Prediction Of The Accuracy Of Student Boarding House Prices Around Widyatama University Using Neural Network Backpropagation Algorithm

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Abstract: Boarding room rental services are a business that has been around for a long time. One of the target consumers of this business is from students who plan to stay temporarily during the lecture period so that they are close to the campus location where the student is studying. A strategic location such as in the area of one of the campuses in Bandung, namely the Widyatama University Campus, provides added value for boarding owners and also consumers who will rent, but there are several problems in this boarding rental business, namely the lack of knowledge of information on boarding rental prices around the area. campus due to the lack of effort made by boarding house owners in surveying boarding rental price data. In addition, boarding house owners find it difficult to determine the range of rental prices in accordance with boarding facilities. This problem is also experienced by prospective boarding house tenants in estimating whether the rental price offered is ideal and comparable to the facilities that will be obtained. This research conducts trials and predicts the range of rental prices in accordance with the parameters of the facilities that have been defined based on a survey of boarding price data via the internet and predicts how accurate the model used is. The method used is an artificial neural network with a backpropagation algorithm. The results of this study indicate that the 14-12-10-2-1 model with an epoch of 100 produces an accuracy rate of 87.18% and an MSE of 0.0033.

Keywords: Boarding House, Rental Price, Neural Network, Prediction, Backpropagation

1. Introduction

Most of the students who have graduated from high school, vocational high school will continue their studies to a higher level, namely to the college or university they want [1]. Not a few of these students want to continue their studies at favorite universities in big cities due to many considerations such as the desired study or faculty only at certain universities or favorite universities, the facilities and infrastructure at the chosen favorite university are usually very complete. and adequate, the existence of scholarships from the government or schools for certain students who excel and meet the requirements provide the opportunity for these students to continue their studies to favorite universities [2].

However, in this case, in carrying out the study plan, there are several constraints, such as students who are outside the big cities to outside the island, of course there is no other reason except having to migrate and stay temporarily in the city where the intended university is located so that can be closer to the distance from the temporary residence to the campus, as well as to save on transportation costs and make it easier for prospective students to be more productive both in their chosen studies and extracurricular activities outside of study. Boarding is one solution for students who live far from the university. Boarding or boarding house is a temporary residence offered by lodging service providers consisting of several rooms and their facilities at a price determined by the boarding owner, while the length of the rental is determined by the tenant. [3].

The boarding house business around the university has become quite a profitable business. Many students who come from outside the city and outside the region who want to study at universities in big cities, one of which is the city of Bandung. In order for students to be more active and productive on campus, the issue of housing is an important thing to consider because the distance between the residence which is close to the university can support study activities and other activities on campus. To choose a boarding house to rent, apart from the distance from the campus that needs to be considered, there are other things to consider such as price, room size, the facilities available in the boarding room to support student productivity and comfort.

2. Theoretical

Problems faced by students who want to rent boarding rooms apart from considering the various things that have been previously stated, namely the lack of knowledge of information about the boarding house location and the price range around the campus. On the other hand, some boarding house owners do unknow the price range of boarding houses in the vicinity because they do not see the survey data or look for information on boarding prices in the vicinity of the boarding houses. Especially if the boarding house is located in the area around the campus, in general, there are many other boarding house competitors with varied and competitive rental prices.

Based on the things stated earlier, the researcher conducted a trial to conduct research using the artificial neural network method with the backpropagation algorithm. This method was chosen because the algorithm can predict and calculate prices with a fairly high level of accuracy, especially in predicting boarding rental prices with several input values that will affect the boarding rental price. The research conducted trials to create a suitable and accurate artificial neural network architecture and model to predict boarding rental prices.

This research was conducted using an artificial intelligence approach, one of which is the Backpropagation Algorithm. This algorithm will be used in predicting the accuracy of boarding rental prices around Widyatama University. The following are some of the previous studies that have been conducted by researchers in predicting several cases using the backpropagation algorithm. Researchers used five studies as reference sources in completing this research.

The first research is related to the implementation of the backpropagation algorithm in predicting house prices by Jiang (2019) [4] entitled "Prediction of House Price Based on The Back Propagation Neural Network in The Keras Deep Learning Framework". The results of this study indicate that the backpropagation algorithm using Keras and the ELU activation function can achieve a good level of accuracy in predicting house prices with an accuracy level of 95.59%.

