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Forecasting Analysis of Production and Sales of LCGC Cars in Indonesia

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Keywords**:** *Forecast, Trend Analysis, Exponential Smoothing, Moving Average, Linear Regression.*

Abstract: This study aims to analyze the forecasting of production and sales of LCGC cars. The population of this study is LCGC cars circulating in Indonesia, with samples of sales data wholesale, retail sales and production of LCGC cars form Toyota, Daihatsu and Honda in Indonesia.The data analysis method uses POM QM for Windows. The results found that of the 4 time series and causal forecasting methods: Trend Analysis, Moving Average, Exponential Smoothing, and Linear Regressions. The Exponential Smoothing method has the best level of accuracy, with each alpha value for Wholesale α=0.51, Retail Sales α=0.37, Production α=0.70. The implications of this research are discussed in the article.

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Introduction

Low-Cost Green Car (LCGC) is considered to have given a new spirit to the Indonesian automotive industry. Since its launch in 2013, LCGC has achieved various positive achievements (CNN Indonesia, 2019). According to Marketing Director of PT Honda Prospect Motor (HPM), Yusak Billy, quoted by Detik.com (2023) "People who previously used two-wheeled vehicles and want to buy a car as a first-time buyer, usually choose LCGC. Our customer are also 70% first-time buyers. So, I don't think it will reduce the LCGC market,"

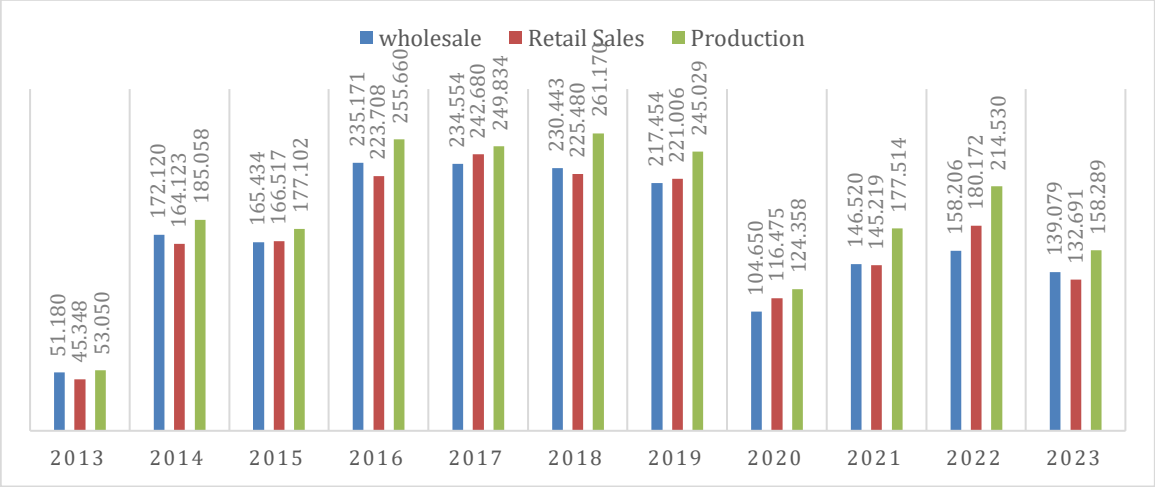

Figure 1. Graph of Wholesale, Retail Sales, Production

Source: Indonesian Automobile Industry Data Gaikindo, 2023.

Based on the data above, LCGC production has good development, from the beginning of production until 2018 recorded a graph that continues to increase. In 2020, it fell due to the COVID-19 virus which caused the automotive industry to be sluggish, recorded a decline of -49% from 2019 production, it took 3 years to get back up after the government revoked the status of the COVID-19 Pandemic. But now the challenges for LCGC manufacturers have increased after the Government no longer provide special treatment for the LCGC segment as when it was first introduced in 2013. At the beginning of its existence, the government exempted the Sales Tax on Luxury Goods (PPnBM), but now the rate will increase by 5% in the near future. This policy has led to the potential extinction of the LCGC market in the future.

Actually, the era of LCGC 'extinction' started some time ago. This was marked by manufacturers' decisions to stop production of their LCGC car. Nissan Motor Indonesia (NMI) stopped production of the Datsun Go in January 2020, and Suzuki Indonesia stopped production of the Karimun Wagon R in 2021. Currently, the LCGC segment is populated by only three car manufacturers (Daihatsu, Toyota, and Honda) with five products on offer. Although wholesale sales increased slightly, they are still below 200 thousand unit (146,520 unit in 2021 and 158,206 units in 2022), retail sales are also still below 200 thousand unit (145,219 units in 2021 and 180,172 units in 2022). CNBC (2023) In addition, the Chinese car market in Indonesia is predicted to get bigger along with the increase in Low-Cost Green Car (LCGC) prices.

Research Gap based on existing study, the provided study focuses on forecasting LCGC car sales in Indonesia using exponential smoothing and compares it to trend analysis. While the research offers valuable insights, there's a gap to be explored by incorporating additional forecasting methods. Limited Scope of Forecasting Techniques: The study only utilizes two methods: exponential smoothing and trend analysis. There's an opportunity to investigate the effectiveness of other commonly used forecasting techniques like: Linear Regression and Moving Average. By incorporating these additional methods, you can create a more comprehensive comparison and identify the most accurate forecasting technique for LCGC car sales in Indonesia.

Then what is the future of LCGC in Indonesia in the next few years? Based on this, researchers will examine further by raising the research title, namely "Analysis of Forecasting Production and Sales of LCGC Cars in Indonesia". Based on the problems that have been described, the research objectives expected in this study are as follows:

1. Analyzing LCGC production and sales forecasting after the COVID-19 Pandemic status was changed to Endemic, LCGC price increases amid competition from cars made in China.
2. Finding the most appropriate method used to forecast production and sales (wholesale & retail sales) of LCGC after the COVID-19 Pandemic status was changed to Endemic, LCGC car price increases amid competition from cars made in China.

