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2 Predicting the Success of Garment Sales on Transaction Data using the Classification Method with the Naïve Bayes Algorithm

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Abstract— In facing business competition, one of which is the fast-growing garment business, companies must maintain the continuity of the business they run and meet consumer needs. Companies must be able to predict what items are selling well from processing previous transaction data so that the results can help the company know what goods must be produced in the following year to meet consumer needs. Because of that, this research reprocesses sales transaction data for 2020 to classify goods sold and not sold using the Naïve Bayes algorithm, a classification algorithm using probability and statistical methods proposed by British scientist Thomas Bayes. Sales transaction data for 2020 will be processed using existing processes in the Knowledge Discovery Database (KDD), such as data selection, preprocessing, transformation, data mining, and evaluation. The supporting application used to process sales transaction data is Knime. Based on the partition from three ranges of training data and data testing (70% : 30% | 60% : 40% | 50% : 50%), the results of this study show that the accuracy level from the confusion matrix with the Naïve Bayes algorithm is above 90%, which means the Naïve Bayes algorithm can be used to predict garment sales so that it can be a reference for companies to increase sales in the following years of goods that are classified as buyable by consumers using the Naïve Bayes algorithm.

30 **Keywords**—Data Mining, Prediction, Classification Method, Naïve Bayes Algorithm

I. INTRODUCTION

According to Samuel et al [1], sales is an activity carried out by a company to maintain its business to develop and get the desired profit. In the times that continue to grow, competition in the world of business and technology is increasing rapidly, making business people compete to develop their business by utilizing existing technology and also so that their business can always survive in the fast competition. Pransiska, Mirza, & Andri [2] said that to meet consumer desires, business people must improve product quality and add the products consumers like and often buy. The utilization of sales transaction data in the database can be used to support decision-making activities. Not only relying on sales transaction data but data analysis is needed to explore its potentially important information [3].

The establishment of companies in Indonesia that compete and are engaged in the same field, one of which is a garment company. Many garment companies in Indonesia cause business people to think about strategies and advantages to maintain their business and make a profit. As in CV. XYZ is a company engaged in the retail garment sector. This company sells various clothing categories such as Dresses, Tunics, Pants, Blouses, Blazers, and others. Many fabrics are used in this clothing category, reaching 500 types of materials. In one year, clothes sold reached 3000 pcs. The problems faced by CV. XYZ is that this company has not been able to predict from existing sales transactions to find out which clothing categories are dominantly sold and not sold because, so far, the company has not used a unique method to find this out, so the company cannot prepare clothing stocks according to consumer demand. Resulting in unstable sales and sales transactions that have been collected so far not to be processed further but only used as archives and sales reports. Therefore, the company's lack of knowledge in processing existing sales transaction data causes the company to be unable to predict sales ups and downs, resulting in too much capital and accumulation of clothing which results in losses for the company.

1 A method or technique is needed to turn piles of data into valuable information or helpful knowledge to support business decision-making, namely data mining [4]. Peling et al [5] describe data mining as extracting essential and exciting information or patterns from big data in databases through algorithms and extraction techniques in statistics, machine learning, and database management systems. The classification method is part of the method derived from data mining that aims to predict from previous transaction data which goods will increase so that the company can improve its products or which goods will decrease so that the amount of production can be adjusted [6]. Based on Annur's opinion [7], the Naïve Bayes algorithm can be used in a classification method to calculate the attribute probability of data based on its class.

1 Several previous studies using the classification method with the Naïve Bayes algorithm were research in journals [8], this research classified the sale of credit at RA Cell stores using the Naïve Bayes algorithm with a supporting

application, namely RapidMiner. The results of this study produce an accuracy rate of 97.50% and the best-selling product type is Telkomsel pulses.

