Using the Arima Method with Minitab Applications for Forecasting Work Order Projects of Casting Construction (Case Study: PT.Bumi Sarana Beton)

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A R T I C L E   I N F O

A B S T R A C K

The ARIMA method is a non-stationary homogeneous time series model that uses the procedure for applying the Autoregressive model or scheme and the Moving Average in preparing its forecasts. The purpose of this study was to determine the application of the Autoregressive Integrated Moving Average (ARIMA) method and minitab application at PT. Bumi Sarana Beton in planning the estimated number of work orders. It can be concluded that for K-225 the best model is the ARIMA model (2,0,0) because it has the lowest MSE value and for K-400 the best model to use is the ARIMA model (2,0,2) because it has the smallest value. From the results of the research that has been done, it can be concluded that the production of K-225 in 2022 is 3573.50 m3, while using the ARIMA method in 2023 the total production is 3920.61 m3 and in 2024 the total production is 3573.50 m3. to 3824.36 m3. Production of K-400 in 2022 was 2015.00 m3, while using the ARIMA method in 2023 a total production of 1857.07 m3 was obtained and in 2024 a total production of 2045.89 m3 was obtained.

1.   Introduction

Forecasting is one of the statistical methods that play an important role in decision making. Forecasting serves to estimate what will happen in the future based on past data. [1] The ARIMA method is a nonstationary homogeneity time series model that uses procedures for applying Autoregressive and Moving Average models or schemes in the preparation of forecasts. [2]

Conducting research with the title Analysis and Implementation of Data Mining to Predict the Number of Building Materials Using the Autoreggresive Intergrated Moving Average (ARIMA) Algorithm. [3] Research on Estimating the Number of Construction Project

Work Orders Using the ARIMA (Autoregressive Integrated Moving Average) Method. [4] Research on Material Inventory Study Based on Material Requirement Planning (MRP) Method on Fresh Concrete Production (Case Study: PT. Bumi Sarana Beton). [5] Research on the Use of Arima Method with Minitab Application for Forecasting Revenue Data of Putra Mndiri Stone Breaking Company. [6]

The results showed that PT Bumi Sarana Beton Makassar (Hadji Kalla project) has implemented responsibility accounting. [7] Based on the analysis of PT Surindo Andalan data from the author regarding forecasting with the ARIMA approach in the MINITAB program, it can be concluded that the best ARIMA model with the smallest mean square of 2709.7 and the smallest mean square error of 225.808333 is the ARIMA (2,0,4) model. [8]

Project scheduling using precedent diagrams and project equipment transfer matrices can be used as an alternative to scheduling projects simultaneously. [9] Using the MRP method with lot sizing calculations at the Masohi Power Center can help plan the raw material requirements for each product item in a timely manner, so that the production process will be carried out properly according to the planned capacity and orders can be fulfilled on time. [10] Implementing a project is the process of converting inputs in the form of activities and resources into outputs as specified.[11]

2. Research Method

The data used in this research is secondary data. The author obtains data by receiving work order recapitulation data for construction projects from January 2022 to December 2022.

This research used MINITAB is a computer program designed to perform statistical processing (Sunday, n.d.). Minitab combines ease of use like Microsoft Excel with the ability to perform complex statistical analysis (Simarmata, 2010).

MINITAB is statistical software that provides a wide range of capabilities for both basic and advanced statistical analysis. The program's powerful capabilities and ease of use make it ideal as a teaching tool. Minitab was developed at Pennsylvania State University by researchers Barbara F. Ryan, Thomas A. Ryan, Jr., and Brian L. Joiner in 1972. MINITAB has become the standard for statistical learning. And since MINITAB is the leading package used to improve processes and quality within companies, students studying MINITAB definitely benefit from knowing and also being able to use the tools used in the real world of business (Ryan, Joiner, & Cryer, 2005).

3. Description And Technical

1) The steps for analyzing data using the ARIMA model are as follows:
    1. Displaying data plots to find out whether the data is patterned or not
    2. Identify stationary or non-stationary models.
    3. Estimation of parameters by conducting hypothesis testing to determine whether or not the parameters are significant.
       Hypothesis:
           H0 = parameter that is not significant
           H1 = significant parameter
           Tolerance levels (α): 5% = 0.05
2) Research steps using the minitab19 application
   The general stages in the analysis carried out are as follows.
   1. Model identification
       Model identification is used to select the right model for forecasting, the stages in the identification are:
   a. Create time series plots
       The purpose of making this plot is to find out the trend of a data.

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b. Make ACF and PACF plots

The next step is to make ACF and PACF plots to find out the stationarity of the variance and average estimates of the model to be used.

c. Data Stationarity Test

After analyzing the data by looking at the time series plots as well as the ACF and PACF, the data stationarity is checked. A data is said to be stationary in terms of variance if it has a Rounded Value of 1, while a data is said to be stationary in average if the trend graph in the trend analysis plot is horizontal, which means that the average and trend of the data do not change over time. If the data used in the analysis turns out to be non-stationary, it is necessary to carry out stationarity by transforming the data on data that is not stationary in terms of variance and differentiation on data that is not stationary in terms of average. In this case, the first is to perform a transformation if the data is not stationary in the new range, then the differentiation if the data is not stationary in the average.

2. Estimation or Estimated Model

If we have done the analysis from the previous step, we get the equation for the forecasting model. The next step is to estimate the model to determine whether the model is feasible or not for forecasting. The steps are by looking at the p-value of Box-Cox and also AR and MA where each value cannot be more than 0.05.

3. Verify

After obtaining the appropriate equation model for use in forecasting, the next step is to verify the best equation model for use in forecasting. In this case it can be searched by looking at the smallest error or MSE.

4. Forecasting or Forecasting

Forecasting is an activity of estimating what will happen in the future.
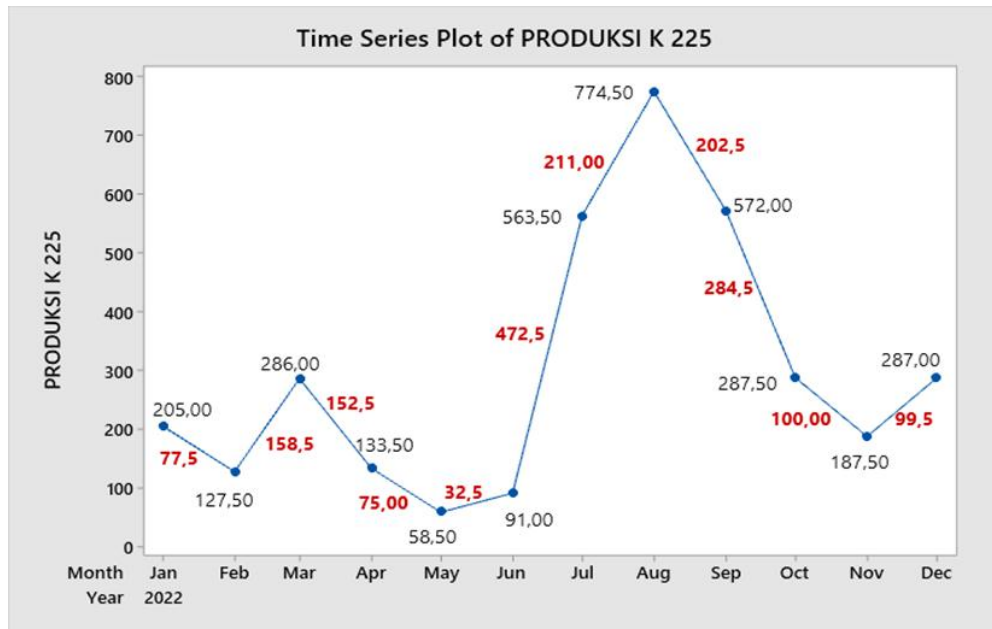
4. Results And Discussion