This study aims to contribute to both policymakers and businesses within Indonesia's automotive sub-sector. Policymakers can leverage the research results to evaluate existing policies and make informed decisions impacting the industry. For businesses, the findings can serve as valuable insights for management teams, aiding them in planning and adapting to meet evolving market needs.

Literature Review and Hypothesis Development

Definition of Forecasting

Forecasting is the first step in production planning and control. Forecasting involves thinking about a quantity, such as the demand for one or more products in the future (Rony, Nur, Jaharuddin, Andry, 2019). According to (Rusdiana, 2014) Based on the time period, forecasting can be divided into:

1. Short-term forecasting. ≤ 1 Year
2. Medium-term forecasting. 1 to 5 Years
3. Long-term forecasting. > 5 Years

Forecasting Objectives

Forecasting in production activities aims to anticipate uncertainty, so that estimates are obtained that are close to the actual situation. Although forecasting will never be "perfect", forecasting results provide direction for planning (Rony et al., 2019). The goal of forecasting is to get results that can minimize errors, which can be measured by *Mean Absolute Percent Error* (MAPE) (Pangestu Subagyo in Rusdiana, 2014). Good forecasting has several criteria, including

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accuracy, cost, and convenience. (Nasution in Rusdiana, 2014). In making forecasts, some things that must be considered are:

1. Forecast are bound to contain errors,
2. Forecasting should provide information on some measure of error,
3. Short-term forecasting is more accurate than long-term forecasting.

Based on its nature, forecasting can be divided into two methods, namely qualitative and quantitative forecasting (Rusdiana, 2014).

Reseach Framework

The framework in this study is described as follows:

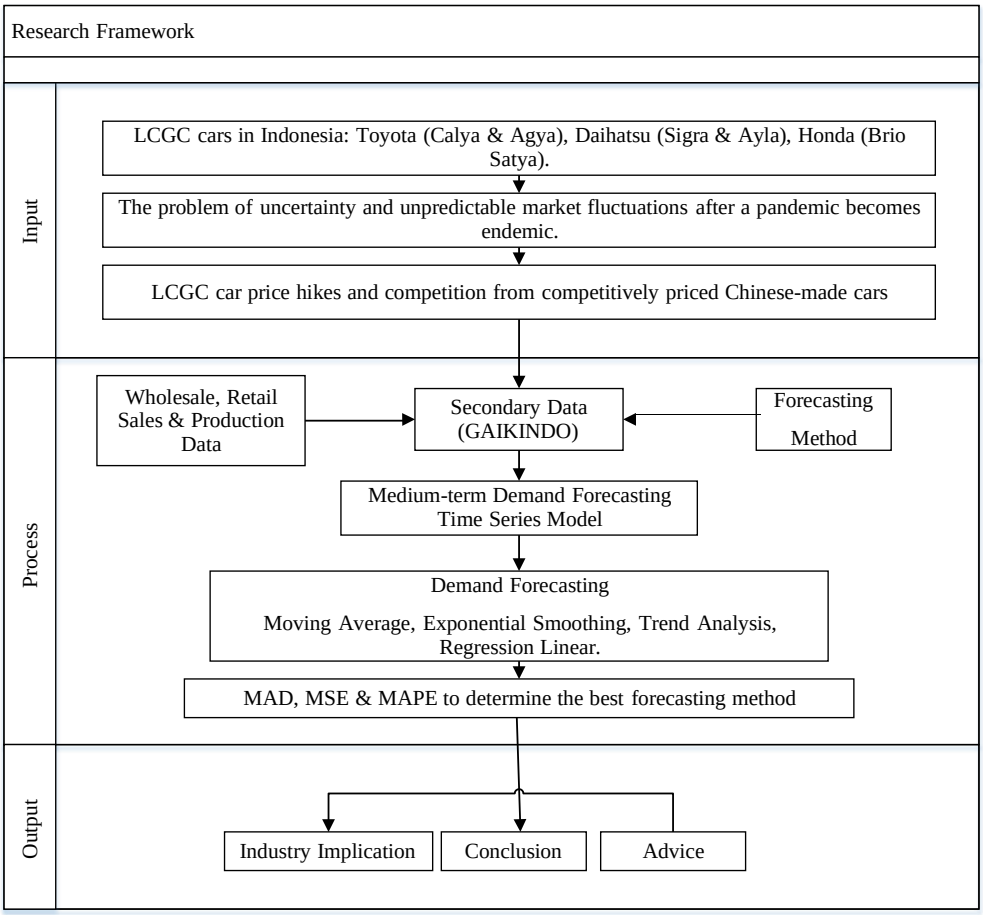

Figure 2. Research Framework

Research Method

This research design is a type of quantitative descriptive research using time series and causal quantitative methods using forecasting testing as follow:

Trend Analysis Method

The Trend Analysis method consists of two approaches to forecasting, namely by using the midpoint as the base year and the first year as the base year (Akhmad, 2018).

$$\mathbf{Y = a + bX}$$

Description:

Y = The amount of sales represented by the vertical axis on the graph.

X = Sales planning year represented by the horizontal axis

a = Fixed component of sales each year

b = Sales growth rate for each year

Moving Average Method

The moving average method calculates a rolling average to forecast sales in future periods (Akhmad, 2018). The determination of the number *n* is based on experiments or simulations by considering real situation in the field. The moving average calculation changes over time, where new data is added and old data is removed. Here is the mathematical formula:

$$\hat{Y}t = \frac{Yt-1 + Yt-2 + \cdots + Yt-n}{n}$$

Description:

Y_t = Forecasting period *t* demand

Y = Latest period actual forecasting

t = Most recent period

n = Number of moving average periods

Exponential Smoothing Method

According to Akhmad (2018) The exponential forecasting method give less and less weight to the demand from the previous period as the data ages. Therefore, newer demand data gets a greater weight than older demand data. The exponential forecasting method is particularly attractive for production and operations applications that involve forecasting a large number of items. This method is particularly suitable for the following conditions:

1. The time scope of forecasting is relatively short, such as daily, weekly, or monthly demand.
2. External information on the causal relationship between the demand for a product and the independent factors that influence it is not widely available.
3. The effort required in forecasting is minimal, both in terms of the ease of application of the method and the storage time required for its application.
4. Updating the forecast with new data can be done easily by simply entering the data
5. The forecast needs to be adjusted by incorporating elements of randomness (demand frequencies is averaged out) as well as trends and seasonality.