The second research is related to the implementation of the backpropagation algorithm in predicting rice production carried out by Hutabarat (2018; Kopar, 2018; Afonso & Silva, 2019; Hadi & Muhammad, 2019; Balbay, 2019; Atik & Erkan, 2019; Bomani et al., 2019; Kaya & Aydin, 2019) [5] entitled "Application of the Backpropagation Algorithm in Predicting Production of Rice Paddy Plants by Regencies / Cities in North Sumatra". The results of this study show that the implementation using the backpropagation algorithm and the Matlab application produces an accuracy of 91% with the 3-9-1 architectural model and the MSE error calculation is 0.0025657.

The third research is related to the implementation of the backpropagation algorithm in predicting the human development index (forecasting) conducted by Siregar (2017) [6] entitled "Analysis Accuracy of Artificial Neural Networks Using Backpropagation Algorithm In Predicting Process (Forecasting)". The results of this study show that the backpropagation algorithm with a model architecture that has been arranged such as 3-48-1 can predict forecasts with an accuracy of 100%.

The fourth research is related to this research which discusses the development of boarding house information systems around Soegijapranata Catholic University conducted by Widiastuti et al (2021) [7] entitled "The Information Systems of Boarding House Search Application In Soegijapranata Catholic. University Semarang Based On Android ". The results of this study indicate that the boarding house search system application based on facility requirements can make it easier for students to find the ideal boarding house. About 30 respondents from homestay seekers and 10 respondents from boarding owners indicated that the application was helpful and useful and provided accurate information

3.   Research methods

This research is made using quantitative research methods using data sets that are already available or have been collected by third parties which are then designed and adjusted to the case studies taken, namely the prediction of boarding rental prices in the area around Widyatama University using the Neural Network Backpropagation Algorithm with several stages of research including namely (1) data collection, (2) collection of literature studies, (3) problem identification, (4) homestay set data, (5) determining models, and (6) data testing.
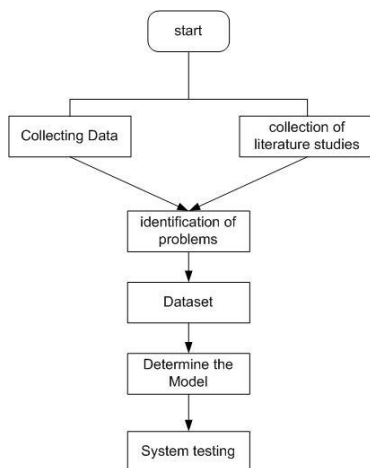
Figure 1.1 Research Framework.

3.1 Data Collection

At this stage, the data used in this study are data taken from the number 1 homestay information search application website in Indonesia [26], namely https://mamikos.com/. Data collection was carried out from March 2021 to April 2021. The search method for collecting data was by entering the location of Widyatama University in the search field. Then the selected search results come from a list of areas with the name Widyatama University. The radius used in the homestay info search filter uses a radius of 3 KM to 4 KM. One by one the information on boarding houses is collected into a data set in a spreadsheet file which is then processed and adjusted according to research needs.

3.2 Collection of Literature Studies

The purpose of collecting this literature study is to collect and study ebooks and previous research journals to be a source of reference in this study, researchers conduct library research collections through searches from Google Scholar and Literature Search in the Mendeley application. The existence of this literature study can complement the theory and basic knowledge of artificial neural networks with the Backpropagation Algorithm method implemented in this study.

3.3 Problem Identification

This stage is the stage of identifying the data that has been collected along with references as theoretical material in order to obtain the appropriate data set for the case study of this research. From the data that has been obtained, the researcher found a problem during the process of collecting data sets from the Mamikos Site, namely the determination of boarding rental prices that were inconsistent with the size of the rooms and facilities obtained. Therefore data selection is carried out for input data such as room size, room facilities, bathroom and boarding rental prices.