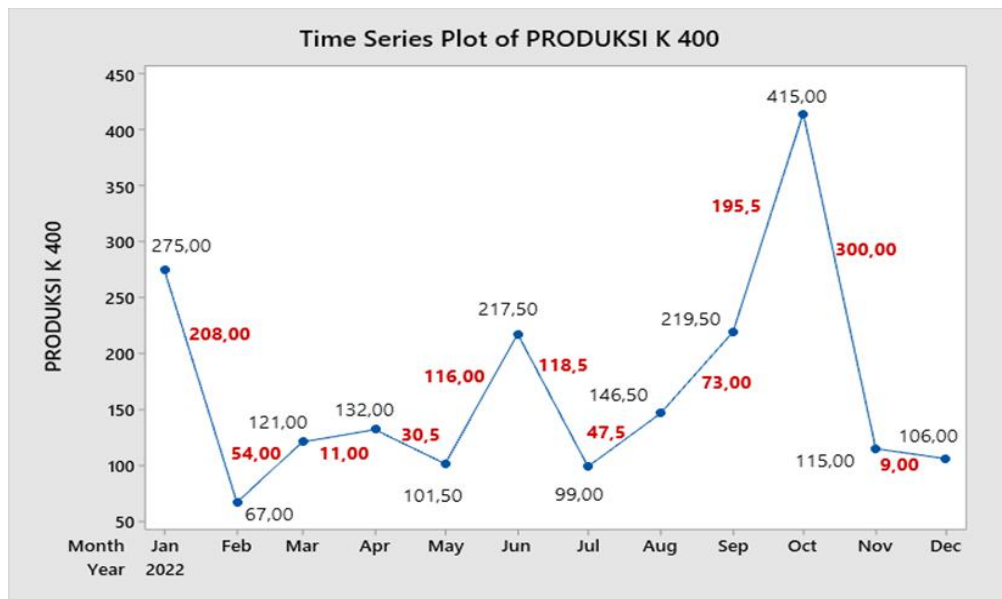**Figure 1.** Time series plot of K-225 production results

Figure 2. Time series plot of K-400 production results

If observed from the results of the two data plots of K-225 and K-400 production above, it canbe seen that the K-225 production has a slightly decreasing graph and then rises again over time, the K-400 production can also be seen to have a graph initially very high until it decreases and slowly rises and falls over time.
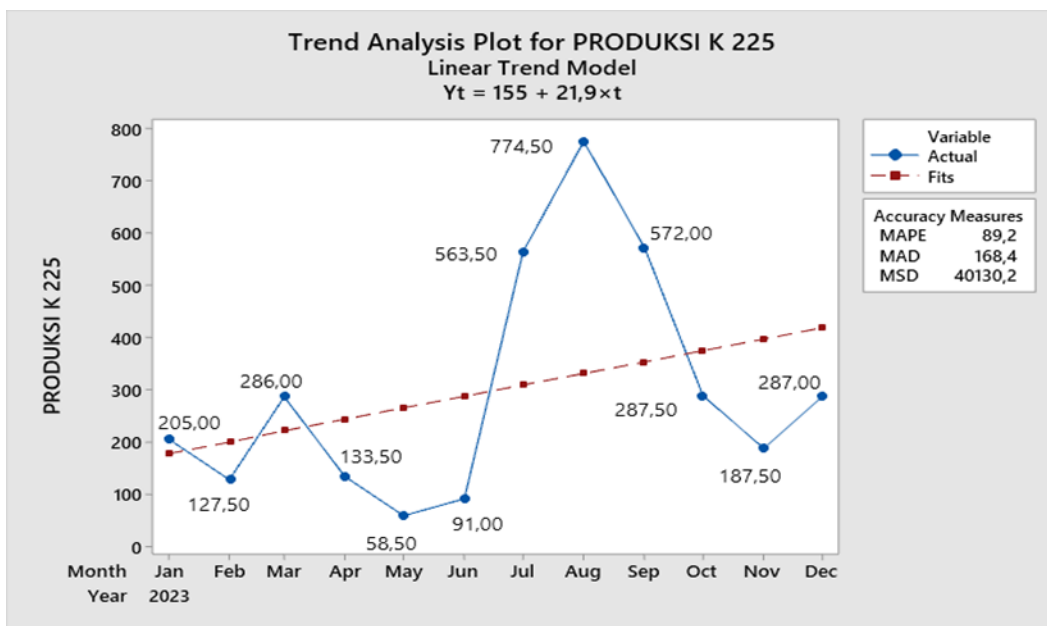

Figure 3. Trend plot of K-225 production yield analysis

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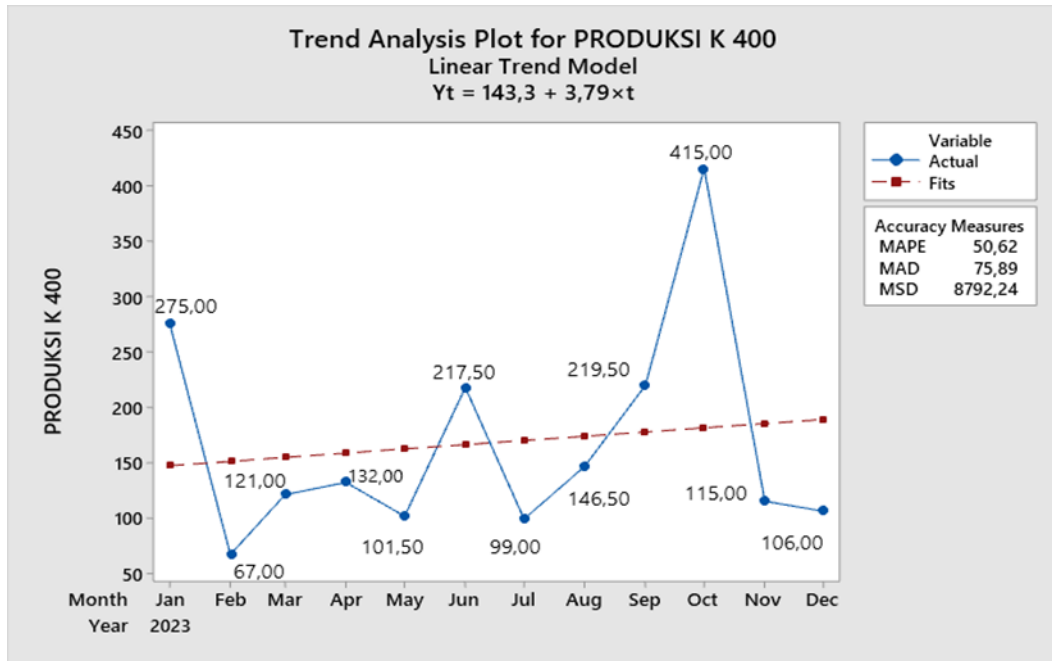
Figure 4. Trend plot of K-400 production yield analysis

