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Optimizing Iron Price Forecasting with Linear Regression Analysis and RapidMiner

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Abstract: Competition in companies often occurs in price, advertising and promotion, and quality. Price is very influential on competition in a business. The price of a product is one of the things that influences buyers to want to buy a product or not; therefore, price is very important to determine. There are two objectives in this study; the first objective is to predict the right iron price to be used in the following year so that it can be used to increase the competitiveness of the company. The second objective is to determine the attributes that affect the price. This research uses a linear regression algorithm to predict prices and measure the attributes' relationship using the RapidMiner tool. RapidMiner is software that functions as a learning tool in data mining science in which various data processing models are ready to be used easily. From the test results on the training data, an accuracy value of 95% was obtained with a threshold value of 30, which stated that the results were accurate. Then, the factors that affect the price produce factors from the size variable (mm) and unit (kg); between the two variables that affect the price, there are results from the variables that most affect the price, namely size (mm). For the performance of the linear regression model calculated using the root mean square error (RMSE) produces a value of 199,291.

Keywords: Business competition, Factors Affecting Price, Linear Regression, Price Prediction, RapidMiner.

INTRODUCTION

Currently, business competition in Indonesia is increasing due to the high demand for products in business. Competition in companies often occurs in price, advertising and promotion, and quality (Setiyono & Sutrimah, 2016). Setiyono Therefore, Price significantly affects competition in a business, so companies are required to improve their competitiveness. The Price of a product continuously is one of the things that influences buyers to want to buy a product or not. Therefore, Price is significant to determine. According to Kotler and Armstrong (2018: 324), Price is the amount of money spent on a product or service or the value exchanged by consumers to obtain benefits, ownership, or use of a product or service. Price makes the first benchmark in buying and selling (Mulyana & Siburian, 2018). One of the keys to business success is setting the right selling price. The price set by the seller determines whether or not the goods or services sold are sold, which, of course, will impact the business's sustainability (Harga & Komis, 2015). According to Laksana (2019: 110), factors that affect prices are supply, demand, and competition because if the price of goods increases, the number of offers will also increase.The price of a product can be a factor that affects demand. Companies need to estimate product demand, which is essential in pricing a product. The high price factor of goods will usually make people rethink before making transactions; if the price of goods is low, then demand will be high because the price is the primary consideration in the eyes of consumers. Supply can be defined as the amount of a product producers want to offer (sell) at various price levels at a particular place and time. In contrast, demand is defined as the desire of consumers to buy a good or commodity in a specific place and time when other factors do not change (Laili et al., 2021). With the factors that affect price, it is necessary to carry out a pricing strategy. Setting the right selling price is one of the main factors for success in entrepreneurship.

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CV Barokah Steel is a company that sells unprocessed raw iron plates. CV Barokah Steel is located in Ngingas Village, Waru Sidoarjo District. This Company has many competitors in the village. The number of companies selling iron plates in the town makes competition tighter and requires a strategy in marketing by predicting the selling price of goods. Predicting prices is familiar to the Company; knowing the prediction of the cost of iron plates in the future will help the Company understand the price that is feasible to use and give to buyers. Accurate prediction of the selling price of iron is also essential in market operations on iron sales(Bin, 2004). Forecasting or prediction has been used as a tool or one of the considerations when making decisions, especially in business or economics, where profits or profits are achieved as much as possible, and losses are minimized as much as possible(Ayuni & Fitrianah, 2019). Suppose prediction is applied in the marketing department. In that case, the company will be more helpful in business competition because this prediction can provide the best output, so the risk of planning errors can be minimized(Sitepu et al., 2019). Prediction or forecasting is an attempt to estimate or forecast something that will happen in the future using relevant historical information(Wanto & Windarto, 2017).