The basic formula used in exponential forecasting is:

New forecast = Past Forecast + α (Past period actual demand – Past period forecast)

The equation is mathematically written:

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$$\mathbf{F_1 = F_{t-1} + \alpha\,(A_{t-1} - F_{t-1})}$$

Description:

F1 = New forecast

F = Previous forecast

α = Constant

A = Previous period actual demand

Linear Regression Method

The most commonly used causal forecasting model is Linear Regressions Analysis (Akhmad, 2018). A simple linear regression model is a probabilistic model that describe a linear relationship between two variables, where one variable is considered to affect the other. The influencing variable is called the independent variable, while the influenced variable is called and the dependent variable. The probabilistic model for simple linear regressions is as follows (Firda, Sawarni, 2020):

$$Y=\beta\mathbf{0}+\beta\mathbf{1}X$$

Description:

Y = Dependent variable

$\beta 0$ = Intercept

$\beta 1$ = Coefficient

X = Independent variable

Forecasting Error Calculation

The forecasting error calculation is used in two types of decisions. First, to compare the accuracy and select the most optimal forecasting method among the existing methods. Second, to evaluate how close to reality the forecasting results are. Error testing is done by comparing forecasting results with actual data, so the error can only be known if actual data is obtained (Heizer and Render, 2014).

MAD (Mean Absolute Deviation)

MAD is appropriate when error analysis is done in the same units as actual demand. The following is the mathematical model:

$$\mathbf{MAD} = \frac{\sum_{i=1}^{n} |Yi - \hat{Y}i|}{n}$$

MSE (Mean Square Error)

This error calculation penalizes large differences over small differences through quadratic calculations. Here is the mathematical model:

$$\mathbf{MSE} = \frac{\sum_{i=1}^{n} |Yi - \hat{Y}i|^2}{n}$$

Description:

F1 = New forecast

F = Previous forecast

α = Constant

A = Previous period actual demand

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MAPE (Mean Absolute Percent Error)

In some situations, it is more convenient to display the error value as a percentage rather than in units. This measurement is appropriate when the size of the variable being forecasted determines the accuracy of the forecast. Here is the mathematical model:

$$\mathbf{MAPE} = \frac{100 \sum_{i=1}^{n} |\mathrm{Y}i - \hat{\mathrm{Y}}i| \,/\mathrm{Yi}}{n}$$

Description:

Yi = Actual demand of period *i*
Ŷi = Period *i* forecast value
i = Period -1 (1,2,3,…,n)
n = Number of periods being compared

Table 1. MAPE Value Range

MAPE Range	Description
<10%	Excellent Forecasting Model
10% - 20%	Good Forecasting Model
20% - 50%	Viable Forecasting Model
>50%	Poor Forecasting Model

Source: Lewis,1982

Population and Sample

The population in this study includes all types of cars from all brand in Indonesia, consisting of 36 trademarks. The sample method used is purposive sampling, which is a method that selects samples based on certain criteria. In this study, the criteria are car manufacturers that still produce LCGCs in Indonesia. The sample used includes sales data (Wholesale and Retail) and LCGC production from Toyota, Daihatsu, and Honda in Indonesia, which are members of the Indonesian Automotive Industry Association (GAIKINDO).

Data Collection Methods

The data collection technique used in this research is library research. The secondary data obtained includes the history, literature and profile of the research object that has been determined, car production and sales data tables in accordance with the object of research, theories related to research variables, and other supporting data sourced from the company's internet, articles related to research topics, and previous research journals.

Data Analysis Method

This research focuses on forecasting analysis of production and sales (wholesale & retail) of LCGC from January 2022 to December 2023. The analysis method used is medium-term demand forecasting with a time series model. The forecasting period will be carried out until December 2024, the software used to analyze forecasting in this study is POM QM and Excel.

Research Flow

Based on the results of the above explanation, it can be concluded that the flow of this research is as follow:

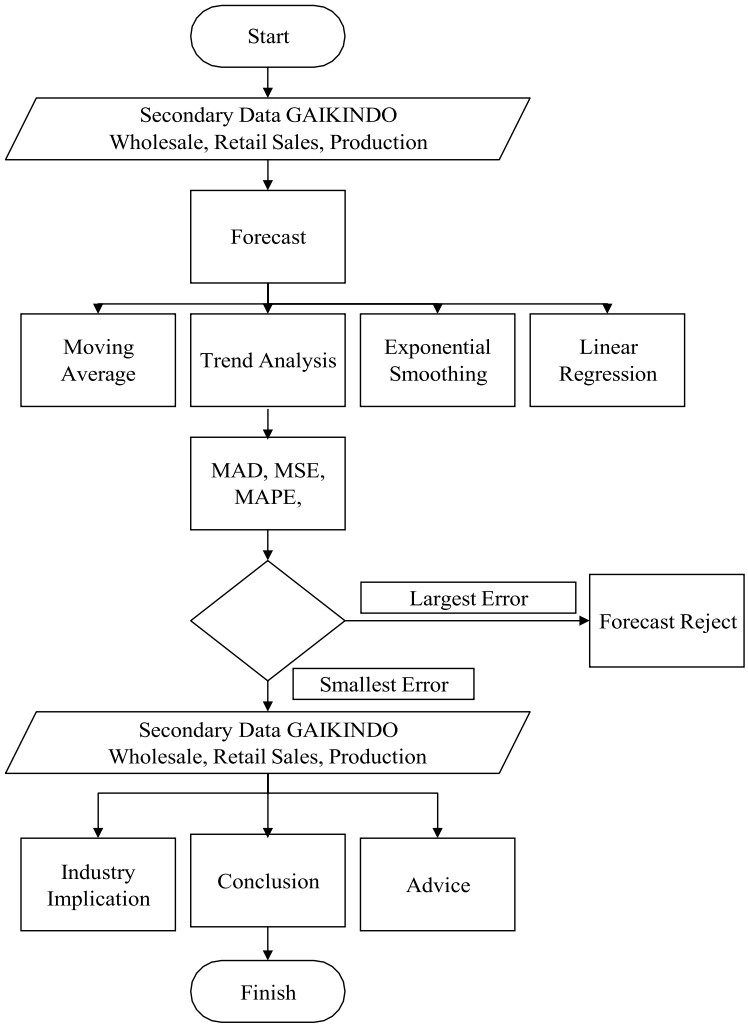

Figure 3. Research Flow Chart

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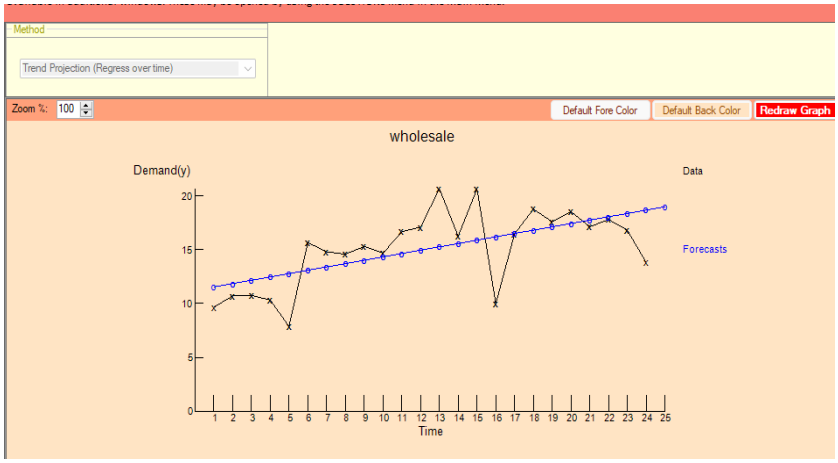
Result and Discussion

Table 2. Result of Forecast Trend Analysis Wholesale

Measure	Value	Future Period	Forecast
Error Measures		25	19,011
Bias (Mean Error)	0	26	19,322
MAD (Mean Absolute Deviation)	2,088	27	19,633
MSE (Mean Squared Error)	7,451	28	19,944
Standard Error (denom=n-2=22)	2,851	29	20,255
MAPE (Mean Absolute Percent Error)	15,76%	30	20,566
Regression line		31	20,878
Demand(y) = 11,232		32	21,189
+ ,311 * Time		33	21,5
Statistics		34	21,811
Correlation coefficient	0,619	35	22,122
Coefficient of determination (r^2)	0,384	36	22,433
		37	22,745
		38	23,056

Source: Data processed (2024)



Source: Data processed (2024)

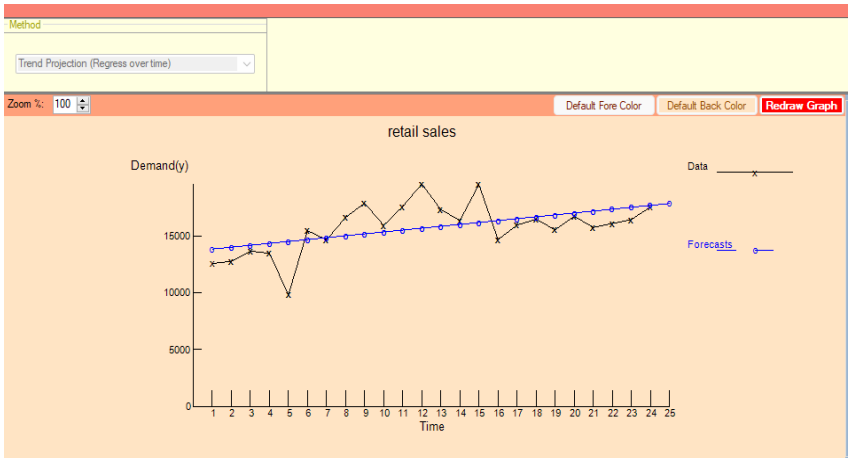
Figure 4. Graph of Forecast Trend Analysis Wholesale

Table 3. Result of Forecast Trend Analysis Retail Sales

Measure	Value	Future Period	Forecast
Error Measures		25	17873,32
Bias (Mean Error)	0	26	18040,73
MAD (Mean Absolute Deviation)	1402,79	27	18208,14
MSE (Mean Squared Error)	3343121	28	18375,55
Standard Error (denom=n-2=22)	1909,723	29	18542,97
MAPE (Mean Absolute Percent Error)	9,31%	30	18710,38

Regression line		31	18877,79
Demand(y) = 13688,02		32	19045,2
+ 167,412 * Time		33	19212,62
Statistics		34	19380,03
Correlation coefficient	0,535	35	19547,44
Coefficient of determination (r^2)	0,287	36	19714,85
		37	19882,26
		38	20049,68

Source: Data processed (2024)



Source: Data processed (2024)

Figure 5. Graph of Forecast Trend Analysis Retail Sales

Table 4. Result of Forecast Trend Analysis Production

Measure	Value	Future Period	Forecast
Error Measures		25	20812,06
Bias (Mean Error)	0	26	20989,96
MAD (Mean Absolute Deviation)	2839,271	27	21167,86
MSE (Mean Squared Error)	12433630	28	21345,75
Standard Error (denom=n-2=22)	3682,928	29	21523,65
MAPE (Mean Absolute Percent Error)	17,71%	30	21701,55
Regression line		31	21879,45
Demand(y) = 16364,61		32	22057,35
+ 177,898 * Time		33	22235,24
Statistics		34	22413,14
Correlation coefficient	0,33	35	22591,04
Coefficient of determination (r^2)	0,109	36	22768,94
		37	22946,84
		38	23124,73