The dots in the center of the graph are trend lines that represent the average value. If observedfrom the graph above, it is not stationary in average because the line moves upward, which means that the average value or trend of the data is always increasing.
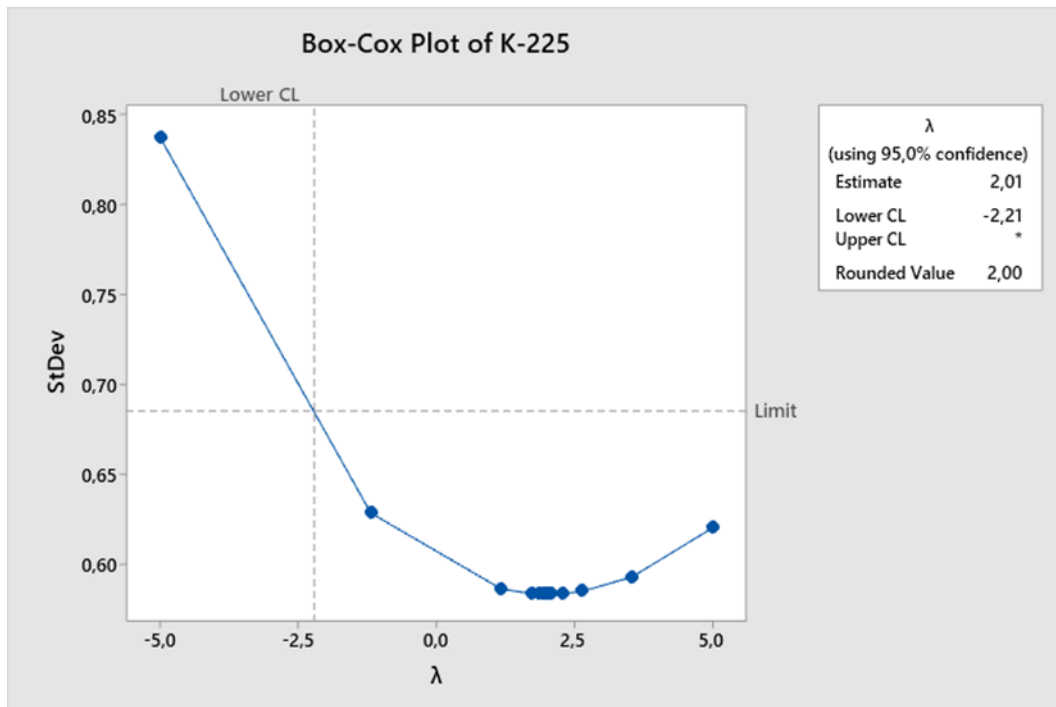

Figure 5. Box-Cox Transformation output of K-225 production original data
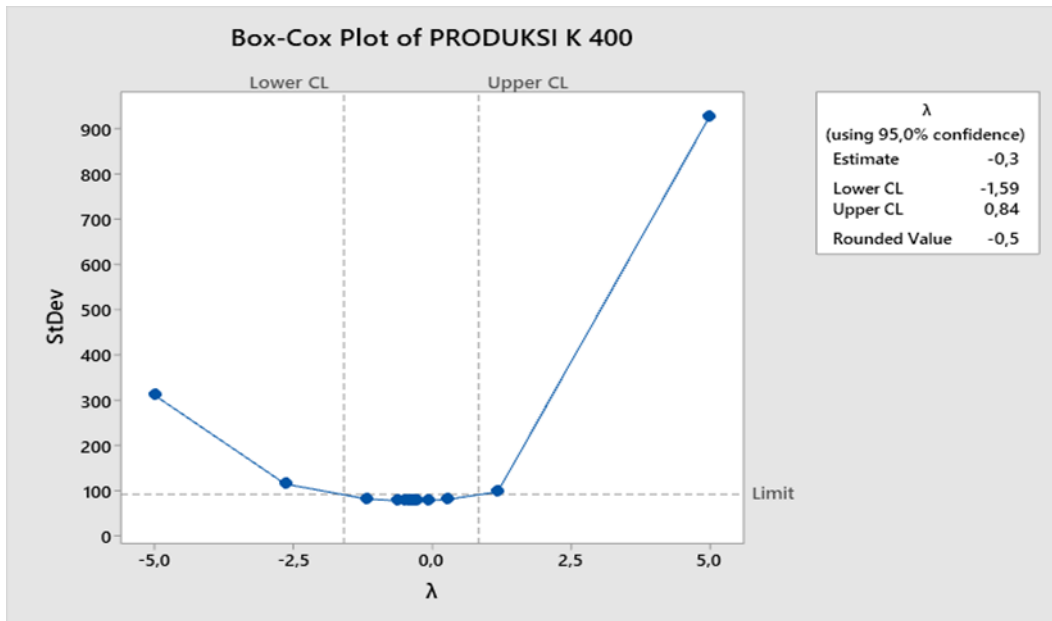
Figure 6. Box-Cox Transformation output of K-400 production original data