Based on the explanation above, to overcome this problem, a strategy in marketing is needed, namely setting a fair price by predicting the price of iron plates at CV. Barokah Steel. Price prediction is done using RapidMiner tools and linear regression algorithms. Linear regression is a statistical method used to predict and model/measure the relationship between variables (such as price, promotion, weather, etc.)(Widiastuti et al., 2022). So, this research uses a linear regression algorithm to predict prices and measure the relationship of the attributes using the RapidMiner Application. This RapidMiner application is very appropriate to use in processing prediction data because RapidMiner is software that anyone can access, is open source, and has many tools that can be used. RapidMiner is used as a solution to analyze data processing. Using this RapidMiner application is also relatively easy because it only uses drag-and-drop tools in the RapidMiner application (Sari et al., 2020). The existence of increasingly fierce price competition raises new issues to be researched due to the limited literature related to iron price prediction. Previous researchers predominantly studied iron demand using the Monte Carlo method (Monte et al., 2023) product quality (Rusadi et al., 2018) and increase sales (Pohan & Saragih, 2023). Not in terms of price prediction, even though price prediction is significant in today's business competition. Even .ntil now, there has yet to be any use of linear regression methods in predicting iron prices. Thus, this research is a filler for the need for more literature regarding using linear regression methods in iron price prediction. There are two objectives in this study; the first objective is to predict the right iron price to be used in the following year so that it can be used to increase the competitiveness of the company. The second goal is to determine the attributes that affect the price. The results of this price prediction can be a reference for companies in setting corporate strategies and increasing sales through price evaluation.

LITERATURE REVIEW

Business competition

Business competition is the competition of traders who are both trying or wanting to get profits, market share, and also the number of sales. These traders usually compete by differentiating prices, product quality, distribution, and promotion. The goal is to win a bigger market, and so on. Usually, this is triggered by the similarity of market share, the similarity of the types of products sold, and others(Siti Hofifah, 2020).

Price Competition

Price competition is competition between sellers who try to attract customers' attention by offering goods at lower prices than other sellers. The cost of the product is one of the things that decides whether the buyer wants to buy the product or not. Therefore, it is important to determine. Price competition occurs to make the product the number 1 choice of buyers and make the product sell more. This price competition is usually carried out by business people whose products are common, targeted by many people, and involve many producers as well(Solihin, 2019).

Pricing Strategy

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Pricing Strategy is a policy adopted by a company to determine the price to be used for its products and services. The total revenue generated from the set price multiplied by the units sold must cover operating costs and allow a sufficient profit margin. This pricing strategy is very important because it is a key variable in financial modeling, which determines the revenue achieved, the profit earned, and the amount reinvested in the growth of the company for long-term survival(Govoni, 2012)

METHOD

In this study, the research method used was a quantitative approach. The technique used in this research method is using linear regression. Linear regression is a technique for building models to predict the value of given input data; linear regression can also be used to determine the strength of the relationship between the dependent and independent variables (Himawan et al., 2022). The data used in this research is data from 2020 to 2022. The tool used in this research is RapidMiner. RapidMiner is software that functions as a learning tool in data mining science in which various data processing models are ready to be used efficiently (Wijaya & Abdillah, 2023). RapidMiner is also commonly used in business, commercial applications, research, and education, as well as training needs due to its speed in prototyping and supporting all machine learning data preparation, visualization, validation, and optimization processes (Kori, 2017). RapidMiner can examine data quantitatively and qualitatively to obtain the expected information or knowledge (Uska et al., 2020). The following are the stages of the research concept as shown below.