Research in journals [9], this study predicts pesticide sales at CV. Mitra Artha Sejati uses the Naïve Bayes algorithm. This research was made to increase the company's turnover to achieve targets originating from the sales data processing for 2017, 2018, 2019, and 2020. The results of prediction calculations using the Naïve Bayes algorithm produce an accuracy rate of up to 94.59%.

Research in journals [10], this research predicts sale of motorcycle spare parts at PT. Indako Trading Coy. This study uses the Naïve Bayes algorithm to provide solutions for reducing the capital costs of spare parts inventory that is too large, stabilize stocks according to consumer needs and predict sales of motorcycle spare parts at PT. Indako Trading Coy.

Based on the explanation above, the authors use the Naïve Bayes algorithm because this algorithm is a classification method that predicts future opportunities based on previous experience by changing CV. XYZ sales transaction data for 2020 aims to gain essential knowledge for companies to set good marketing strategies in dealing with other business competitors and can also increase the company's sales turnover. With this research, it is hoped that past sales transaction data will be able to provide new information using the classification method with the Naïve Bayes algorithm to the company so that it can be used as a solution for the company to be able to find out product sales strategies and manage clothing stocks according to predictions that will sell well to meet consumer needs so that companies does not incur too much production cost.

II. THEORETICAL FRAMEWORK

In this section, the author will explain the theories used in this research. In overcoming the existing problems in CV. XYZ, the author uses one of the current data mining methods, namely classification. The classification method is one of the functions in data mining which is included in supervised learning and produces a model to predict the class or category of objects in the database [11]. For example, predicting the sale of goods that are sold or not sold, determines whether a student is diligent or lazy [12].

A. Naïve Bayes Algorithm

Opinion by Bhatia et al [13], Naïve Bayes is an algorithm used to classify using probability and statistical methods. The Naïve Bayes algorithm can predict future opportunities based on previous experience, known as the Bayes theorem [14]. The formula for Bayes' theorem is :

$$P(A|B) = \frac{P(B|A) \times P(A)}{P(B)} \quad (1)$$

B. Naïve Bayes Algorithm Testing

As stated by Nawangsih & Setyaningsih [8], to find out the performance of Naïve Bayes, we use a confusion matrix to calculate the Accuracy value (the level of accuracy between the predicted value and the actual value). Precision (the level of precision between the information requested by the user and the answer gave the system. Recall (the success rate of the system in retrieving information).

$$Accuracy = \frac{TP+TN}{TP+TN+FP+FN} \quad (2)$$

$$Recall = \frac{TP}{TP+FN} \quad (3)$$

$$Precision = \frac{TP}{TP+FP} \quad (4)$$

TP or True Positive, generated from amount of positive data predicted to be positive. TN or True Negative, generated from amount of negative data predicted to be negative. FP or False Positive, generated from amount of positive data predicted to be negative. FN or False Negative, generated from amount of negative data predicted to be positive [15].

C. Knime Tools

Knime is open-source software with the Java programming language for creating data science knowledge that allows users to visualize incoming data streams, carry out certain stages of analysis or all phases of research and view the modeling results interactively [16].

III. RESEARCH METHOD

In conducting research, it is necessary to have well-organized and systematic stages of running according to the expected goals. Fig. 1 is the stages of the research methodology in this study are as follows : (1) Identification of problems, this phase is the first step taken to determine the formulation of the problem from the research and make the existing issues. Then, from the problem in analysis, find out how to solve the problem and determine the scope of the problem under study. In this study, the issues contained in CV. XYZ is this company that can not predict the rise and fall of sales because the existing transaction data is not processed anymore to get valuable knowledge. (2) Literature study, the author looks for references to research from journals, books, or other references to complete this research in terms of concepts and theories so that it has excellent and relevant sources. So the author can increase understanding and theoretical knowledge about the studied problems. (3) Collecting data, data collection is done by coming directly to the garment retail company, namely CV. XYZ and conducted interviews with the HRD Manager regarding clothing sales in the company. Also, the author asked for sales transaction data for 2020 to be processed further. (4) Data processing, sales transaction data obtained by the author will be processed first before entering the data mining process using Knime as a supporting application. (5) Result analysis, the analysis is carried out by looking at the results of testing the Knime application using the classification method with the Naïve Bayes algorithm and looking at the accuracy, precision, and recall values.