A data is said to be stationary to the variety if the Rounded Value value on BoxCox is 1 of thetwo data above has not been said to be stationary to the variety
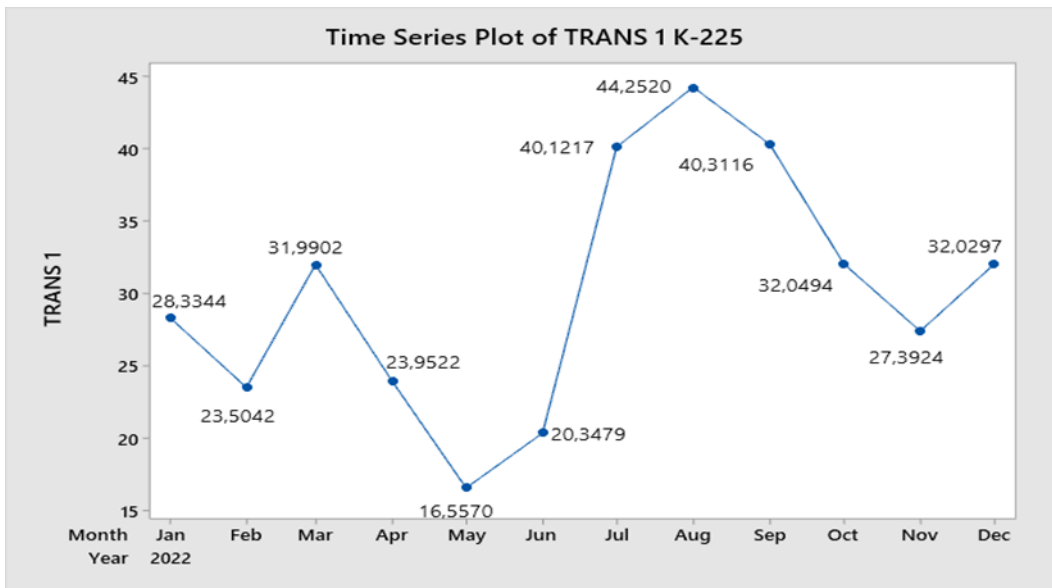
Figure 7. Time series plot of K-225 transformation data

Using the Arima Method with Minitab Applications for Forecasting Work Order Projects of Casting Construction (Case Study: PT. Bumi Sarana Beton)
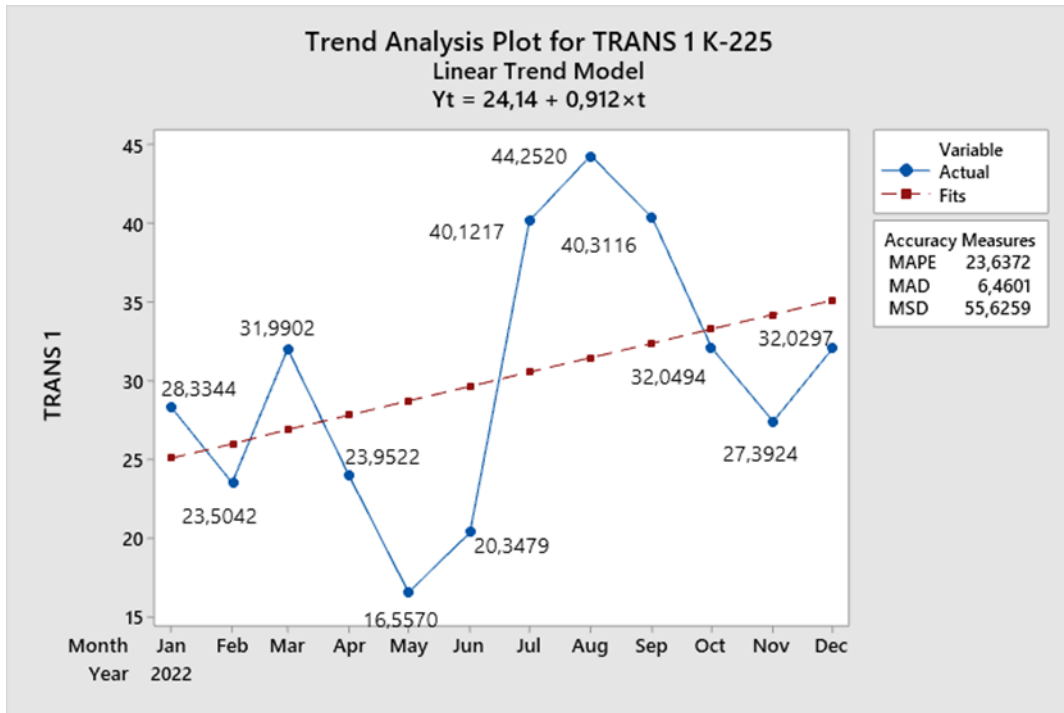
Figure 8. Plot trend analysis of K-225 transformation data
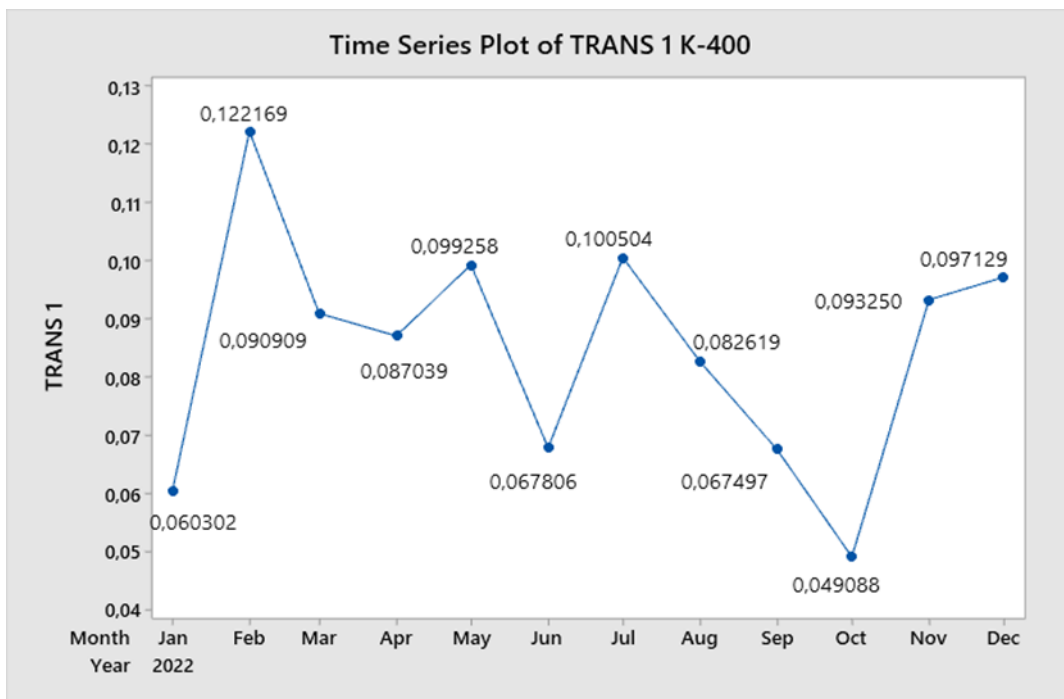
Figure 9. Time series plot of K-400 transformation data