3.1 *Data set* Indekos

The data that has been selected and entered into a spreadsheet file as input parameters, is converted into a file with CSV (Comma-separated values) format in order to facilitate data testing with the Backpropagation Algorithm from an artificial neural network. There are 15 data columns that will be tested in this study, including room size, mattress, wardrobe, table, TV, sink, bathroom inside, outside bathroom, shower, hot water, Wi-Fi, rental permit for 2 people, AC. , price class level and boarding rental prices. Class is the level of the boarding house rental price, if the boarding house rental price is less than IDR 650,000 then the value is 0, if the boarding house price is more than IDR 650,000 and less than IDR 850,000, then the value is 1, if the boarding rental price more than the same as IDR 850,000 and less than IDR 1,300,000, then the value is 2, and the boarding house rental price is more than IDR 1,300,000, - the value is 3. This class classification is based on the median calculation of the total boarding price available on the data set.

Table 1.1 Boarding house data set Part 1

Room Size (m^2)	Mattress	Wardrobe	Table	TV	Wastafel	Ensuite Bathroom
16	1	1	1	0	1	0
9	1	1	0	0	0	1
12	1	1	1	1	0	1
9	1	1	1	0	0	0
15	1	1	1	0	0	0
10.5	1	0	1	0	0	0
16	1	1	0	0	0	0
16	1	1	1	1	0	0
12	1	1	1	0	0	0
12	1	1	1	0	0	0

3.4 Specifying the Model

The neural network model used in this study is designed to have the ability to recognize the network pattern at the layer. This model consists of three layers, namely the input layer, the process layer, and the output layer. Following are the model specifications which can be seen in Table 4.5.

Tabel 4.1 Spesifikasi Model

Input Layer	14
Process Layer	12-10-2
Output Layer	1 (boarding house rental price)
Epoch	100
Activation Function	ReLU
Batch Size	32
Loss	*Mean Squared Error*
Optimizer	adam

4. Testing system

The data taken from the homestay ad search application website https://mamikos.com/ is used for testing and validation purposes on the artificial neural network model created. The ReLU function is used in both the process layer and the output layer. The ReLU function is considered the most suitable for use because it produces a numeric value greater than 0, in contrast to linear functions which can be negative. The input and output values are normalized so that they are in the range 0 and 1 in the pre-processing phase. On networks trained using the Backpropagation algorithm, weights and biases will be optimized when the output value has been produced. Based on the specifications, the model created is optimized using the Adam Optimization Algorithm and loss function Mean Squared Error. ANN Testing Scheme with the same batch size, learning rate and momentum. Pattern testing of each scheme is carried out to obtain data loss, namely the results of MSE (Mean Squared Error).

Table 5.1. Specifications of Multiple Model Testing

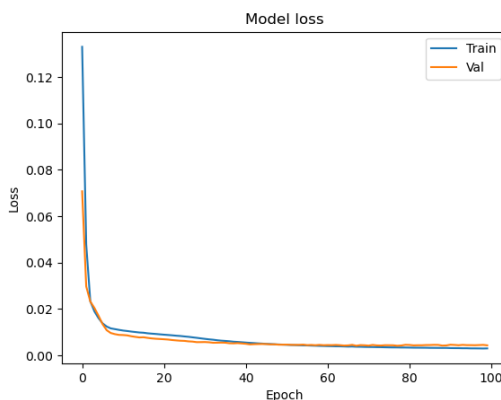| Testing	Training Data	Test Data	Validation Data	Pola	Epoch
1	245	53	52	14-28-7-1	100
2	245	53	52	14-28-14-7-1	100
3	245	53	52	14-32-14-7-1	100
4	245	53	52	14-12-10-2-1	100

Figure 5.1. 1st Test Loss Model Graph

From the graph image of the resulting loss model in Figure 5.1. Testing 1 obtained an MSE of 0.0043, an Explain Variance Score of 0.8413, and a R2 score of 0.8304.
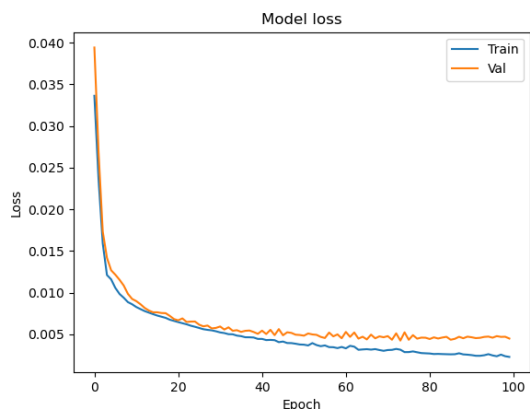

