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Forecasting System Prototype Amount Of Printing Raw Material Inventory Needs Using The Autoregressive Integrated Moving Average (Arima) Method

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ABSTRACT

Manage the amount of raw material inventory which plays an important role for the company. The smoothness of the production process is influenced by the availability of the raw materials used. The company has difficulty determining the need for raw materials. The company experiences excess and shortage of raw materials, resulting in losses and failures to meet consumer needs. To overcome these problems, it is necessary to forecast the need for raw materials in order to minimize the shortage and excess of raw materials and make the best use of raw materials. The method used in this study is the autoregressive integrated moving average (ARIMA) method. The results of this study indicate that the ARIMA model (0,1,1) can be used to predict the amount of demand for raw materials in the appropriate category. This is supported by the test results. The error value with the MSE method is 45,689.58 and the MAPE value is 19.52%.

1. Introduction

Printing is a production process carried out using a bulk printing machine, writing and drawing with ink on paper. Digital printing is one of the sub-categories of commercial printing that has advantages in the speed of printing document sheets directly through a computer without going through intermediaries such as film or plate printing as in conventional printing (Verano, 2018). In the business world, especially in the field of production or trading of goods, managing the quantity of raw materials is an important thing for businesses because if managed properly, it will maximize the management of existing inventory. of goods or raw materials with minimal costs, ensure that the production process can run smoothly. Raw material inventory management should be done with a structured mechanism to match what is needed.

Data Mining, Data mining is a series of processes in searching for patterns, relationships, extracting added value from large-sized data and information in the form of knowledge with the aim of finding relationships and simplifying data in order to obtain understandable and useful information with the help of statistics and mathematics (Abdurrahman, 2016). There are several fields of science in data mining, here is a picture of the field of science in data mining: (Makin, 2019)

Statistics, the field of statistics is the oldest data mining field, without statistics, data mining would never exist. Artificial Intelligence. The field of artificial intelligence is different from statistics. The technique used in this field is to develop a human reasoning model technique. Pattern recognition. The field of pattern recognition is a field of data mining by digging or studying data from the past so that patterns are formed that can be used to be developed with other fields of science.

Data mining is divided into 6 groups, which are as follows (Hasugian, 2018): Description is a way to describe patterns and trends in data in a concise and simple way.

Classification the method used to classify data sets. In classification, there are target categorical variables. Estimate, This third group is almost the same as the previous one but uses numerical data. Forecasting

Forecasting is estimating the outcome of things that are not yet known. Forecasting is almost the same as estimation, the difference is that the data used is time series data. Clustering It works by grouping records or

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observing and forming classes of objects that have something in common. Association the association does a search to find the attributes that appear.

CRISP-DM, daimler Chrysler (Daimler-Benz), SPSS (ISL), NCR are the three initiators of the data mining market that compile CRISP-DM (Cross Industry Standard Process for Data Mining) as a data mining standard which has 6 (six) phases as stated in Figure 1 (Yuniarti, 2018).

Figure1. Process Model CRISP-DM

According to CRISP-DM, data mining project is a life cycle consisting of six stages business Understanding, data Understanding, data Preparation, modeling, evaluation,deployment. Raw material is something that is used to make finished goods, raw materials must be related to being one with finished goods. In a company, raw materials and auxiliary materials have a very important meaning, because capital occurs in the production process until the production results. (Sulaiman, et al, 2015).

Inventory is a general term for things or organizational resources that are stored in anticipation of meeting demand (Anggraini, et al, 2019). Forecasting, Forecasting is a method for estimating a value in the future by using past data (Wardah, et al 2016). Time series is a series of data collected, recorded, or observed for an event, occurrence, symptom or change that is taken from time to time (Tholib, 2016).

Autoregressive Integrated Moving Average (ARIMA), The Autoregressive Integrated Moving Average (ARIMA) method is a method used for short-term forecasting (Hartati, 2017). ARIMA model has three processes, namely Autoregressive, Integrated, Moving Average denoted as (p, d, q). The Autoregressive Integrated Moving Average (ARIMA) model was studied extensively by George Box and Gwilym Jenkins in 1976, and its name is synonymous with the ARIMA process (Rohmah, 2018). The procedure for using the Box-Jenkins ARIMA method: (Handayani, 2017). Time Series Data Stationary Stationary time series data is a condition where the generation process that underlies a time series is based on the mean and variance values. Estimated Model, After we identify one or several temporary models for a time series, the next step is to find the best or most efficient estimate for the model parameters. Diagnostic Checking, diagnostic checking that will be carried out includes parameter significance test and model suitability test. Selection of the Best Model, there are many possibilities of finding more than one model, so it is necessary to select the best model.