Using the Arima Method with Minitab Applications for Forecasting Work Order Projects of Casting Construction (Case Study: PT. Bumi Sarana Beton)
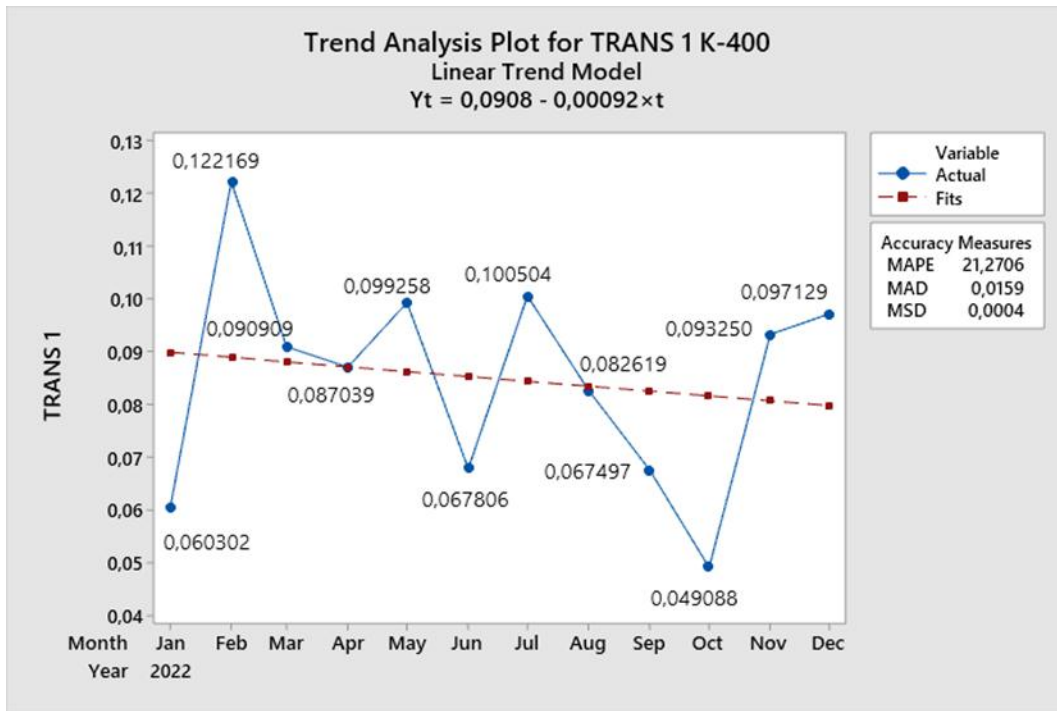
Figure 10. Plot trend analysis of K-400 transformation data

From the data plot above, it can be seen that the data that has been transformed is still not stationary on average because the trend line on the graph is getting higher which means that the average is not fixed, the solution is to do differentiation.

Table 1. Differentiation result 1 of K-225 transformation data

Month	Production K 225	Trans 1	Diff
January 2022	205.00	28.3344	*
February	127.50	23.5042	-4.8302
March	286.00	31.9902	8.486011
April	133.50	23.9522	-8.03801
May	58.50	16.5569	-7.39525
June	91.00	20.3478	3.790875
July	563.50	40.1216	19.77382
August	774.50	44.2520	4.130324
September	572.00	40.3115	-3.94043
October	287.50	32.0494	-8.26212
November	187.50	27.3924	-4.657
December	287.00	32.0297	4.637298

Source: research of data analysis in minitab 19

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Table 1. Differentiation result 1 of K-400 transformation data

Month	Production K 400	Trans 1	Diff
January 2022	275.00	0.060302	*
February	67.00	0.122169	0.061867
March	121.00	0.090909	-0.03126
April	132.00	0.087038	-0.00387
May	101.50	0.099258	0.01222
June	217.50	0.067806	-0.03145
July	99.00	0.100503	0.032697
August	146.50	0.082619	-0.01788
September	219.50	0.067496	-0.01512
October	415.00	0.049088	-0.01841
November	115.00	0.093250	0.044162

Source: research of data analysis in minitab 19

After obtaining the differentiation results, it is checked again whether it is stationary onaverage by making a trend graph, following the output results.
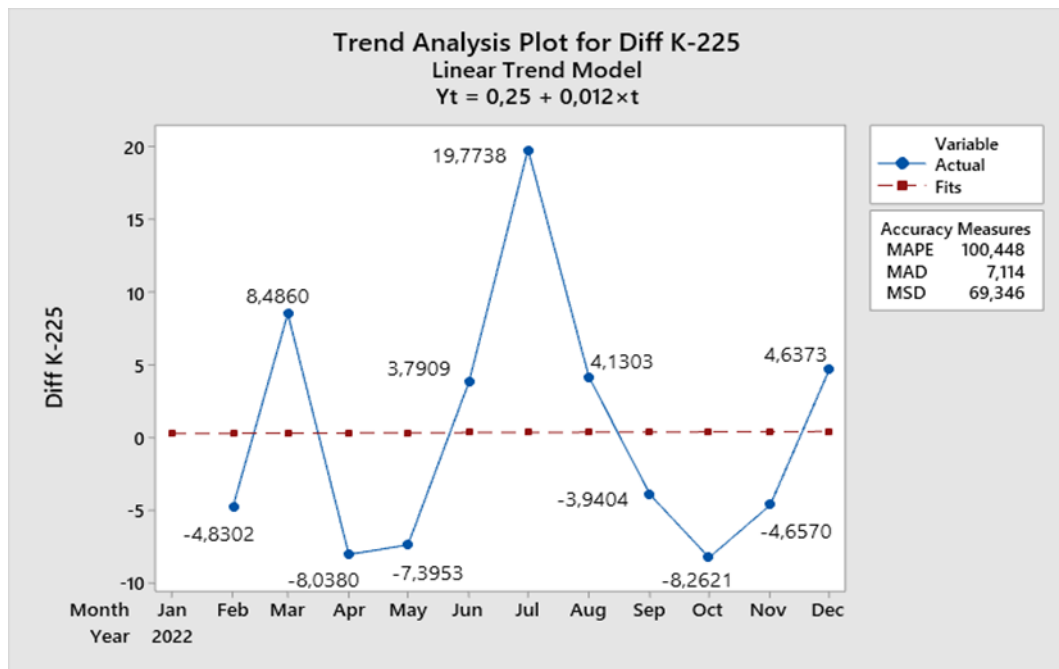
Figure 11. Trend plot of K-225 differentiation result data
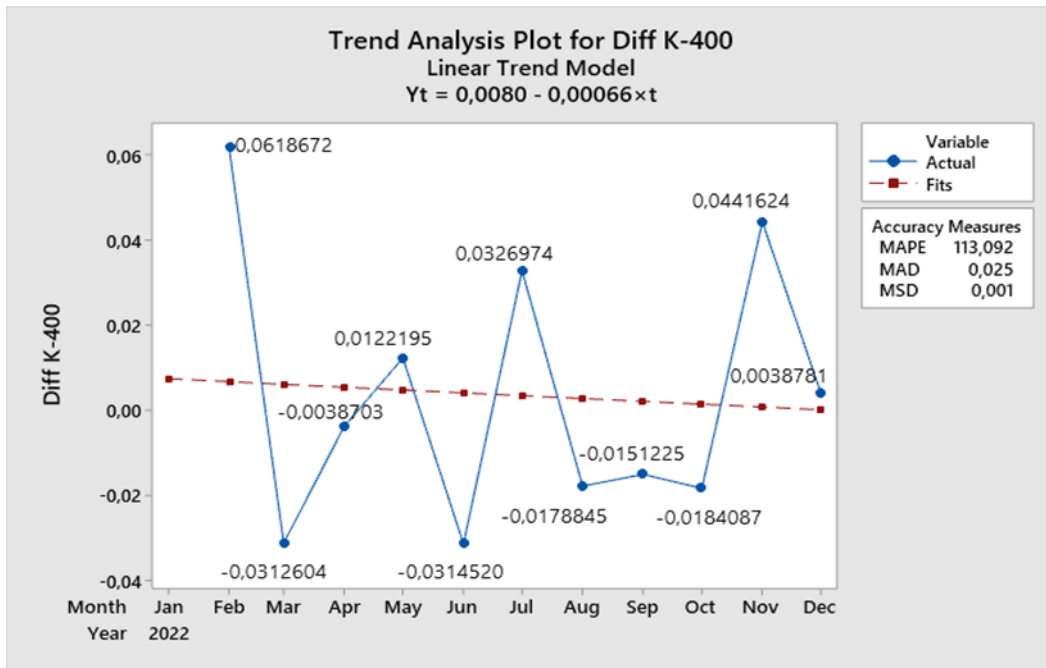
Figure 12. Trend plot of K-400 differentiation result data

