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Prediction analysis of retail store sales level using neural network algorithm method based on customer segments

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ABSTRACT

Marketing activities are of significant importance to business operations, as they are uniquely positioned to provide value to consumers. The marketing mix represents one of the strategic approaches employed to attain these organizational objectives. However, the company's sales data is only available for consultation in the archives. By understanding customer preferences and requirements, the company can readily develop an effective marketing strategy to compete with similar businesses. Accordingly, this study employs the neural network methodology to forecast sales based on the company's historical sales data. The research method employs a neural network due to its capacity for processing substantial data sets with flexibility. Moreover, the Root Mean Square Error (RMSE) must be employed to ascertain the precision of the utilized model. The findings of this study indicate that the discrepancy between the actual and predicted values is minimal, suggesting that the model is able to accurately represent the data. Similarly, the results of the RMSE (Root Mean Square Error) demonstrate that the model's accuracy is improving, with minimal values observed in each segment. A 4P marketing mix strategy may be employed to enhance the company's sales potential. Based on the findings of the research, it can be posited that the results of the prediction data set, the visual prediction results, and the RMSE using the Neural Network method can be utilized effectively and accurately to forecast sales and assist company owners and management in considering target sales levels in the future.

1. Introduction

Marketing is a process through which products are identified that will be purchased by customers for the purpose of generating profit [1]. In the context of globalization and the accompanying rapid growth of business, it is a significant challenge for businesspeople to gain competitive advantage in the business market and to encourage companies to engage in marketing activities for their products in order to attract consumers. Marketing activities are of significant importance in business operations, as they are positioned to provide value to consumers [2]. The evolution of computers is a notable example of this phenomenon, and the advent of these devices has

the potential to enhance the dissemination of information within communities [3]. Consequently, computers present business opportunities, one of which is the sale of computers and related devices.

The marketing mix consists of product, price, promotion, and location, which can be done to maximize the level of sales success, and all of that aims to obtain the desired target [4]. Based on this definition, the marketing components in the marketing mix [5] can be used to achieve the target goals desired by the company and can be used to assist managers or company owners in carrying out tactics and other activities [6].

However, the number of competitors in similar business fields makes entrepreneurs race each other to meet consumer needs [7] by seeing the opportunities that exist. For product sales to increase, one of which is by utilizing sales transaction data. So far, the sales data of computer equipment at CV Analys Jaya Computindo is only for archiving and is not used for customer sales analysis. Therefore, with the recording of sales data every day, more sales data will be recorded and the existing sales data can be analyzed to predict sales used for the coming month or year. This analysis process can be done using the RapidMiner application to get sales prediction results from product sales data [8]. Thus, this study uses RapidMiner with the Neural Network method [9] to be able to evaluate the sales strategy of the products sold and can predict sales from the data that has been collected. With the application of the right prediction algorithm, the company has a good chance of making the right decision so that it can be useful for entrepreneurs competing with similar businesses in the future [10]. Sales data taken for processing is data from the CV Analys Jaya Computindo and data sorting is carried out in Microsoft Excel, in this study, what is used is data on the number of items sold and segments or buyers in CV Analys Jaya Computindo.

Previous research has discussed with the K-Nearest Neighbor method [11], the Naïve Bayes method [12], and with the Deep Neural Network method [13]. Still, in previous studies, it was included in the classification, not prediction/forecasting because the data processed is a large amount of data and the available data attributes are clear without the need for grouping or classification. So, the author chose this Neural Network to be the method used research. Neural Network works like a human neural network computed into a computer algorithm. This method allows for complex problem-solving, unclear mathematical problems, nonlinear problems, or stochastic problems [14]. It has the advantages of high accuracy, easy to manage and dynamic because it uses samples, and can train large datasets because it mimics how the human brain works [15]. Thus, this research can fill literature regarding sales predictions using the Neural Network method.

According to Kotler and Armstrong, the marketing mix is a controlled tactical marketing tool companies use to produce the desired output in the target market [16]. The marketing mix can be grouped into four key factors, commonly called the 4Ps: Product, Price, Place, and Promotion [17]. There is also an overview of these 4Ps regarding product mix, the price of a product, and a combination of promotional planning to get closer to customers in a distribution manner that can be considered properly [18].

Neural Networks solve complex computations such as prediction, pattern recognition, and modeling. These instructions are converted into computer programs and machine code that can be used to find more complex trends [19]. It has also proven to be effectively used for problem-solving in pattern recognition and data analysis, as well as for control evaluation [20].