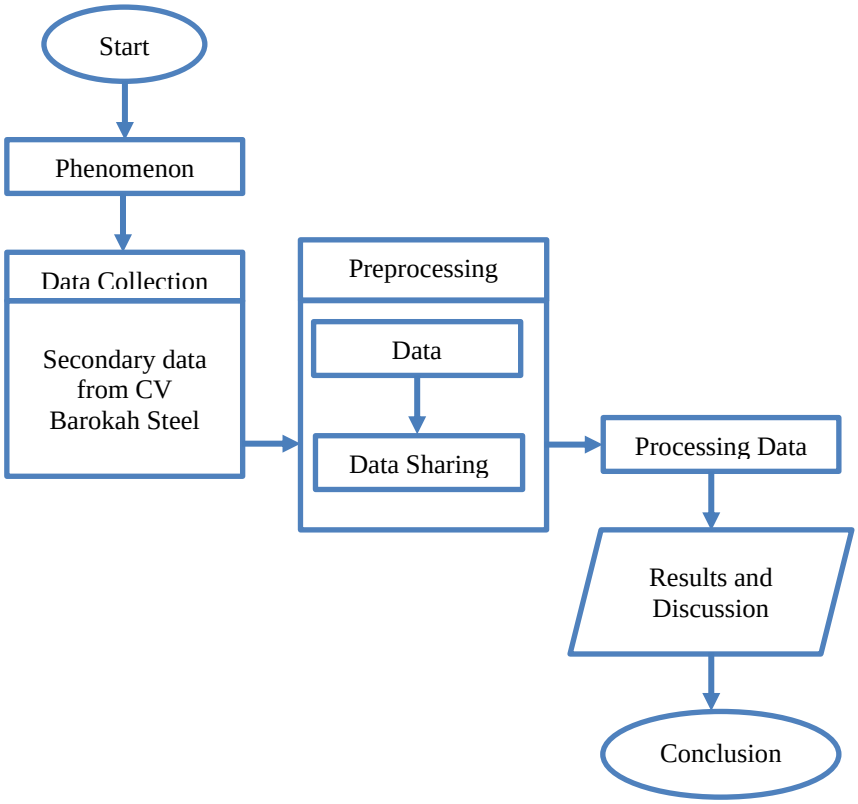

Figure1 research consent stage

The data source obtained is secondary data through a third party, CV. Barokah Steel is in the form of 3000 records of iron plate sales transaction data and has eight attributes: date characteristics, item name, size, weight (kg), total price, buyer name, and payment. The data is data from 2020 to 2022.

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Preprocessing is done to process raw data first before processing by eliminating inappropriate data. The data preprocessing stage in this research is data selection and division before becoming data ready to be processed. The attributes used in data processing to obtain a prediction model with the linear regression method in this study are the price, date, size, and weight (Kg) attributes. Attributes that are not used are the attributes of the item name, total cost, buyer's name, and payment. Some attributes are not used because these attributes have no influence on the prediction results and do not have a significant relationship with the attributes that will be used to predict the results (Andriani et al., 2023). Then, the data is divided into two parts. The first part is used as training data, namely data from 2020 to 2021, and the rest is used as data for 2022; training data is data that will be processed, and testing data is data that will be a reference in predicting prices (Warsino, 2017). Five sequences in RapidMiner stages are used for data processing. First, read Excel is used to import and read the data to be processed. Second, set role sets the attributes that will be used to predict roles. Third, the linear regression operator is an algorithm model used in research to create a model based on the algorithm that has been selected. Fourth, in the apply model, the apply model operator supports the model chosen, namely linear regression, which is used to apply the model that has been used. Fifth, the performance operator displays the results of predicting data to measure the accuracy value (Pertiwi & Indrajit, 2017). In this data processing, the operator panel described previously will be tested in the RapidMiner application, and the operator panel connection can be seen in the figure below. The following are the stages carried out in testing the linear regression algorithm using RapidMiner:

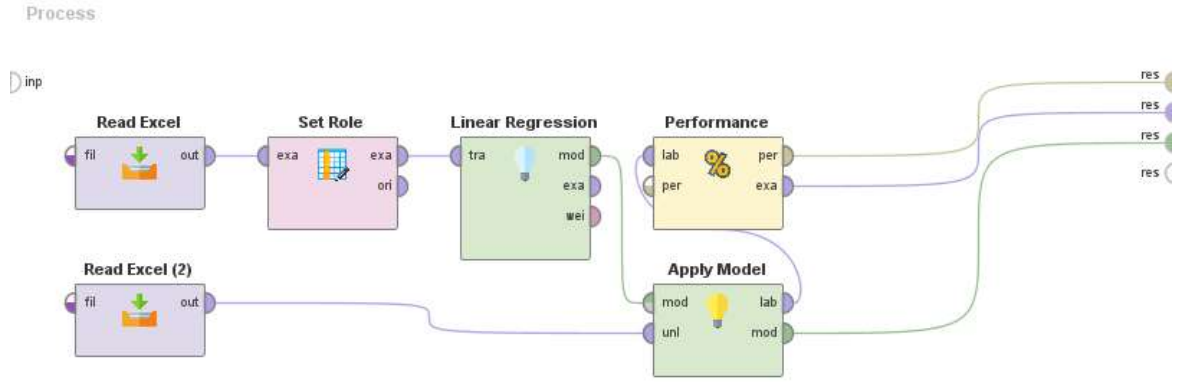

Figure 2. Linear Regression Algorithm Using RapidMiner

Figure 2 show the steps of using RapidMiner. The first step is to prepare the data for processing; data that has been separated into training data and testing data must first be entered into the RapidMiner application by selecting import data and then joined in the respective read excel operators; the data division process can also be done using the split data operator. The next step after completing the data import is to add and connect to the set role operator in the RapidMiner application and to determine the attributes that will be used as labels or attributes that will be used as a reference for prediction. Then, it is added and connected to the linear regression algorithm model for model building. The model-building process uses training data, and the evaluation process uses testing data. The next step is to add the apply model operator, which is used to apply the model used in the linear regression test. The next step is to add a performance operator to see accurate results on the data. After all operator panels are connected by drawing a line on the result, the data is ready to be run by clicking the run icon button on the toolbar to display the results.

RESULT

In this study, researchers used the rapid miner software previously described. They used a linear regression algorithm to identify sales data that would get Root Mean Square Error (RMSE) results, variables that affect prices, and price predictions that can be used in decision-making. The data source used as the object of this research is sales data taken from the company's internal data from 2020 to 2022, which amounts to 3027 iron plate sales data at CV. Barokah Steel and the variables to be processed are purchase date data, iron plate price data per kg, size data (mm) on iron plates, and

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purchase units (kg). The results of data division into training and testing can be seen in Table 1 and Table 2.

Table 1. Training Data Display on Rapidminer

No.	Date	Price	Measurement (Mm)	Kg
1	August 3rd, 2020	11500	3	260
2	August 4th, 2020	13000	4	1392
3	August 7th, 2020	11500	3	184
4	August 12th, 2020	10000	2	725
5	August 15th, 2020	10000	2	148
6	August 19th, 2020	14500	5	664
7	August 20th, 2020	10000	2	2386
8	August 24th, 2020	10000	2	3478
9	August 27th, 2020	10000	2	306
10	September 1st, 2020	16000	6	1180
11	September 5th, 2020	11500	3	778
12	September 7th, 2020	10000	2	638
13	September 10th, 2020	10000	2	2048

The Table above displays training data with two special attributes, namely attributes (ID (date) and Label (price)). This training data is a reference for price prediction; the training data contains data from 2020 to 2021.

Table 2. Display of testing data

No.	Date	Price	Measurement (Mm)	Kg
1	January 13th, 2022	14500	5	161
2	January 24th, 2022	13000	4	130
3	January 28th, 2022	11500	3	124
4	February 4th, 2022	11500	3	1158
5	March 25th, 2022	13500	4,5	386
6	April 9th, 2022	13500	4,5	310
7	April 14th, 2022	13500	4,5	98
8	April 19th, 2022	11500	3	10300
9	April 20th, 2022	13500	4,5	294
10	May 17th, 2022	14500	5	250
11	May 23th, 2022	14500	5	574
12	June 7th, 2022	11500	3	8838
13	June 14th, 2022	14500	5	450

The Table above displays testing data with two special attributes, namely attributes (ID (date) and Label (price)). This training data will be processed to produce price predictions and attributes that affect prices. The training data contains data from 2022. After that, the training and testing data will be processed using a linear regression model to produce iron price predictions, RMSE, and attributes affecting iron prices. The price prediction results can be seen in **Table 3** below.