From the output results above, it can be concluded that the data is stationary on average because the trend line on the graph is horizontal, which means that the average value of the data is fixed.
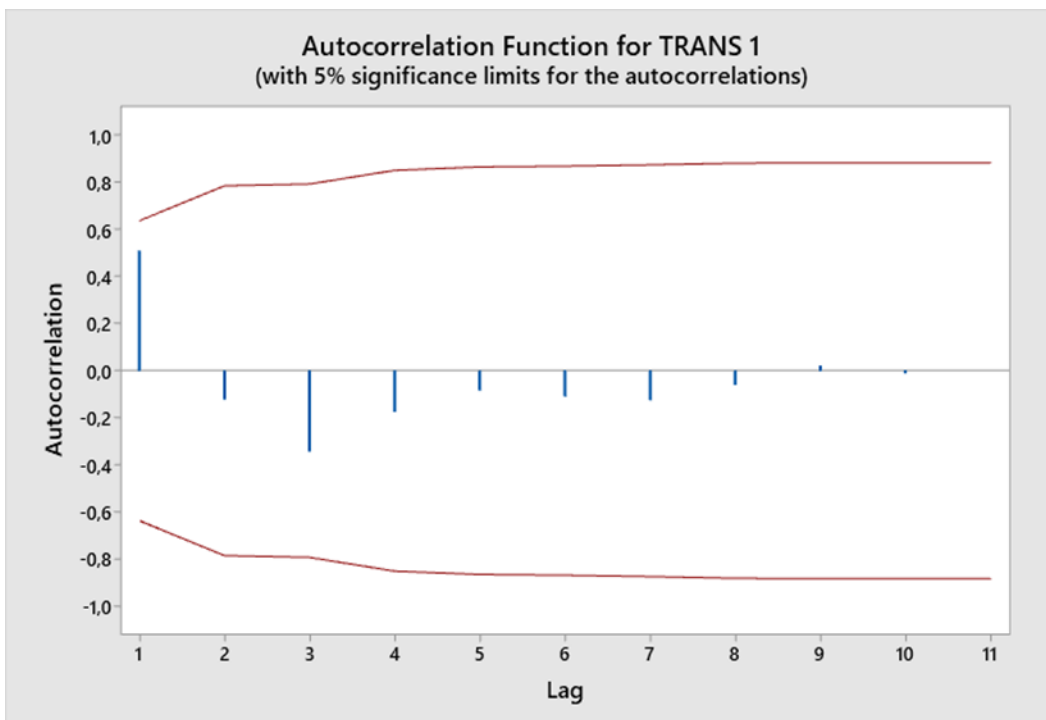
Figure 13. ACF plot of TRANS 1 result data for K-225

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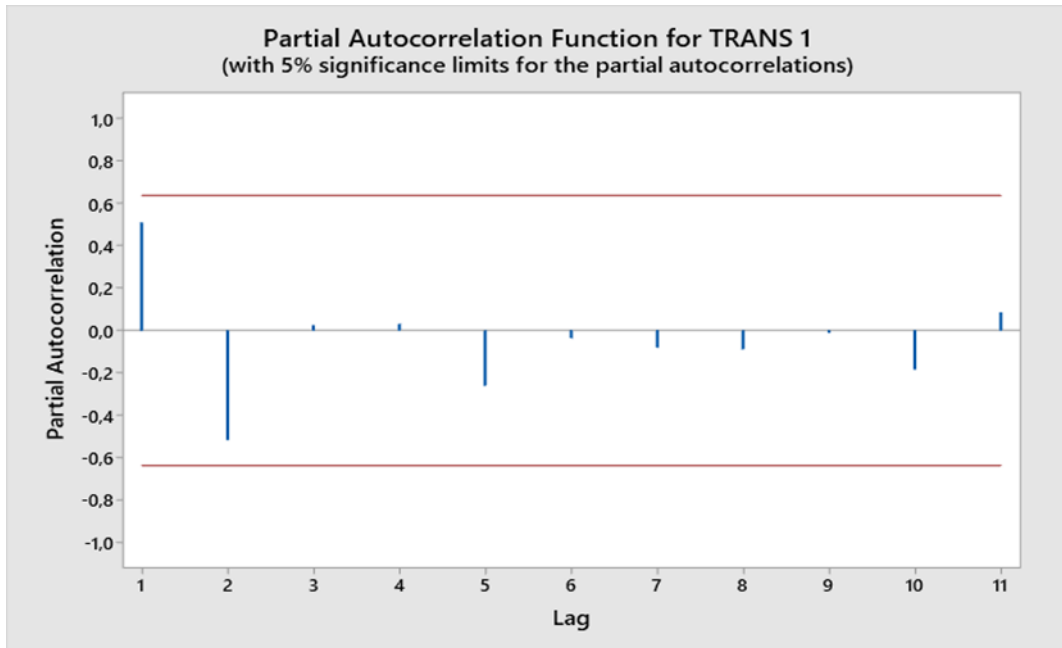
Figure 14. PACF plot of TRANS 1 result data for K-225
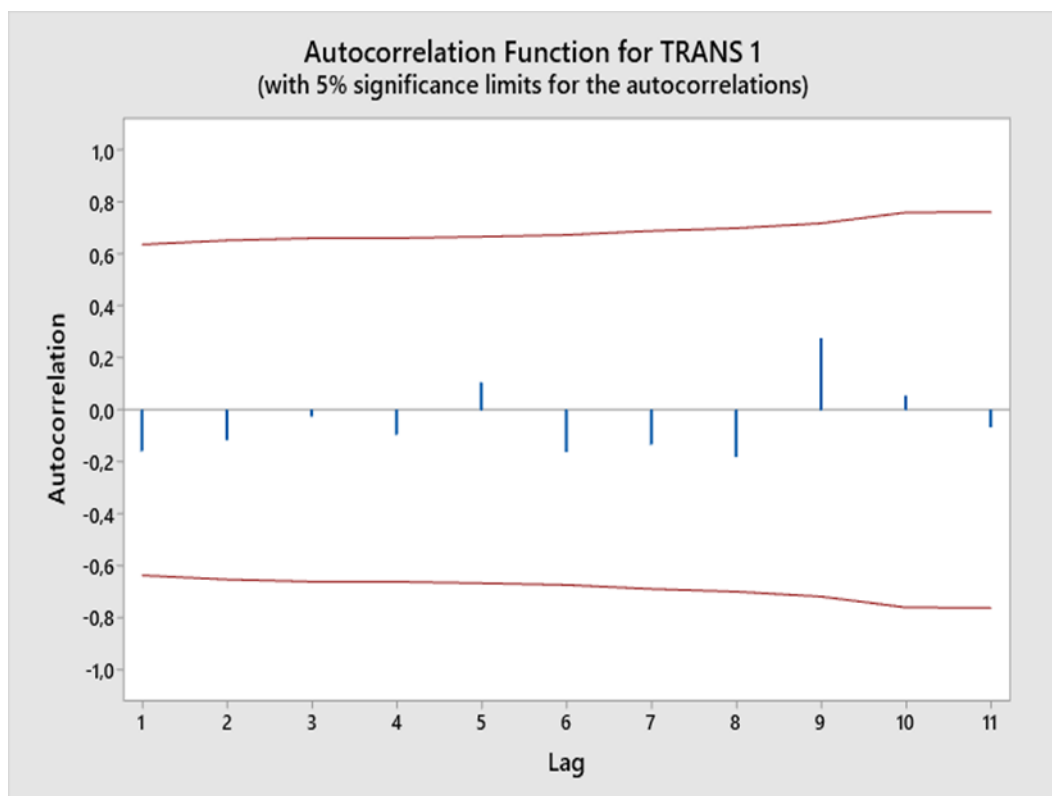
Figure 15. PACF plot of TRANS 1 result data for K-400