Figure 5.2. 2nd Test Loss Model Graph

In Figure 5.2. Test 2 obtained an MSE of 0.0045, an Explain Variance Score of 0.8281, and a R2 score of 0.8236.
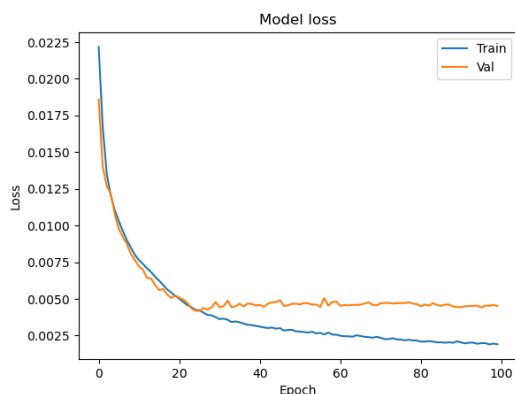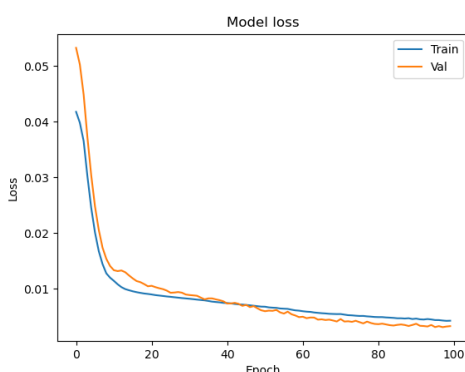
Figure 5.3. 3rd Test Loss Model Graph

In Figure 5.3. Testing 3 obtained an MSE of 0.0045, an Explain Variance Score of 0.833, and a R2 score of

0.8233.

Figure 5.4. 4th Test Loss Model Chart

In Figure 5.4. Testing 4 obtained an MSE of 0.0033, an Explain Variance Score of 0.8808, and a R2 score of 0.8718

From the results of the test data above, a higher accuracy is obtained in test 4 (Figure 5.4). It can be seen that the training loss and validation loss decrease exponentially as the number of epochs increases, which indicates that the model obtains a high degree of accuracy as the epoch increases. The results of the data tested are as follows:

Tabel 5.1. Test Data Results

No	Target	Prediksi	Error (ABS)	Error^2
1	0.26683	0.342779	0.075949	0.00576825
2	0.050211	0.050013	0.000198	0.00000004
3	0.089091	0.050013	0.039078	0.00152711
4	0.466785	0.448273	0.018512	0.00034269
5	0.044657	0.050013	0.005356	0.00002869
6	0.166852	0.166079	0.000773	0.0000006
7	0.044657	0	0.044657	0.00199422
8	0.022439	0.026114	0.003674	0.0000135
9	0.044657	0.050013	0.005356	0.00002869

5. Conclusion

In writing this study, the researcher put forward several explanations for the conclusions, while the conclusions obtained were as follows. Implement the backpropagation algorithm in making the neural network model suitable for predicting boarding rental prices around Widyatama University with the criteria that the model is formed to have the ability to recognize network patterns at the layer. This model consists of three layers, namely the input layer, the process layer, and the output layer. Model specifications are Input Layer worth 14, Process Layer 12-10-2, Output Layer worth 1 (boarding rental price), Epoch worth 100, Activation Function in the form of ReLU, Batch Size worth 32, Loss in the form of Mean Squared Error and using Adam Optimizer.

The results of training data and data testing on boarding rental price survey data around Widyatama University to predict the accuracy of boarding rental prices show fairly good results. This can be seen from the obtained Mean Squared Error, Explain Variance Score, and R2 scores. The MSE score obtained was 0.0033. Then the Explain Variance Score obtained is 0.8808. This score measures how well a model can explain variations in a dataset [27]. The score limit that can be obtained is 1 which indicates that our model is perfect. Then the R2 score obtained is 0.8718. This score refers to the coefficient of determination [27]. In other words the R2 score tells us how well the unknown sample will be predicted by the model created [27]. The best score you can get is 1.

6. Suggestion

In this research, there are several suggestions that can later be used as the development of better research in the future. These suggestions are as follows.
1. The accuracy of the model can be improved by adding to the dataset to be tested.
2. Adding other input parameters such as environmental conditions, ease of access, and so on.
3. Conducting trials using other models in order to get a higher accuracy from this research which has an accuracy rate of 87.18%.

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