Source: Data processed (2024)

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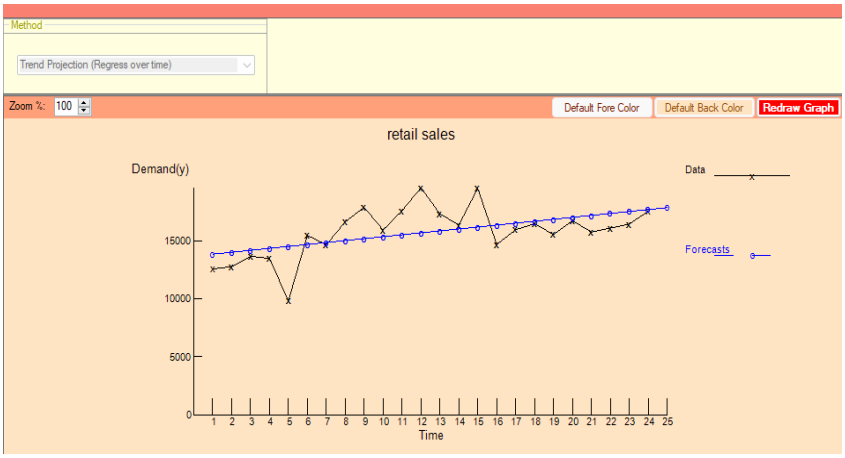


Source: Data processed (2024)

Figure 6. Graph of Forecast Trend Analysis Production

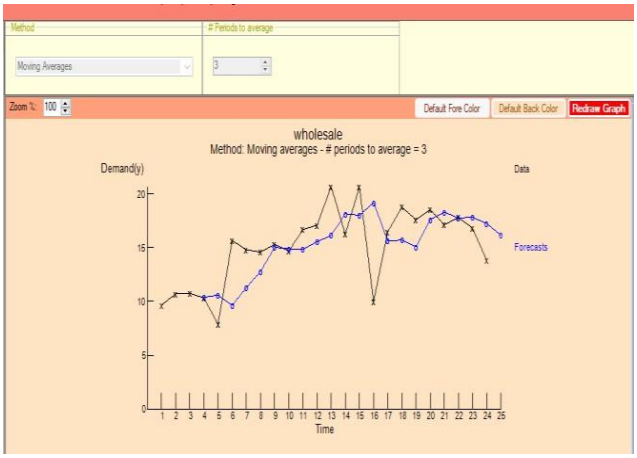
Based on the calculation table of the results of the wholesale, retail sales and production Trend Analysis Method, there are several important points that can be analyzed:

Overall, the forecasting accuracy of wholesale and retail sales looks quite good. The relatively low MAD and MAPE values indicate that the forecast do not different much from the actual values. The higher MSE values indicate that there are some large errors that need to be considered. In contrast to production the forecasting accuracy looks less good. The relatively high MAD and MAPE values indicate that forecasting is much different from the actual values.

Table 5. Result of Forecast Moving Average Wholesale

Measure	Value
Error Measures	
Bias (Mean Error)	0,47
MAD (Mean Absolute Deviation)	2,351
MSE (Mean Squared Error)	10,153
Standard Error (denom=n-2=19)	3,35
MAPE (Mean Absolute Percent Error)	16,70%
Forecast	
next period	16,159

Source: Data processed (2024)



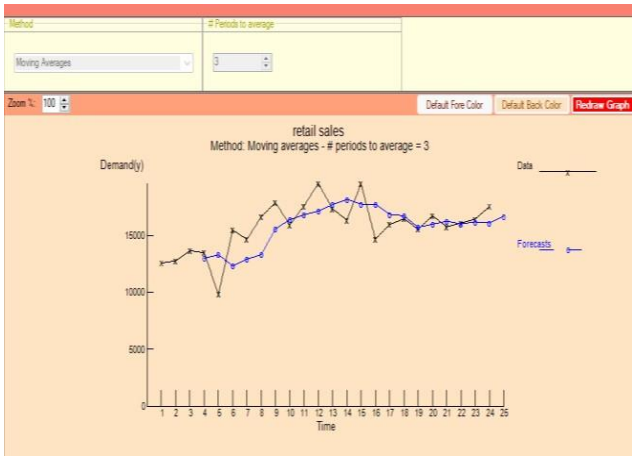
Source: Data processed (2024)

Figure 7. Graph of Forecast Moving Average Wholesale

Table 6. Result of Forecast Moving Average Retail Sales

Measure	Value
Error Measures	
Bias (Mean Error)	358,079
MAD (Mean Absolute Deviation)	1407,921
MSE (Mean Squared Error)	3255087
Standard Error (denom=n-2=19)	1896,768
MAPE (Mean Absolute Percent Error)	9,21%
Forecast	
next period	16706,33

Source: Data processed (2024)



Source: Data processed (2024)

Figure 8. Graph of Forecast Moving Average Retail Sales

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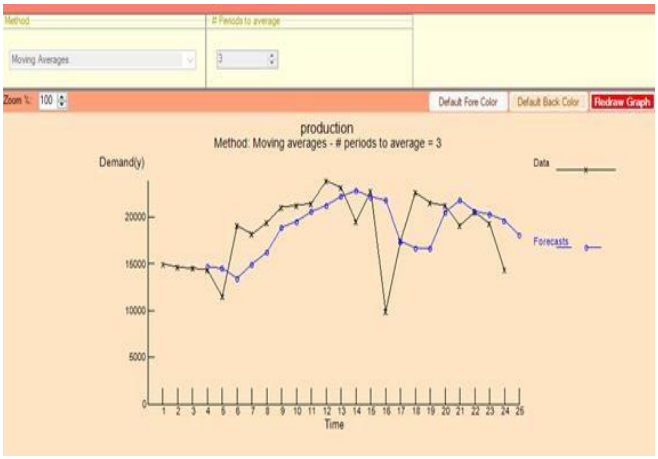
Table 7. Result of Forecast Moving Average Production