The objective of this research is to predict/forecast sales at CV Analys Jaya Computido in the forthcoming year. The principal contribution of this study is to provide recommendations for an optimal marketing strategy, one of which is the 4P marketing mix. This is supported by the Neural Network research method for problem-solving in sales forecasting in the intended company segment. Another contribution is the benefit obtained by the company, namely that the owner and management can evaluate the sales data that has been analyzed in order to increase sales in the segment under study. Thus, the company is better able to compete with other similar businesses.

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2. Method

In this study, the Neural Network method to analyze the required data. Neural Network consists of several simple processing elements that are used as a broad function approach to complex numerical patterns, can process input to output variable optimization functions, can support non-linear data, and is flexible in processing large amounts of data [21]. Neural Network was chosen in this study as a research method to forecast future sales because companies with thousands of sales data will find it easier to analyze using this method. After all, this method can process large amounts of data sets. However, this method cannot be used to classify data like K-Nearest Neighbor because the data source used in this research is sales data with clear attributes. This study uses secondary data from CV Analys Jaya Computindo sales data from 2020 to 2022 in each segment.

Prior to data collection, this research examines the phenomenon of marketing strategies (4P marketing mix) on sales, as well as the results of sales prediction and the determination of the problem formulation. The primary variables of interest are the dates and the items sold in each segment, which encompasses stores, companies, and individuals. Subsequently, the data collection stage should be initiated, utilising Microsoft Excel for the storage of sales data. Once the quantity of data to be processed has been established, the data pre-processing stage may be initiated. This is a procedure whereby the data collected is transformed through the selection and division of the data, thus facilitating its comprehension and utilisation for analytical purposes [22]. If the results are not suitable, the data pre-processing process will be repeated, otherwise, if the data result are suitable, the results of the transformed data will appear, then the results are processed using RapidMiner application to find out whether the results are efficient and accurate or not to forecast sales. The following can be seen in Fig. 1 the steps of the research method [23] used to be well structured and easy to understand.

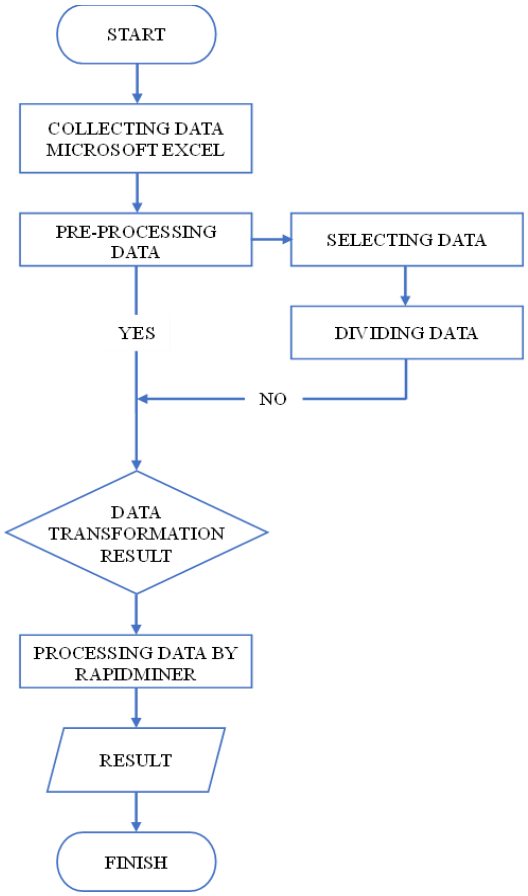

Fig. 1. Research Flow

2.1. Data Collection

In this study, data were collected from CV Analys Jaya Computindo and totaled 2,867 data records. Nine data attributes were provided, including date, segments, sales location, item category, type of item category, number of items sold, unit price (in Indonesian rupiah), total price (in Indonesian rupiah), and payment information from 2020 to 2022. This data collection is stored in Microsoft Excel [24], which will then be entered into RapidMiner to process the results of sales predictions for the next year.

2.2. Data Pre-Processing

Before analyzing the data, pre-processing is done to transform and rearrange the data to make it useful and efficient [25]. The initial stage of data processing, involving the selection of data that will not be utilized, is conducted using Microsoft Excel. The model employs three attributes—date, segment, and number of items sold—to predict sales by segments. The segment attribute is then disaggregated into three categories: stores, companies, and individuals. The number of items sold attribute is disaggregated based on four weeks of sales to obtain the sales target for each month.

