18-18-2 and 12-18-24-2), the best architectural model was obtained from 10-25-25-2 with predictive accuracy of 75%. Training MSE for the prediction of Semester 1 (February) is 0.0000000006 and MSE is testing 0.0005208256. While the training MSE for the prediction of Semester 2 (August) was 0.0000000017 and MSE was tested 0.0010582281.

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