Measure	Value
Error Measures	
Bias (Mean Error)	225,429
MAD (Mean Absolute Deviation)	2865,111
MSE (Mean Squared Error)	15539330
Standard Error (denom=n-2=19)	4144,279
MAPE (Mean Absolute Percent Error)	18,01%
Forecast	
next period	18057,33

Source: Data processed (2024)



Source: Data processed (2024)

Figure 9. Graph of Forecast Moving Average Production

Based on the calculation table of the results of the Moving Average Method of wholesale, retail sales and production moving average method, there are several important points that can be analyzed:

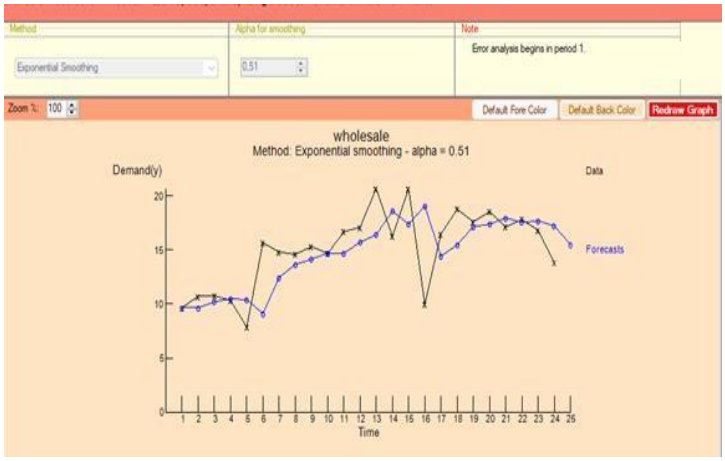
Overall, the forecasting accuracy of the moving average wholesale and retail sales looks quite good. The relatively low MAD and MAPE values indicate that the moving average method is not much different from the actual values. The higher MSE values indicate that there are some large errors that need to be considered. In contrast to production the forecasting accuracy looks less good. The relatively high MAD and MAPE values indicate that forecasting is much different from the actual values.

Table 8. Result of Forecast Exponential Smoothing Wholesale

Measure	Value
Error Measures	
Bias (Mean Error)	498,55
MAD (Mean Absolute Deviation)	2176,883
MSE (Mean Squared Error)	9194824
Standard Error (denom=n-2=21)	3173,409

MAPE (Mean Absolute Percent Error)	15,55%
Forecast	
next period	15505,99

Source: Data processed (2024)



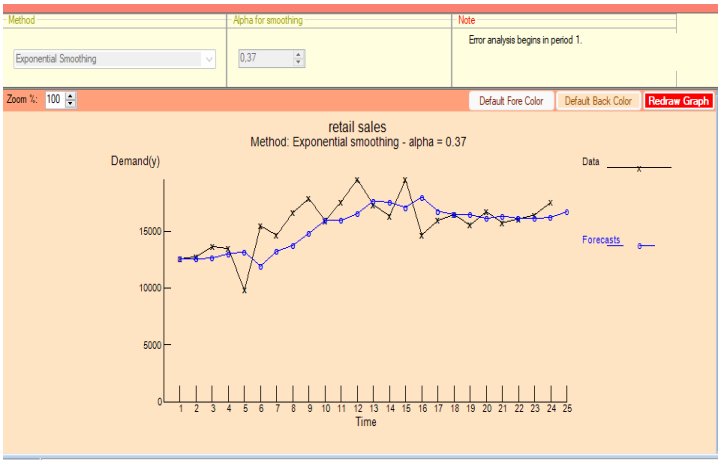
Source: Data processed (2024)

Figure 10. Graph of Forecast Exponential Smoothing Wholesale

Table 9. Result of Forecast Exponential Smoothing Retail Sales

Measure	Value
Error Measures	
Bias (Mean Error)	487,926
MAD (Mean Absolute Deviation)	1415,725
MSE (Mean Squared Error)	3444748
Standard Error (denom=n-2=21)	1942,375
MAPE (Mean Absolute Percent Error)	9,18%
Forecast	
next period	16732,25

Source: Data processed (2024)



Source: Data processed (2024)

Figure 11. Graph of Forecast Exponential Smoothing Retail Sales

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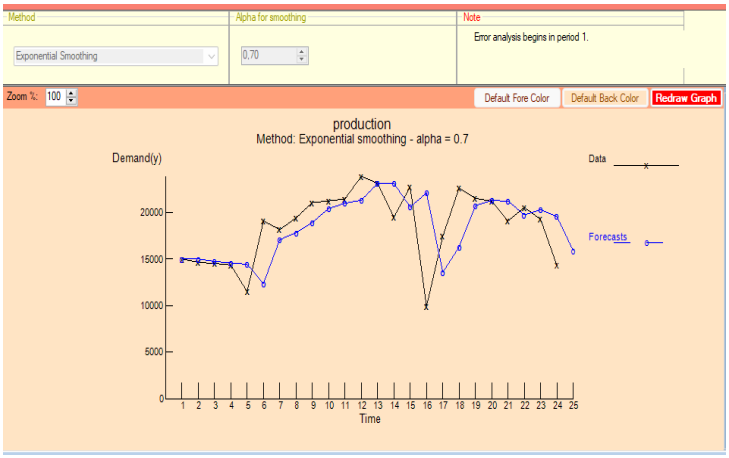
Table 10. Result of Forecast Exponential Smoothing Production

Measure	Value
Error Measures	
Bias (Mean Error)	55,789
MAD (Mean Absolute Deviation)	2499,82
MSE (Mean Squared Error)	14210020
Standard Error (denom=n-2=21)	3945,042
MAPE (Mean Absolute Percent Error)	16,09%
Forecast	
next period	15910,21

Source: Data processed (2024)



Source: Data processed (2024)