Once the data to be utilized has been identified, the subsequent step is to partition the data into two distinct categories: training data and testing data. The training data is used to train the model [26]. In this data division, the sales data for four weeks and the targets are included. The target is the total sales per week for two years, namely 2020 to 2021. The testing data is employed to ascertain the outcomes of the data mining model that has been constructed [27]. Additionally, this data is utilized to derive the projected sales figures for the forthcoming year. As with the training data, the only distinction is the year; the testing data employs sales data from 2022 as the input.

2.3. Data Processing

Following pre-processing, the data undergoes further processing using RapidMiner, along with the selected training and testing data. Subsequently, data division occurs in the input stage, resulting in model formation. This is illustrated in Fig. 2 below.

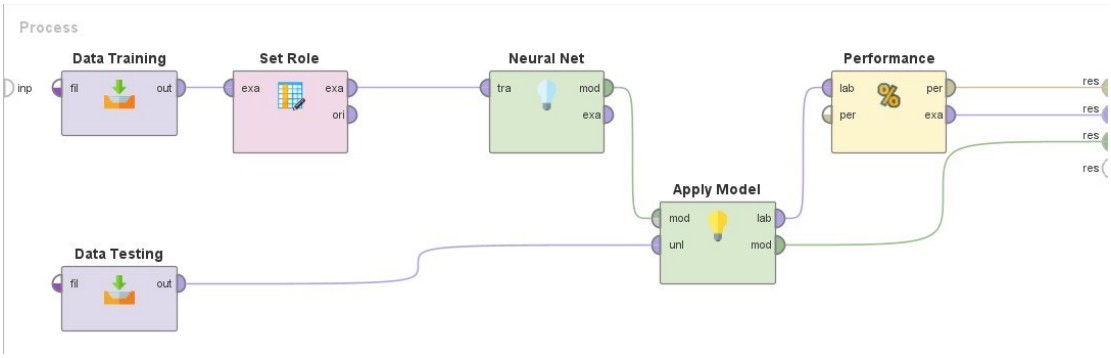

Fig. 2. Data Processing in RapidMinier

The use of a Set Role [28] in this process is to label or select reference data that will be used to compare with the data to be predicted. After that, the Neural Net operator was used as a model to predict sales. To apply the trained model, namely the training data to the testing data, which aims to get the desired prediction, the Apply Model operator is added [29], and then the performance operator is added to find out the RMSE (Root Mean Square Error) on each data processed.

3. Results and Discussion

3.1. Analysis and Result

This research employs the neural network method within the RapidMiner application to ascertain the predictive outcomes of sales data across each segment (stores, companies, and individuals) at CV Analys Jaya Computindo. As was done previously, the pre-processing stage has

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been carried out to select data that is not needed and to divide the data into a training set and a testing set. Subsequently, the sales data based on the existing segments can be processed to determine the sales prediction results. The subsequent section presents the results of the store segment prediction data, as illustrated in Table 1.

Table 1. Store Segment Sales Prediction Result

No.	Date	Week 1	Week 2	Week 3	Week 4	Target	Prediction (Target)
1	January 2022	97	116	132	106	451	464.33
2	February 2022	9	9	6	12	36	48.87
3	March 2022	10	12	9	12	43	54.97
4	April 2022	38	33	27	45	143	134.28
5	May 2022	5	8	5	14	32	46.58
6	June 2022	101	51	88	58	298	268.10
7	July 2022	12	36	21	42	111	116.23
8	August 2022	62	88	89	108	347	347.65
9	September 2022	26	29	52	23	130	128.44
10	October 2022	17	20	14	17	68	74.88
11	November 2022	70	75	50	85	280	267.15
12	December 2022	12	15	15	20	62	70.03

Table 1 illustrates the target column as the result of data pre-processing, namely the transformation of existing data. Each week of sales in a given month is calculated and produces a target or total sales figure for that month, as shown in the week 1 column up to week 4. Subsequently, the processed data generates an attribute column, Prediction (Target) Results, which represents the calculated sales data for each week or month over the course of one year within the specified Store Segment. This column is utilized for sales forecasting purposes, providing insights into the anticipated sales patterns for the subsequent year. This particular store segment is responsible for the greatest number of sales among all other segments.