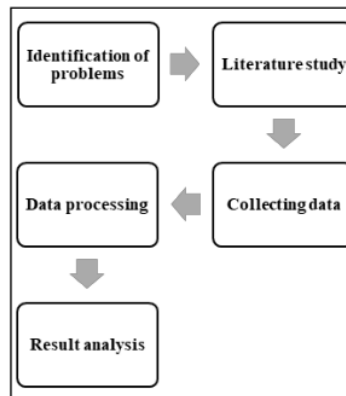


Fig. 1. Research Stages

Processing of sales transaction data for 2020 uses the stages in the Knowledge Discovery in Database (KDD). KDD means a set of processes to find valuable knowledge from data [17].

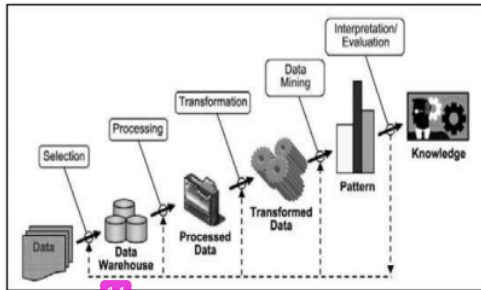


Fig. 2. Knowledge Discovery in Database (KDD) Stages

The explanation of the Fig. 2 are :

1. Data selection

The selection of attributes will be used for the data mining because not all attributes are used entirely [2]. The attributes used in this study can be seen in Table I.

TABLE I. DATA SELECTION

Attributes before selection	Attributes after selection
Date/month	Clothing code
Purchase ID	Sold
Clothing code	
Sold	

2. Preprocessing

Eliminate data duplication, check for inconsistent data, and correct errors in data (typography) [18]. After reviewing the previously selected transaction data, no errors were found.

3. Data transformation

It converted data into a form suitable for data mining [19]. The data attribute that changed is Clothing code into Category. In Table II, there are added attributes, namely Type of Clothes, Transaction, and Criteria.

TABLE II. DATA TRANSFORMATION

Attribute	Class
Category	Blazer, Blouse, Blouse-Import, Coat Import, Dress, Dress-Import, Home Ware, Muslim, Pants, Pants-Import, Scarf, Skirt, Suit, Tunic
Type of clothes	Accessories, Bottom, One Set, Pajamas, Top
Transaction	Sold > 100 : HIGH Sold > 40 : MEDIUM Sold ≤ 40 : LOW
Criteria	Sold > 50 : SOLD Sold ≤ 50 : NOT SOLD

4. Data mining

Apply the classification method with the Naïve Bayes algorithm to process CV. XYZ sales transaction data for 2020 with the help of the Knime app.

5. Evaluation

Explaining the results obtained from the Knime application into information that is easy to understand.

IV. RESULT AND DISCUSSION

The data mining process using the Knime application is taken from CV. XYZ sales transaction data for 2020. The test uses a classification method with the Naïve Bayes algorithm to predict goods sold and not sold. The data to be processed are five attributes, they are : Category, Type of Clothes, Sold, Transaction, and Criteria, totaling 227 records and the label/class is the Criteria.

A. Import Data

In Fig. 3, data imported into the Knime application uses the Ms. Excel format and will be read by Knime Application.