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Figure 16. PACF plot of TRANS 1 result data for K-400

In the plot above, it can be seen that both plots for K-225 and K-400 data do not cross the redsignificant line, therefore the data is stationary on average.

Figure 17. ARIMA dialog field

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Figure 18. Forecast dialog field

Based on the verification results, the best model obtained is the Nonseasonal ARIMA (2, 0, 0)model for K-225 and the ARIMA (2, 0, 2) model for K-400.
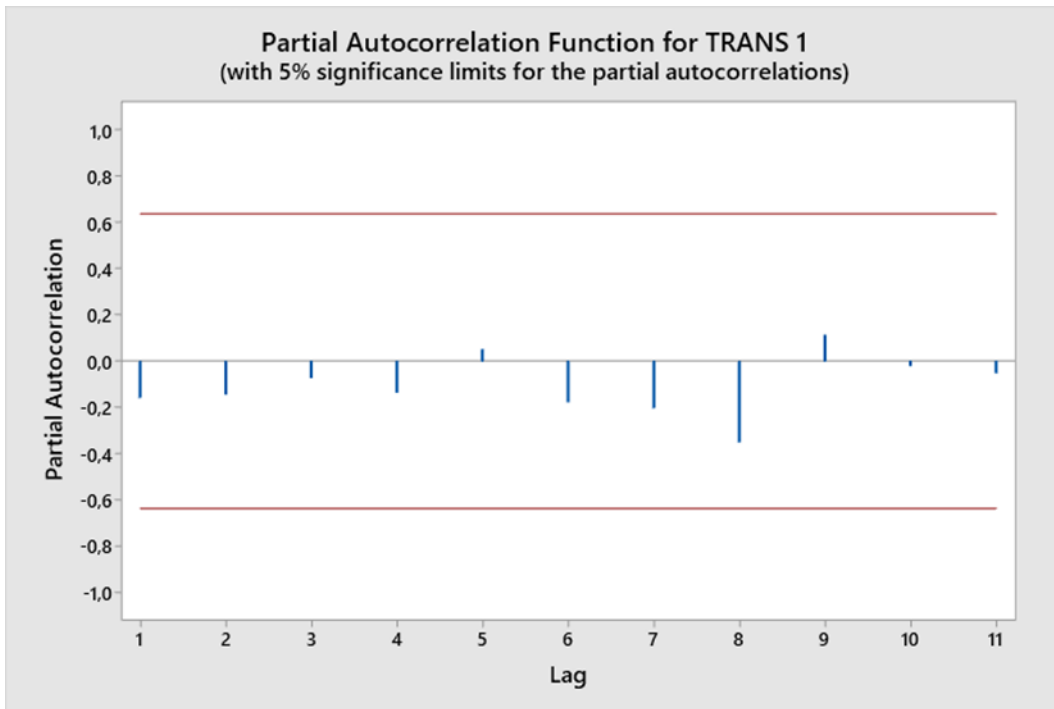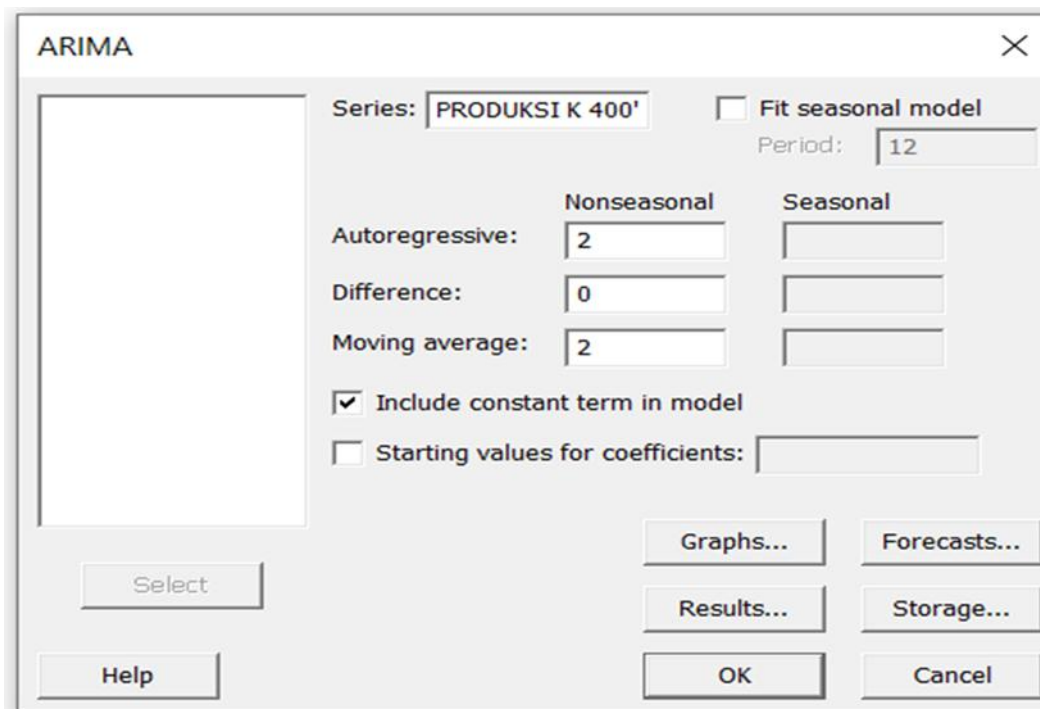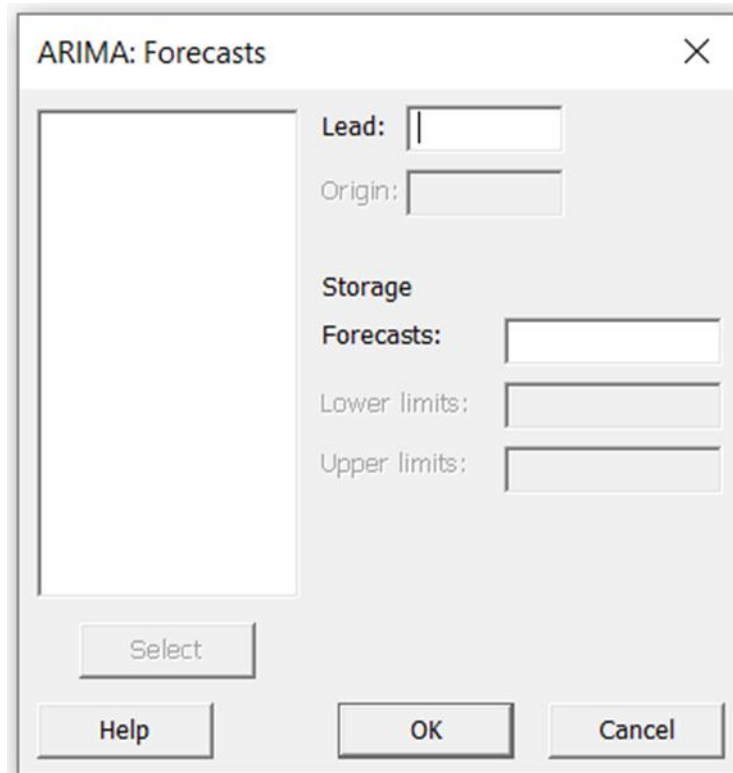
Table 1.1 K-225 production forecasting results