Table 2. Company Segment Sales Prediction Result

No.	Date	Week 1	Week 2	Week 3	Week 4	Target	Prediction (Target)
1	January 2022	21	35	19	36	111	112.94
2	February 2022	8	8	6	7	29	28.40
3	March 2022	23	10	33	47	113	115.59
4	April 2022	28	33	38	22	121	121.54
5	May 2022	25	21	39	30	115	116.50
6	June 2022	28	40	43	32	143	139.20
7	July 2022	25	21	17	30	93	94.42
8	August 2022	21	45	34	23	123	123.14
9	September 2022	26	16	21	16	79	78.40
10	October 2022	27	22	29	31	109	110.90
11	November 2022	36	21	27	30	114	115.85
12	December 2022	11	17	15	16	59	56.59

Similar to Table 1, Table 2 is also the result of processing between training and testing data, resulting in the Prediction (Target) column. In this Company Segment, the number of sales in the target column is quite different from the number of sales in the Store Segment which is not as much as in the Store Segment. In this case, applying the right marketing strategy is important [30] to be considered by the company for evaluation.

Table 3. Individual Segment Sales Prediction Result

No.	Date	Week 1	Week 2	Week 3	Week 4	Target	Prediction (Target)
1	January 2022	2	3	1	2	8	7.81
2	February 2022	1	1	1	1	4	4.37
3	March 2022	2	4	2	2	10	9.75
4	April 2022	1	1	2	2	6	5.810

5	May 2022	3	2	5	3	13	12.96
6	June 2022	4	4	4	2	14	14.27
7	July 2022	1	1	1	1	4	4.37
8	August 2022	1	1	1	1	4	4.37
9	September 2022	1	1	2	1	5	4.96
10	October 2022	4	3	4	5	16	16.849
11	November 2022	2	1	3	1	7	6.53
12	December 2022	1	1	3	2	7	6.53

Table 3 is also the result of processing between training data and testing data, which produces prediction data in the Prediction (Target) column. However, the number of sales in this Individual Segment has a significant difference compared to the Store Segment in Table 1 and the Company Segment in Table 2. The number of sales is quite small, so the company should have the right strategic role to help increase sales in this segment.

The results of sales prediction data using the Neural Network method also produce a visual display that is used to make it easier to find out whether the processed data is efficient. The following visual display results for store segment sales predictions can be seen in Fig. 3.

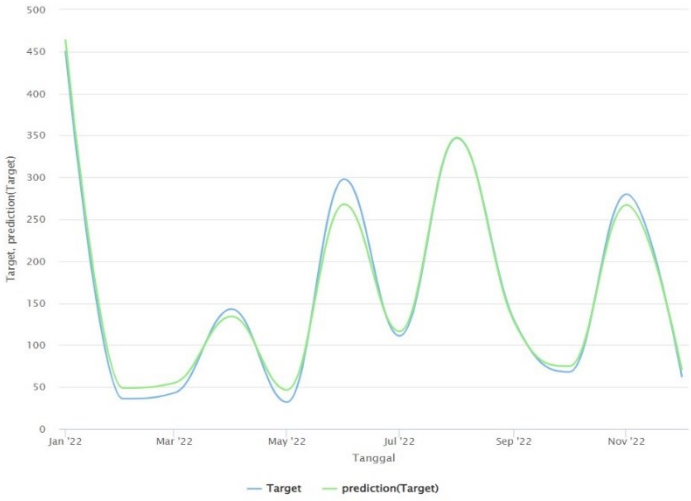

Fig. 3. Visual of Store Segment Sales Prediction Result

Fig. 3 shows the visual results of the Store Segment sales, where the blue line is the actual value of the target attribute and the green line is the predicted value of the target attribute. This visual is used to make it easier to know whether the implemented method runs efficiently or not.