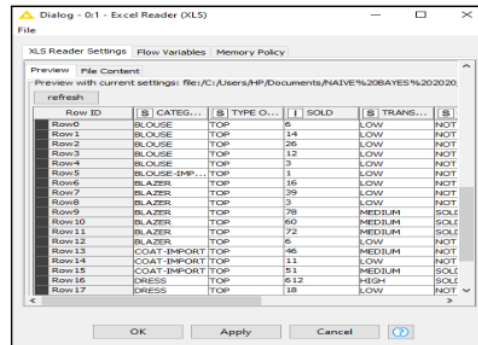


Fig. 3. Data Reading in Knime

B. Node Used in Knime Application

In processing data in the Knime application, some nodes are used and designed to achieve the goals. The image below is a node created in the Knime application. The nodes used start from the Excel Reader to enter sales transaction datasets, Partitioning to divide training data and testing data, Naïve Bayes algorithm nodes, and Scorer to determine the performance resulting from the Naïve Bayes algorithm.

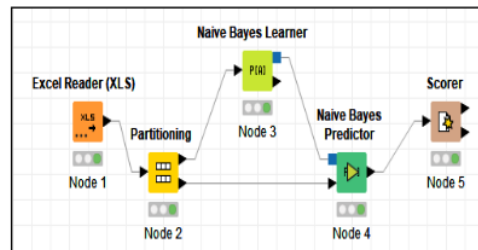


Fig. 4. Node Used in Knime

C. Distribution Training and Testing Data

The data to be processed will be partitioned into three ranges training data and testing data. Table III shows the distribution of training data and testing data using node partitioning in the Knime application. Sampling using stratified sampling based on criteria.

TABLE III. DISTRIBUTION TRAINING AND TESTING DATA

Training data	Testing data
70%	30%
60%	40%
50%	50%

D. Test Results with Knime Application

Table IV shows the calculation results of the Naïve Bayes algorithm derived from the CV. XYZ \$12 transaction dataset for 2020 uses the Knime application with a different distribution of training data and testing data as follows :

TABLE IV. NAÏVE BAYES ALGORITHM CALCULATIONS

Range	Class counts for Criteria			
70 : 30	Not sold	103	65%	
	Sold	55	35%	
	Class/Category	Not sold	Sold	Rate
	Blazer	3	2	3%
	Blouse	5	0	3%
	Coat-import	0	1	1%
	Dress	52	31	53%
	Dress-import	6	0	4%
	Home ware	4	0	3%
	Muslim	2	11	8%
	Pants	15	7	14%
	Pants-import	2	0	1%
	Scarf	1	0	1%
	Skirt	6	2	5%
	Suit	1	0	1%
	Tunic	6	1	4%
Range	Class counts for Criteria			
60 : 40	Not sold	89	65%	
	Sold	47	35%	
	Class/Category	Not sold	Sold	Rate
	Blazer	2	2	3%
	Blouse	4	0	3%
	Coat-import	0	1	1%
	Dress	45	28	54%
	Dress-import	6	0	4%
	Home ware	3	0	2%
	Muslim	2	9	8%
	Pants	12	6	13%
	Pants-import	2	0	1%
	Scarf	1	0	1%
	Skirt	6	1	5%
	Suit	1	0	1%
	Tunic	5	0	4%
Range	Class counts for Criteria			
50 : 50	Not sold	74	65%	
	Sold	39	35%	
	Class/Category	Not sold	Sold	Rate
	Blazer	2	1	3%
Blouse	3	0	3%	

Range	Class counts for Criteria			
70 : 30	Coat-import	0	1	1%
	Dress	37	25	55%
	Dress-import	5	0	4%
	Home ware	3	0	3%
	Muslim	1	8	8%
	Pants	11	3	12%
	Pants-import	1	0	1%
	Skirt	5	1	5%
	Suit	1	0	1%
	Tunic	5	0	4%

Based on the results obtained, we can see that the different distribution of training data and testing data results in a higher number of not sold classes than sold classes. Dress and Pants category received the highest rate in the third division of training data and data testing, which means that Dress and Pants category is a category that is often purchased by consumers, even though there are several types of Dresses and Pants do not sell well. Based on this, the company can increase production from the Dress and Pants category, and reduce the amount of production from less salable categories such as Scraf, Suit, Pants-import category or the category that gets the lowest rate which of course comes from the calculation of Naïve Bayes algorithm in the application Knime so that the capital issued by the company is not too large.