Model Testing, mean Squared Error (MSE) Mean Squared Error (MSE) is the average difference of the squares between the predicted and observed values.

$$\text{MSE} = \sum_{t=1}^{n} \frac{(X_t - F_t)^2}{n} \qquad (1)$$

Where:
Xt = Actual data in period t
Ft = Forecasting value in period t
n = Number of Data

Mean Absolute Percentage Error (MAPE) is a calculation used to calculate the average absolute percentage error.

$$\text{MAPE} = \left(\frac{100\%}{n}\right) \sum_{t=1}^{n} \frac{|X_t - F_t|}{X_t} \qquad (2)$$

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Where:
Xt = Actual data in period t
Ft = Forecasting value in period t
n = Number of Data

Table 1
Range Mape

Range MAPE	Value
<10%	very good forecast
10-20%	good fortune telling
20-50%	decent forecast
>50%	bad fortune telling

Software Minitab, Minitab is a statistical data processing application program that is often used. In addition to providing classical statistical methods such as linear regression analysis, factor analysis and other analyses, Minitab also provides statistical methods for statistical control and experimental design. In addition, this application also makes it easy to create graphs to manipulate data for social and technical purposes (Arnitasari, 2016). Blackbox Testing**,** Black Box testing has a way of working by focusing on domain information, but ignoring the control structure of the software (Jaya, 2018).

2. Research Method

This research is a descriptive study with a quantitative approach and predictions with a statistical approach. The model design method uses the Cross Industry Standard Process for Data Mining (CRISP-DM) method which consists of Business Understanding, Data Understanding, Data Preparation, Modeling, Evaluation and Deployment.

3. Results And Discussion

The reaction The system development model used in this study is the CRISP-DM (Cross Industry Standard Process for Data Mining) model, which consists of:

a. Business Understanding
   We need a system that can be used to predict the amount of raw material inventory needed for the next period.
b. Data Understanding
   Perform data collection and then investigate the data in more detail.
c. Data Preparation
   This phase includes all activities related to data preparation prior to data processing using the autoregressive integrated moving average (ARIMA) method.
d. Modeling At this stage, plotting the data depicted in Figures 3 and 4.

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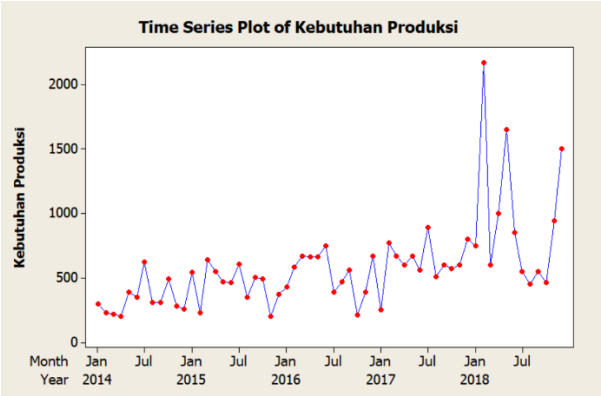

Figure 2. Trends in Plot Analysis

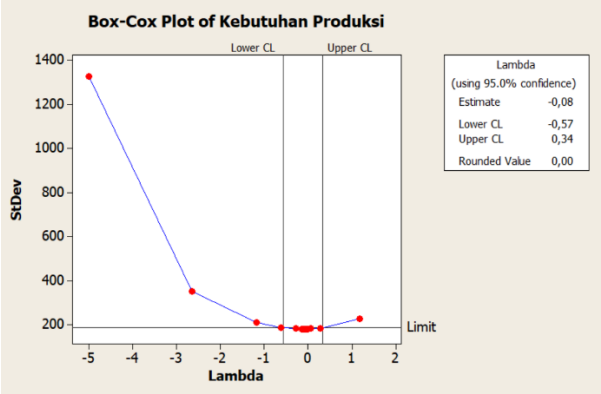

Figure 3 Box-Cox Plot

After making the Box-Cox Plot, the data can be said to be not stationary with respect to variance because it has a rounded value of (0.00) and an estimated value of (-0.08). The boxes have a Rounded Value that is less than 1. When meeting that condition, the first thing to do is perform a transformation to stabilize the variance. The transformation is done three times so that it has a Rounded Value of 1.00, which means that the data is stationary with respect to the variance. Next, make a Trend analysis plot which can be seen in Figure 4 and the Autocorrelation Function in Figure 5.