Figure 12. Graph of Forecast Exponential Smoothing Production

Based on the calculation table of the results of the Exponential Smoothing Method of wholesale, retail sales and production, there are several important points that can be analyzed:

The correct alpha value from the calculation

Wholesale α=0.51

Retail sales α=0.37

Production α=0.70

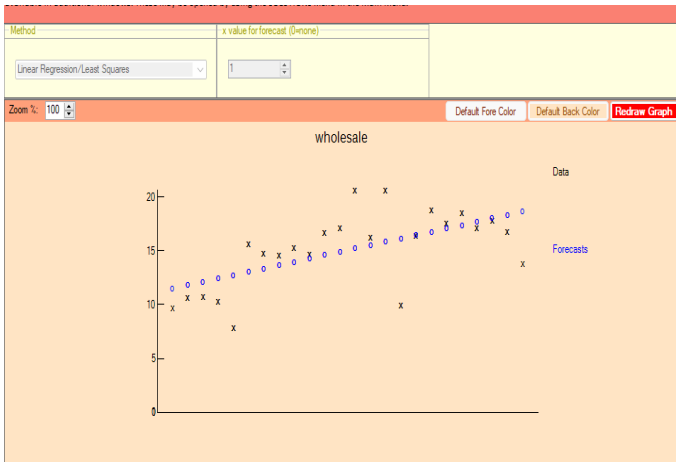
The alpha value is an important parameter in exponential smoothing methods that determines the weight given to recent data. Choosing the right alpha value can help improve forecasting accuracy.

The exponential smoothing method is a fairly effective forecasting method in the table. To improve forecasting accuracy, it is recommended to choose the right alpha value, use more data, and monitor forecasting regularly.

Table 11. Result of Forecast Linear Regression Wholesale

Measure	Value	Future Period	Forecast
Error Measures		25	19,011
Bias (Mean Error)	0	26	19,322
MAD (Mean Absolute Deviation)	2,088	27	19,633
MSE (Mean Squared Error)	7,451	28	19,944
Standard Error (denom=n-2=22)	2,851	29	20,255
MAPE (Mean Absolute Percent Error)	15,76%	30	20,566
Regression line		31	20,878
Demand(y) = 11,232		32	21,189
+ ,311 * Time		33	21,5
Statistics		34	21,811
Correlation coefficient	0,619	35	22,122
Coefficient of determination (r^2)	0,384	36	22,433
Forecast		37	22,745
x = 1	1.154.303	38	23,056

Source: Data processed (2024)



Source: Data processed (2024)

Figure 13. Graph of Forecast Linear Regression Wholesale

Table 12. Result of Forecast Linear Regression Retail Sales

Measure	Value	Future Period	Forecast
Error Measures		25	17873,32
Bias (Mean Error)	0	26	18040,73
MAD (Mean Absolute Deviation)	1402,79	27	18208,14
MSE (Mean Squared Error)	3343121	28	18375,55
Standard Error (denom=n-2=22)	1909,723	29	18542,97
MAPE (Mean Absolute Percent Error)	9,31%	30	18710,38
Regression line		31	18877,79

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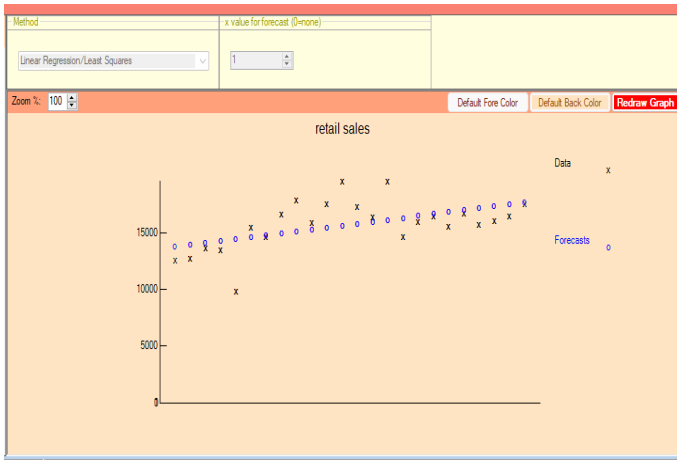
Demand(y) = 13688,02		32	19045,2
+ 167,412 * Time		33	19212,62
Statistics		34	19380,03
Correlation coefficient	0,535	35	19547,44
Coefficient of determination (r^2)	0,287	36	19714,85
Forecast		37	19882,26
x = 1	13855.43	38	20049,68

Source: Data processed (2024)



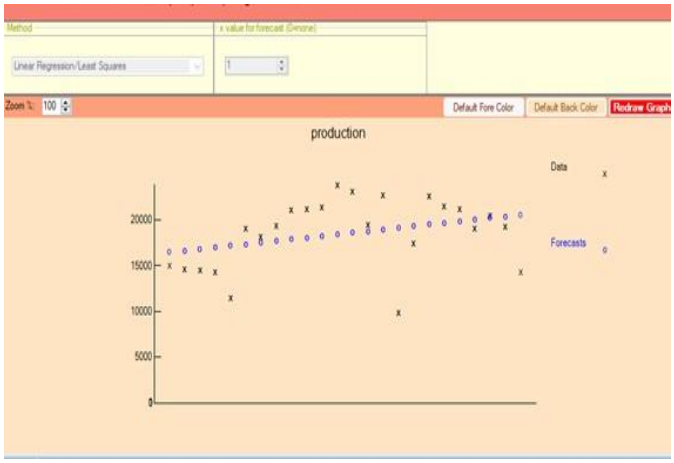
Source: Data processed (2024)