TABLE V. CONFUSION MATRIX RESULTS

Range	Criteria / Prediction Criteria	Not sold	Sold
70 : 30	Not sold	42	3
	Sold	0	24
	Recall	93,3%	100%
	Precision	100%	88,9%
	Accuracy	95,652%	
	Error	4,348%	
Range	Criteria / prediction Criteria	Not sold	Sold
60 : 40	Not sold	56	3
	Sold	1	31
	Recall	94,9%	96,9%
	Precision	98,2%	91,2%
	Accuracy	95,604%	
	Error	4,396%	
Range	Criteria / prediction Criteria	Not sold	Sold
50 : 50	Not sold	71	3
	Sold	1	39
	Recall	95,9%	97,5%
	Precision	98,6%	92,9%
Accuracy	96,491%		

Error	3,509%
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Table V is the result of testing using a confusion matrix from the Naïve Bayes algorithm, which comes from sales transaction data for 2020. An explanation of table V, for example that we can see in the table from the distribution of 70% training data and 30% testing data. It can be seen that 42 records were predicted to be not sold then were true not sold, as many as 3 records were predicted to be not sold but actually sold, as many as 0 records were predicted to be sold but actually not sold, and as many as 24 records were predicted to be sold then were true sold.

The accuracy produced by the Naïve Bayes algorithm on the distribution of 70% training data and 30% testing data is 95.652% with an error of 4.348%, meaning that the similarity of predictions originating from the sales transaction dataset with predictions generated by the Knime application reaches 95.652%. Recall in not sold class was 93.3% and sold class was 100%, meaning that of all goods found in not sold criteria, which were correctly predicted as not sold by the Knime application was 93.3% and of all goods contained in the sold criteria, which is predicted to be sold by the Knime application at 100%. Precision in not sold class is 100% and sold class is 88.9%, meaning that the goods in not sold class are actually not sold reach 100% and the goods in the sold class are actually sold there are 88.9%.

If we look at the results of the accuracy of the Naïve Bayes algorithm, which is produced by partition of training data and test data, the highest accuracy results are obtained from the distribution of 50% training data and 50% testing data. It is proven that the advantages of the Naïve Bayes algorithm described in the journal [20] are that the Naïve Bayes algorithm requires a small amount of training data to determine the parameter estimates needed in the classification process. Therefore, to classify, especially predicting sales using past sales transaction data, companies can use the Naïve Bayes algorithm with a comparison of 2% training data and 50% testing data so that the transaction data can be reprocessed to obtain important knowledge and of course profitable for the company.

V. CONCLUSION

The application of data mining using the classification method with the Naïve Bayes algorithm has been successfully applied to analyze clothing sales predictions on CV. XYZ is sourced from sales transaction data for 2020 to predict whether clothing sales will be sold or not. The division of training data and data testing results produces different accuracy, precision, and recall results. Still, from these three results, the number of records in the not sold class is more than in the sold class, and the accuracy level is very good, reaching 96%.

Based on the results obtained from the Knime application, the accuracy, precision, and recall levels are very high, so this algorithm can be recommended to predict clothing sales in the company to improve sales strategy on CV. XYZ and from the classification results provided by the Knime application, companies can manage clothing production so that clothing that is predicted not sold can be reduced in production and clothing that is predicted to be sold can be increased in production, so companies do not spend large production capital and clothing stocks will always be ready if available buyers who buy.

In future research, data mining applications can be developed to predict sales using the Naïve Bayes algorithm to make it easier for users, or to compare algorithms to classification methods to find out the best accuracy. In addition, the limitations of this research is this research only uses sales transaction data for 2020, so the information obtained is not very extensive.

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