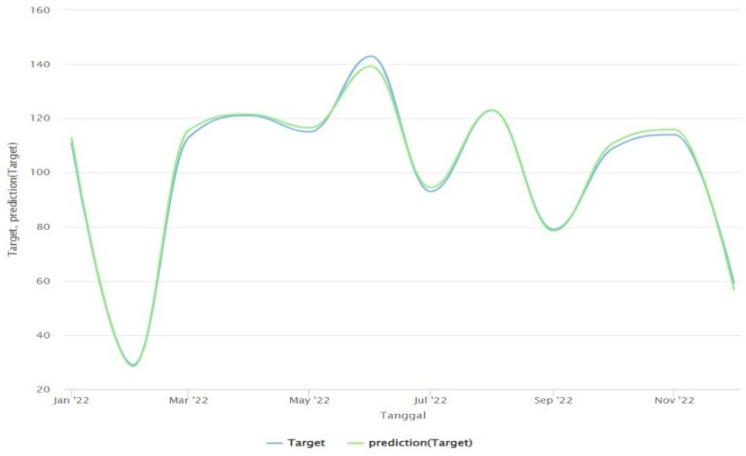

Fig. 4. Visual of Company Segment Sales Prediction Result

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The visual representation of sales for the Company Segment is illustrated in Fig. 4. This figure demonstrates that the number of sales has not undergone a substantial increase or decrease. This is in contrast to the Store Segment, as illustrated in Fig. 3, which exhibits fluctuations in sales volume on a monthly basis. Nevertheless, the sales figures are less impressive than those of the Store Segment.

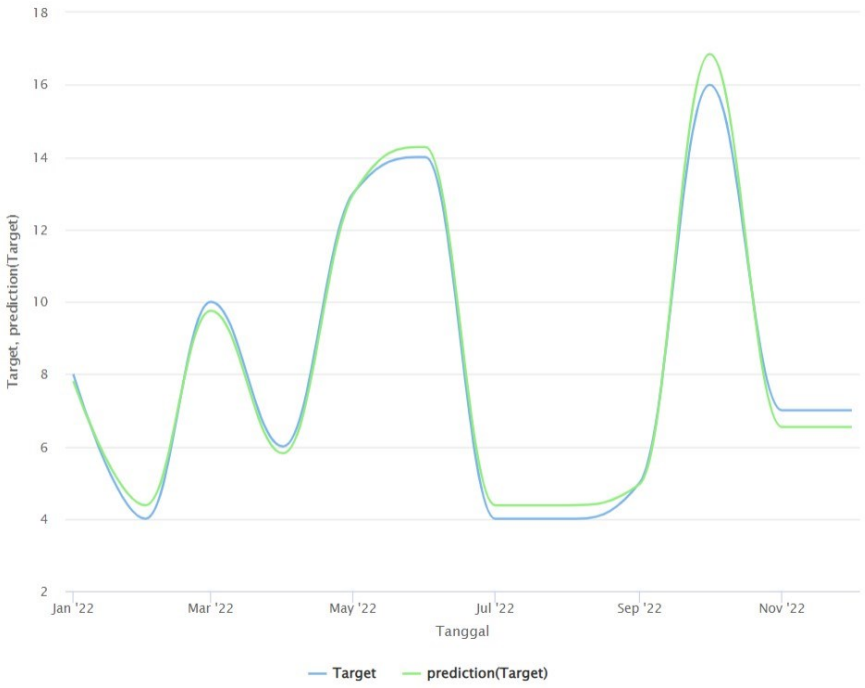

Fig. 5. Visual of Individual Segment Sales Prediction Result

Fig. 5 illustrates the visual results of the individual segment sales, which are markedly inferior to those of the store and company segments, as depicted in Fig. 3 and Fig. 4, respectively. Consequently, the company must implement a more effective and tailored marketing strategy to enhance its sales performance. Once the visual results of the sales predictions in each segment have been evaluated, the subsequent step is to assess the accuracy of the sales predictions. To ascertain the precision of the aforementioned sales predictions, the Root Mean Square Error (RMSE) is employed to gauge the discrepancy between the actual and predicted values, as yielded by the Neural Network methodology [31]. A lower RMSE value indicates a greater degree of accuracy in the model [32]. The following Table 4 presents the RMSE values for each segment.

Table 4. RMSE Value for Each Segment

No.	Segment	RMSE
1	Store	12,83
2	Company	1,89
3	Individual	0,38

3.2. Discussion

The results of the sales forecasting at CV Analys Jaya Computindo, as illustrated in the visual representations in Fig. 3 – Fig. 5, indicate that the target attribute, or total sales per month, exhibits a relatively minor deviation between the actual value (blue line) and the predicted value (green line). This suggests that the predicted data closely approximates the actual data. The research indicates that the discrepancy between the actual and predicted values is not significant. This suggests that the prediction process is viable and the outcomes are effective [33].