Month	Production K 225	Trans 1	Diff	Forecast Tahun 2023	Forecast Tahun 2024
January 2022	205.00	28.3344	*	377.748	315.437
February	127.50	23.5042	-4.8302	395.289	322.894
March	286.00	31.9902	8.486011	350.047	324.449
April	133.50	23.9522	-8.03801	295.641	320.837
May	58.50	16.5569	-7.39525	275.324	316.388
June	91.00	20.3478	3.790875	293.246	314.668
July	563.50	40.1216	19.77382	323.890	316.078
August	774.50	44.2520	4.130324	340.474	318.571
September	572.00	40.3115	-3.94043	335.206	319.954
October	287.50	32.0494	-8.26212	318.982	319.556
November	187.50	27.3924	-4.657	307.332	318.243
December	287.00	32.0297	4.637298	307.426	317.280

Source: research of data analysis in minitab 19

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Table 1.2 K-400 production forecasting results

Month	Production K 400	Trans 1	Diff	Forecast Tahun 2023	Forecast Tahun 2024
January 2022	275.00	0.060302	*	39.473	287.841
February	67.00	0.122169	0.061867	65.667	241.169
March	121.00	0.090909	-0.03126	153.011	148.599
April	132.00	0.087038	-0.00387	247.602	67.138
May	101.50	0.099258	0.01222	291.446	46.618
June	217.50	0.067806	-0.03145	258.009	99.218
July	99.00	0.100503	0.032697	168.274	192.244
August	146.50	0.082619	-0.01788	77.575	268.446
September	219.50	0.067496	-0.01512	41.483	281.250
October	415.00	0.049088	-0.01841	81.757	223.219
November	115.00	0.093250	0.044162	173.233	130.361
December	106.00	0.097128	0.003878	259.541	59.786

Source: research of data analysis in minitab 19

1. Based on the forecasting results in table 1.1, it is found that the production results for K-225 in the first year are unstable where each month there is an increase and decrease. The highest monthly production figure in February was 395,289 m3 and the lowest was in May at 275,324 m3. For the second year experienced the same thing in the first year with the highest production figure in March at 324,449 m3 and the lowest was in June at 314,668 m3.
2. Based on the forecasting results in table 1.2, it is found that the production results for K-400 in the first year are unstable where each month there is a decrease and increase. The highest monthly production rate in May was 291,446 m3 and the lowest was in January at 39,473 m3. For the second year, it experienced the same thing in the first year with the highest production rate in January at 287,841 m3 and the lowest in May at 46,618 m3.

5. Conclusions And Sugesstion
5.1 Conclusions
1. Based on the results of model identification, at least 3 models are obtained that allow it to be used in forecasting, namely ARIMA (2,0,0), ARIMA (2,0,2) and ARIMA (0,0,2) for K-225 and K-400 respectively, but after checking again with the model estimation there are only 2 models that are suitable to be used as forecasting equation models, namely ARIMA (2,0,0) and ARIMA (0,0,2) for K-225 while K-400 is ARIMA (2,0,2) and (0,0,2). After verification by checking the MSE value or error value owned by the two models, the ARIMA (2,0,0) model has an MSE value of 17697.0 and the ARIMA (0,0,2) model has an MSE value of 19156.6 for K-225 data, while for K-400 with the ARIMA (2,0,2) model has an MSE value of 8785.79 and (0,0, 2) has an MSE value of 10109.8, it can be concluded for K-225 that the best model used is the ARIMA (2,0,0) model because it has the smallest MSE value and for K-400 that the best model used is the ARIMA (2,0,2) model because it

has the smallest MSE value as well for the K-225 and K-400 production forecasting model at PT. Bumi Sarana Beton.

2. From the results of the research that has been done, it can be concluded that the production of K-225 in 2022 is 3573.50 m3 while when using the ARIMA method in 2023 the total production is 3920.61 m3 and in 2024 the total production is 3824.36 m3. K-400 production that in 2022 a total of 2015.00 m3 was obtained, while when using the ARIMA method in 2023 a total production of 1857.07 m3 was obtained and in 2024 a total production of 2045.89 m3 was obtained.

5.2 Suggestion

1. From the results of the research is expected to add input to the company PT.Bumi Sarana Beton so that later can be as a reference in improving the quality of the company's production.
2. When viewed from the discussion of the previous chapter that ARIMA has shortcomings in its forecasting which is quite good in short-term forecasting and for long-term forecasting it has an increasingly large error, and this is what needs to be refined.

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