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Table 3. Price Prediction Result Display

No.	Date	Price	Prediction	Measurement (Mm)	Kg
1	January 13th, 2022	14500	14459.094	5	161
2	January 24th, 2022	13000	13033.897	4	130
3	January 28th, 2022	11500	11608.700	3	124
4	February 4th, 2022	11500	11608.700	3	1158
5	March 25th, 2022	13500	13476.495	4,5	386
6	April 9th, 2022	13500	13476.495	4,5	310
7	April 14th, 2022	13500	13476.495	4,5	98
8	April 19th, 2022	11500	11608.700	3	10300
9	April 20th, 2022	13500	13476.495	4,5	294
10	May 17th, 2022	14500	14459.094	5	250
11	May 23th, 2022	14500	14456.094	5	574
12	June 7th, 2022	11500	11608.700	3	8838
13	June 14th, 2022	14500	14459.094	5	450

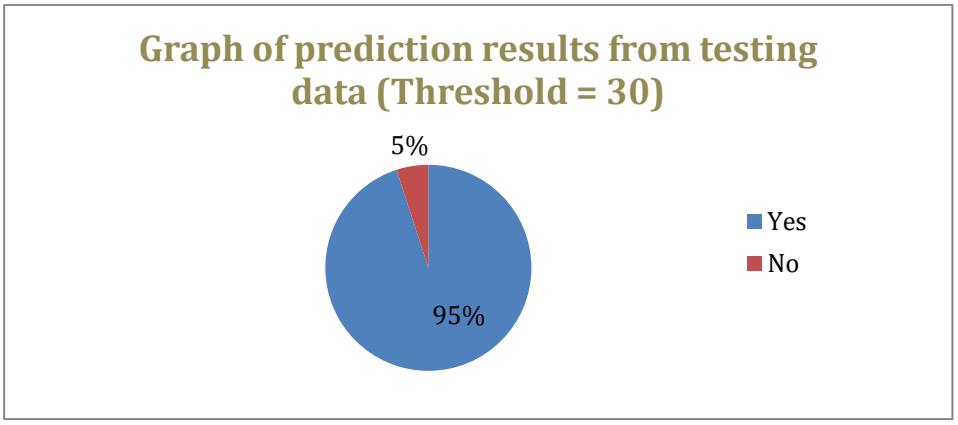

Figure 2. Graphical Display of Price Prediction Results

Based on the prediction results obtained in **Table 3**, the range of values or GAP in the prediction results and prices that are not much different, the prediction results are considered accurate (Sumarjono & Saputra, 2022). Then, the accuracy of the resulting linear regression model can be calculated. The accuracy calculation is done manually by utilizing the Microsoft Excel application. The accuracy calculation is also done by calculating the difference between the value in the "prediction (Price)" variable section and the "Price" variable section in **Figure 2**. If the calculation difference value is still in the threshold range of 30, then the prediction results are correct or accurate (Prasetyo et al., 2021). For example, the "Price" and "prediction(Price)" data in **Table 3** are 14500 and 14459.094. The difference between the two values is 14,444.594, which means that it is still in the range of threshold values. Therefore, the prediction is considered accurate and correct. The testing data prediction graph produces 95% of the data that gets accurate predictions in the threshold value range. Then, the results of the attributes that affect prices can be seen in **Table 4** below.

Table 4. Result display of attributes that affect price

Attribut	Code
Measurement (Mm)	***
Kg	**

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Based on the table above, the attributes or variables that affect the price of iron are the attributes of size (mm) and unit (kg). It can affect because the attributes that come out in the results are the size attributes (mm) and units (kg). The attributes that most affect the price of iron can be seen in the code table, which has three-star code signs while kg only has two-star code signs, it can be concluded that the size (mm) has more influence on the price of iron than the unit (kg) (Novianty et al., 2021). In addition, this study also assessed the performance of the linear regression model obtained. This assessment is done by utilizing the performance operator. The results of the linear regression model performance test process can be seen in **Table 5** below.