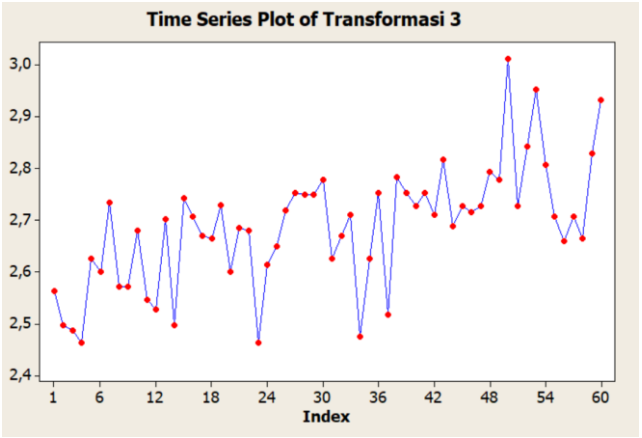

Figure 4 Trends in Data Transformation Plot Analysis

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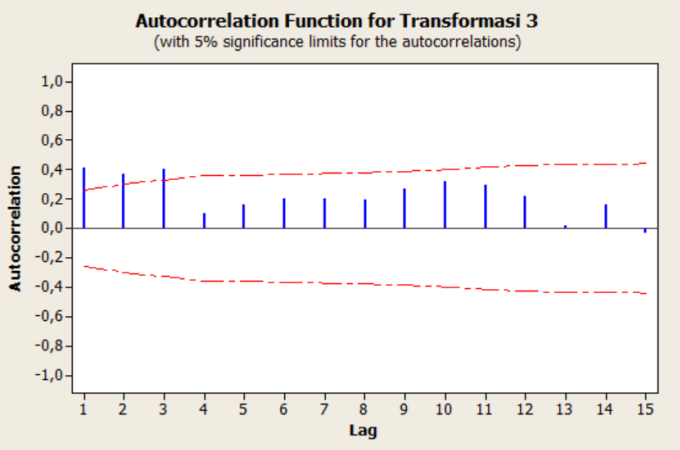

Figure 5 Autocorrelation Function Data Transformation

After the transformation, differencing is performed, identifying Autocorrelation Function (ACF) and Partial Autocorrelation Function (PACF) plot models. Furthermore, model estimation and Diagnostic Checking are carried out. Then the ARIMA Model (1,1,0) model with 1 times differencing, the AR coefficient 1 is significant with a p-value (0, 000 < 0.05 ()). ARIMA model (0,1,1) with 1 times differencing, MA coefficient 1 is significant with p-value (0, 000 < 0.05 ()). After getting the model, it is evaluated.

3.1 Evaluation

To calculate the error, the writer uses Mean Square Error (MSE) and Mean Absolute Percent Error (MAPE).

$$\text{MSE} = \frac{548275}{12} = 45.689{,}58$$

$$\text{MAPE} = \frac{2{,}342}{12} = 19{,}52\%$$

Based on the tests that have been carried out, it is known that the MSE value is 45,689.58 and the MAPE value is 19.52%, which means that forecasting the amount of 56 gr of Book Paper raw material needs using the ARIMA model (0.1,1) has good forecasting model capabilities.

3.2 Prototype

At this stage, the author implements the ARIMA forecasting model (0,1,1) into an application system prototype. Prototype was built using the PHP programming language.