Figure 14. Graph of Forecast Linear Regression Retail Sales

Table 13. Result of Forecast Linear Regression Production

Measure	Value	Future Period	Forecast
Error Measures		25	20812,06
Bias (Mean Error)	0	26	20989,96
MAD (Mean Absolute Deviation)	2839,271	27	21167,86
MSE (Mean Squared Error)	12433630	28	21345,75
Standard Error (denom=n-2=22)	3682,928	29	21523,65
MAPE (Mean Absolute Percent Error)	17,71%	30	21701,55
Regression line		31	21879,45
Demand(y) = 16364,61		32	22057,35
+ 177,898 * Time		33	22235,24
Statistics		34	22413,14
Correlation coefficient	0,33	35	22591,04
Coefficient of determination (r^2)	0,109	36	22768,94
Forecast		37	22946,84
x = 1	16542.51	38	23124,73

Source: Data processed (2024)



Source: Data processed (2024)

Figure 15. Graph of Forecast Linear Regression Production

Based on the table of calculation of the results of the Linear Regression Method of wholesale, retail sales and production, there are several important point that can be analyzed:

The Correlation Coefficient value: wholesale 0.619, retail sales 0.535, production 0.33 indicates that there is a moderate positive relationship between the independent variable (time) and the dependent variable (demand).

The Coefficient of Determination (r^2): wholesale 0.384, retail sales 0.287, production 0.109 indicates that the variation in demand can be explained by the time variable. Wholesale 38.4%, retail sales 28,7%, production 10.9%.

Overall, the forecasting results of the linear regression method show moderate accuracy. The error measures show that the average error is not too large and there is a positive relationship between the independent variable and the dependent variable.

The ideal MAPE value is less than 10%. In this table, the MAPE value of 15.76% wholesale, 9.31% retail sales shows that the forecasting accuracy is quite good. While for production 17.71% shows that the forecasting accuracy is low.

The ideal r^2 value is more than 0.5. In this table, the r^2 value of 0.384 wholesale, 0.287 retail sales indicates that the relationship between the independent variable and the dependent variable is not very strong. As for production, the r^2 value of 0.109 indicates that the relationship between the independent variable and dependent variable is weak.

The forecasting results of the linear regression method are not reliable for predicting future demand. This forecasting method can be improved by considering other variables, using other forecasting methods, and monitoring and evaluating the model regularly.

Table 14. Recapitulation Table MAD, MSE, MAPE

MAD	Wholesale	Retail Sales	Production
Trend Analysis	2,088	1402,79	2839,271
Moving Average	2,351	1407,921	2865,111
Exponential Smoothing	2,177	1415,725	2499,82

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Linear Regression	2,088	1402,79	2839,271
Smallest Error	**2,088**	**1402,79**	**2499,82**

MSE	**Wholesale**	**Retail Sales**	**Production**
Trend Analysis	7,451	3343121	12433630
Moving Average	10,153	3255087	15539330
Exponential Smoothing	9,195	3444748	14210020
Linear Regression	7,451	3343121	12433630
Smallest Error	**7,451**	**3255087**	**12433630**

MAPE	**Wholesale**	**Retail Sales**	**Production**
Trend Analysis	15,76%	9,31%	17,71%
Moving Average	16,70%	9,21%	18,01%
Exponential Smoothing	15,55%	9,18%	16,09%
Linear Regression	15,76%	9,31%	17,71%
Smallest Error	**15,55%**	**9,18%**	**16,09%**

Source: Data processed (2024)

Based on the MAD, MSE, MAPE Recapitulation Table, there are several important points that can be analyzed:

- The smallest MAD (Mean Absolute Deviation) value for wholesale and retail sales using the Trend Analysis and Linear Regression forecasting methods shows that the average forecasting error is 2,088 units, in contrast to production the smallest MAD value using the Exponential Smoothing Method shows that the average forecasting error is 2,499.82 units.
- The smallest MSE (Mean Squared Error) value for wholesale and production using the Trend Analysis and Linear Regression forecasting methods show that the average square of the forecasting error is 7,451 units, in contrast to retail sales the smallest MSE value using the Moving Average Methods shows that the average square of the forecasting errors is 3,255,087 units.
- The smallest MAPE (Mean Absolute Percentage Error) values for wholesale, retail sales, and production using the exponential smoothing forecasting method show that the average percentage of forecasting error is below 20%. This means that overall, the forecasting accuracy looks good.

It can be concluded that the exponential smoothing method is a fairly effective forecasting method in the table. To improve forecasting accuracy, it is recommended to choose the right data alpha value, use more data and monitor forecasting regularly.

Conclusion

Based on the results and discussion carried out in this study, it can be concluded that: Analyze the forecasting of LCGC production and sales after COVID-19 Pandemic status was changed to Endemic, the increase in LCGC prices amid competition from cars made in China. Using 3 time series forecasting methods, namely: Trend Analysis, Moving Average, and Exponential Smoothing, plus 1 causal forecasting method using Linear Regressions. Forecasting calculations using software POM QM production and sales (wholesale & retail sales), the lowest MAPE is obtained using the Exponential Smoothing Method. These results are 16.09% in production, 15.55% in wholesale and 9.18% in retail sales. Referring to the range of MAPE values which are <10% which means the forecasting model is excellent, 10%-20% which means the forecasting model is good.

Advice

Efforts to increase demand for motor vehicles can be made by providing incentives to potential consumers. The PPnBM DTP implemented by the government for the last two years (2021-2022) has proven to be quite effective in restoring the motor vehicle market after experiencing a sharp decline due to the COVID-19 Pandemic. This incentive has succeeded in significantly restoring demand for 4-wheeled vehicles. The automotive industry plays a significant role in contributing to the economy, including expanding export markets and increasing domestic demand. To achieve increased demand, policies that support economic growth are needed so that people's income also increases.

Limitations and Suggestions for Future Research

This research is conducted using time series and causal assumptions to forecast the production, sales (wholesale & retail sales) of LCGC in the future. However, this research does not consider other factors in forecasting. Therefore, future research can perform forecasting using other methods so that factors that may affect car sales can be taken into account. This research only conducts medium-term observations, namely for 24 months. This makes a little historical data even though the data is the basis for forecasting. Therefore, future research can carry out long, medium and short-term forecasting so that it can see more detailed forecasting results because it assumes different scenarios.

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