Table 5. Display of Performance Test Results

root_mean_square_error	199.291

Based on Table 5, the results of the root mean square error (RMSE) value obtained is 199.291, where the smaller (closer to 0) the RMSE value, the more accurate the predicted value is (Salwa et al., 2018). Root Mean Square Error (RMSE) is the square root of the square of the average error resulting from the calculation (Prasetyo et al., 2021) (Normah et al., 2022). It can also be an alternative method for evaluating forecasting techniques used to measure the accuracy of prediction results (Sanjaya & Heksaputra, 2020).

DISCUSSION

In the development of the economic system in Indonesia, business competition has become one of the economic instruments since the reformation. Competing activities in business between one businessman and another are unavoidable. Increasingly fierce business competition has many consequences for company competition (Setiyono & Sutrimah, 2016). In the world of increasingly fierce business competition, business people are required to create strategies so that companies are able to compete with other companies. Business competition occurs to require companies to be more competitive so as not to lose competitiveness with other companies. In addition, the number of similar products makes the CV. Barokah Steel company must be more innovative in developing strategies so that the products it produces can compete in the market. In business competition, several factors influence competition, namely price competition. Determining an effective product pricing strategy is an essential step in achieving marketing success and profits for the company. In price competition, pricing is needed; pricing for companies is a way to differentiate their offerings from competitors. Setting the right selling price is one of the main factors to achieve success in entrepreneurship. To determine the price setting, a strategy is needed in pricing, namely by predicting the price of the product (Palupi, 2017).

The prediction of iron prices in 2020 to 2022 that has been carried out produces new iron price predictions that can be used for the following year. The prediction of the resulting iron price is not much different from the original price, whose value is still within the threshold of the value range of 30 and gets 95% data accuracy, which means that predictions on iron prices using this linear regression method can be used or recommended for future years. The results of this study are in line with research conducted by (Hilmam Winnos, 2022) with the results of research stating that the linear regression method gets a high accuracy value of 98.9% and linear regression is able to predict well, as evidenced by the graph in the study (Edi et al., 2023).

One of the factors that affect the price of a product is product differentiation; products are divided into several forms such as size, shape or physical structure, differences in packaging, quality, brand, and color of a product. The purpose of this differentiation is to distinguish the products of certain product bidders from other product bidders. Production costs are also a factor that affects the price of a product, and this production cost will lead to product results. The larger the size (mm) of the iron, the more expensive the price will be (Lathiifa & Ali, 2013).

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The predictions generated at CV. Barokah Steel, which has been carried out, gets the results of variables or sizes (mm) and units (kg), which include variables that affect the price of iron. The variable or attribute size (mm) is included in the variables that are very influential compared to the unit (kg) in the results obtained previously because the difference in size will affect the price and make the price will also be different. The results of this study are in line with research conducted (Ayesha Rizky Novianti) with the results of research that quality, brand, physical structure size at the price of a product is declared valid or influential (Pandiangan et al., 2021)

CONCLUSION

Based on the results of data processing carried out previously, the linear regression method in rapid mining is quite good. It can be applied in the case of Predicting Iron Prices and Factors that affect Iron Prices at CV. Barokah Steel. From the test results on the training data, an accuracy value of 95% was obtained with a threshold value of 30, which stated that the result was accurate. Then, the factors that affect the price produce factors from the size variable (mm) and unit (kg); between the two variables that affect the price, there are results from the variables that most affect the price, namely size (mm). For the performance of the linear regression model calculated using the root mean square error (RMSE) produces a value of 199,291. This indicates that the performance of the resulting model is quite good. The prediction using linear regression on rapid miners is expected to be used as a strategy for improving the competitiveness of the company.

However, in this study, the shortcoming of this method is the use of more than one method or one function in prediction calculations. This will result in inaccurate predictions because it only produces one result from the method; besides that, researchers suggest adding more methods or more than one to find out more accurate results on price prediction if using two or more models can be known through differences and more accurate results. Thus, the development of a better prediction model will help companies increase their competitiveness.

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