CV Analys Jaya Computindo is classified as a new company engaged in the sale of computers and supporting equipment, so competing with companies in similar fields requires the right strategy so as to be kept from the business market. By implementing a basic marketing strategy, namely the 4P marketing mix, the company has the opportunity to increase the number of sales [34] Product is one of the important elements because by providing a diversity of brands sold, consumers have a wide variety of choices to buy. Also, for product packaging that is good or not damaged when the goods are sent to consumers, the company will have more value from consumers who have bought goods from the company. It can be seen in the Store Segment sales data set in Table 1 that the sales of products in CV Analys Jaya Computindo are quite diverse and have good packaging, so the Store Segment makes many repeat purchases each year because the items they are looking for are in the company, according to the visual prediction in Fig. 3, which states that in the coming year sales of goods in the Store Segment will also increase so that the owner or management of the company needs to maintain this product marketing mix strategy. In line with research, which states that product is an important element because it can affect other marketing strategies [35] other research states that good product quality will impact on consumer loyalty and increase revenue [36].

Price, namely setting the price for each item sold that consumers must pay, is also a consideration for consumers in buying products sold by the company. So, the company must be able to set prices that compete with other similar companies. It can be seen in the Store Segment sales data set in Table 1 and the Company Segment in Table 2 that the prices set by CV Analys Jaya Computindo are quite affordable and can compete with companies in similar fields so for the Store Segment, the prices offered by the company can be resold and for the Company Segment the prices offered by the company are following the company's financial expenditure budget. Other research states that pricing is a critical point in the marketing mix because it determines the income of a business [37] and also other research states that price is one of the elements that influence on consumer satisfaction and decision-making [38].

Place is the place or location where the company is established, and the location must be accessible to consumers. The company's sales location can also be in the form of social media managed by company management to reach a wider range of consumers. In line with research, which states that location is where entrepreneurs determine the location of their business the choice of place is the most important factor in running a business [39]. The sales location of CV Analys Jaya Computindo is in the form of a house. No social media is run to reach a wider range of consumers, especially for the Individual Segment. When viewed in the Individual Segment sales data set in Table 3, the sales location of CV Analys Jaya Computindo still needs further consideration or evaluation by the owner and management of the company because sales in the Individual Segment are still not more widely reached due to the location which is a house and has no sign, and also does not yet have social media or e-commerce as a place to make sales. Research states that location is the bridge between sellers and buyers [40], an important factor to increase sales and reach the widest possible audience.

The promotion of goods and services, defined as a communication activity between sellers and buyers, can also exert an unconscious influence on consumers, prompting them to purchase items they desire or require. Other research indicates that, through the use of promotional or advertising activities, the company in question is able to declare the brand of the product in question and persuade consumers to purchase it by highlighting the various attributes of the product [41]. The promotion can be disseminated through a variety of channels, including the use of printed materials such as brochures. In the current digital age, social media has emerged as a prominent avenue for promotional activities. The promotional media utilized by CV Analys Jaya Computindo remains primarily word-of-mouth, with consumers acquiring knowledge of the company through the recommendations of individuals who have previously made purchases. Table 3 reveals that the owners and management of CV Analys Jaya Computindo must enhance their promotional marketing strategy. This can be achieved by leveraging social media to create educational and creative content that educates consumers about the company and its products. Other research indicates that promotion is a significant determinant of the success of marketing activities [42]. Despite the quality of the product being satisfactory, the lack of

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awareness among consumers will inevitably result in a degree of hesitation when it comes to making a purchase.

4. Conclusion

The results of the prediction data set, the visual prediction results, and the RMSE (Root Mean Square Error) demonstrate that sales prediction in each segment in CV Analys Jaya Computindo using the Neural Network method in the RapidMiner application can be used effectively and accurately to forecast sales. The visual results of the prediction of each segment, namely the line deviation between the actual value and the predicted value, demonstrate a minimal discrepancy, as evidenced by the accuracy test using RMSE (Root Mean Square Error) in each segment, which yielded a very low value: 12.83 for the Store Segment, 1.89 for the Company Segment, and 0.38 for the Individual Segment. The analysis of retail store sales using the neural network method provides insights that can inform the development of marketing mix strategies. It is recommended that the proprietor and administrative staff of the company consider the prospective sales target for the forthcoming period. It should be noted, however, that the present study is subject to certain limitations with respect to the data analyzed, namely that it employs only sales data pertaining to the aforementioned segments, namely stores, companies, and individuals. CV Analys Jaya Computindo is a company engaged in the sale of computers and related products. The company offers a wide range of computer-related products. It is hoped that further research will examine this topic with other, more diverse data or with other methods related to existing company data.

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