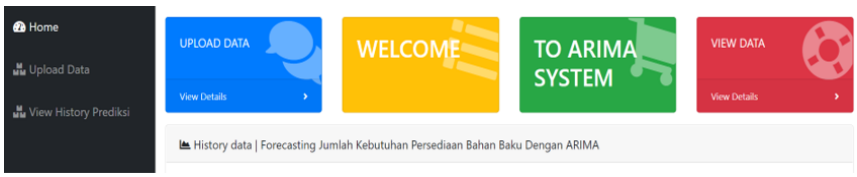

Figure 6 Home

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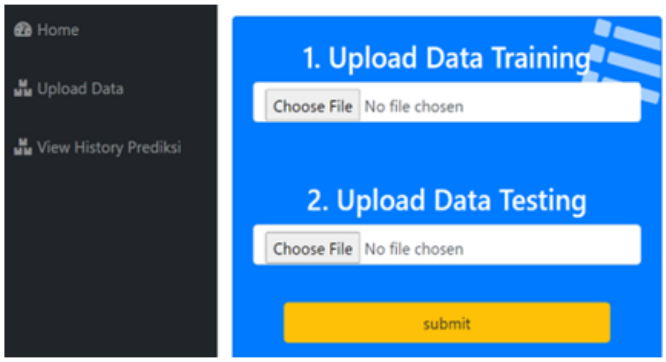
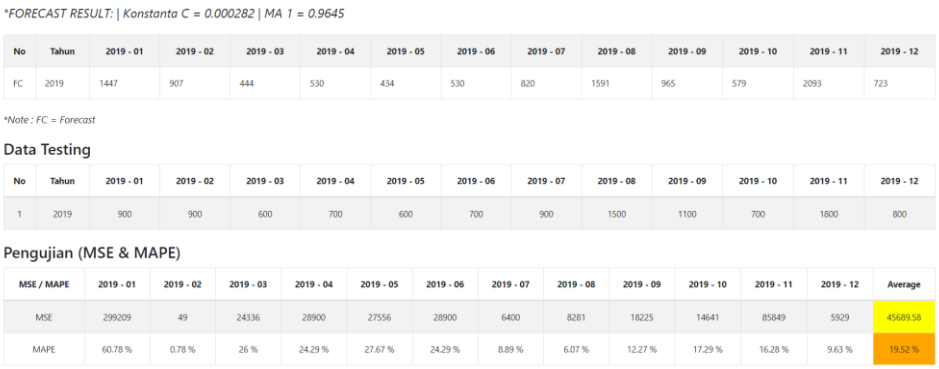


Figure 7 Upload Data

Figure 8. Forecasting Process



FORECAST RESULT: | Konstanta C = 0.000282 | MA 1 = 0.9645

No	Tahun	2019 - 01	2019 - 02	2019 - 03	2019 - 04	2019 - 05	2019 - 06	2019 - 07	2019 - 08	2019 - 09	2019 - 10	2019 - 11	2019 - 12
FC	2019	1447	907	444	530	434	530	820	1591	965	579	2093	723

Note : FC = Forecast

Data Testing

No	Tahun	2019 - 01	2019 - 02	2019 - 03	2019 - 04	2019 - 05	2019 - 06	2019 - 07	2019 - 08	2019 - 09	2019 - 10	2019 - 11	2019 - 12
1	2019	900	900	600	700	600	700	900	1500	1100	700	1800	800

Pengujian (MSE & MAPE)

MSE / MAPE	2019 - 01	2019 - 02	2019 - 03	2019 - 04	2019 - 05	2019 - 06	2019 - 07	2019 - 08	2019 - 09	2019 - 10	2019 - 11	2019 - 12	Average
MSE	299209	49	24336	28900	27556	28900	6400	8281	18225	14641	85849	5929	45689.58
MAPE	60.78 %	0.78 %	26 %	24.29 %	27.67 %	24.29 %	8.89 %	6.07 %	12.27 %	17.29 %	16.28 %	9.63 %	19.52 %

Figure 9. Forecasting Results

4. Conclusion

Based on the problems, literature study, literature study, research methodology and the results of the discussion in the study, it can be concluded that: The ARIMA method can be used to predict the demand for raw materials, enabling the company to minimize the shortage and excess of raw materials with a profit of 26,000,000. The best prediction model is ARIMA model (0,1,1). The amount of raw material needs is influenced by the results of observations 60 months ago and forecasting errors in the next 12 months. ARIMA model (0,1,1) is known to have very good predictive modeling ability. This is evidenced by the test results. The MSE method error value is 45,689.58 and the MAPE value is 19.52%.

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