# Car Demand Forecasting of Toyota in Indonesia: A Case Study Medium Price Category

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## Abstract

In the competitive car market, demand forecasting plays an important role. Accurate forecasting will provide many benefits to a company's supply chain process. Forecasting with past data alone is not sufficient to forecast demand. In other words, it takes variables that also influence demand forecasting. Through the journal review process and the Delphi method, seven variables are produced that affect the demand for medium-prices Toyota cars in Indonesia. These variables are six variables that have been used before and one variable, namely COVID-19, disrupts car demand in Indonesia. This study uses Multiple Linear Regression with 2018 - 2020 data, and with this model, 2021 and 2022 demand forecasts are generated. Forecasting with this model is compared with 2021 factual data, it is found that this forecasting model is of good quality.

## Keywords

Car Demand, COVID-19, Delphi Method, Forecasting, Multiple Linear Regression.

## 1. Introduction

Cars as the automotive industry make a significant contribution to the Indonesian economy. (Indonesian Information Portal 2021) said that in recent years the contribution of the automotive sector to the national gross domestic product (GDP) was quite significant, which was around six percent. Figure 1. shows the total sales of cars from dealers to consumers in Indonesia in the last ten years.

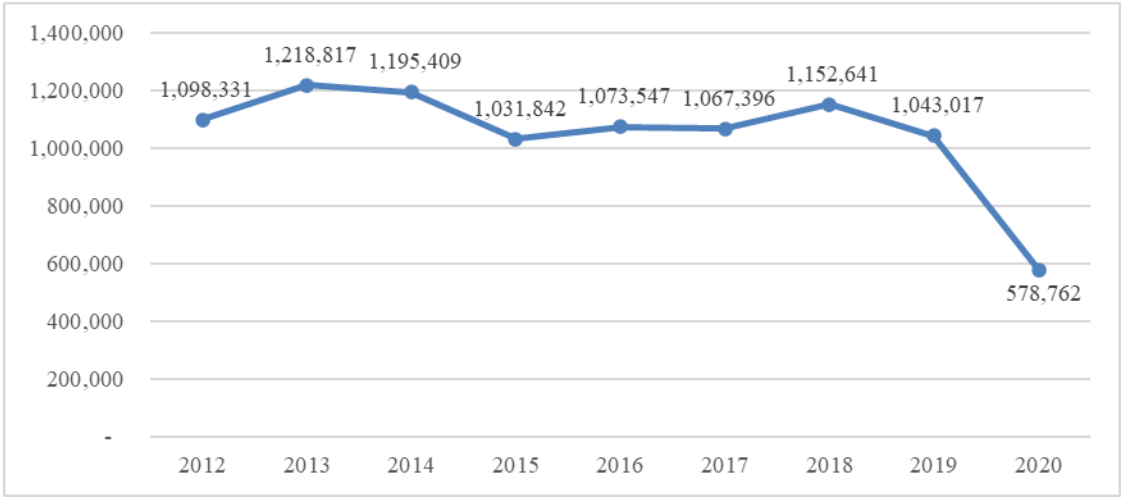


Figure 1. Car Sales in Indonesia

Based on the graph above, most car sales from dealers to consumers occurred in 2013, with total sales of 1,218,817 cars. Meanwhile, a significant decline in sales only occurred in 2020, minus 45% compared to 2019, with record sales of only 578,762 cars. Overall, it was not only the automotive industry that experienced a decline. Data from (the

Ministry of Finance 2021) shows that Indonesia's economic growth in 2020 was minus 2.07% compared to 2019. This record made Indonesia in 2020 experience the worst economic growth after the 1998 monetary crisis. At that time, Indonesia's economic growth was minus 13,1 percent (Kencana 2021).

The economic crisis in Indonesia in 1998 was different from 2020. At the end of 2019, the first case of pneumonia caused by a new type of coronavirus was in Wuhan, China. The virus spread rapidly throughout the world as COVID-19 (J. Yang et al. 2020). Since March 11 2020, Covid-19 has been considered a global pandemic by the World Health Organization (WHO) in most countries, including Indonesia (Dong et al. 2020). Based on WHO research, COVID-19 infects the human respiratory system, which can cause mild flu to death. COVID-19 has a short incubation period so that this disease can spread massively and quickly (Kirigia & Muthuri 2020). The number of COVID-19 cases is increasing rapidly worldwide, including in Indonesia.

As a result, many countries have taken various policies to respond to COVID-19, including the lockdown known as Large-Scale Social Restrictions (PSBB) in Indonesia (Hadiwardoyo 2020). This PSBB policy has caused many people to be economically disturbed and decide not to buy a car. In support of increasing car sales, the government provides tax discounts or incentives for reducing PPnBM rates for motor vehicles, in this case, new cars for the 1,500 cc segment for the sedan and 4x2 categories from March 2021 to December 2021 (Lidyana 2021). This policy has proven to encourage consumer interest in buying cars.

Toyota in Indonesia currently sells 20 models of private cars with different prices and qualities in each model. Of the 20 models, 18 were selected and classified into three price categories: low price, medium price, and high price. Prices are taken based on November 2021 prices, with possible changes in the future (Auto 2000 2021). The classification of Toyota car models in Indonesia is as follows:
1. Low prices: Agya, Calya, Avanza, Rush, Yaris, Vios
2. Medium prices: Sienta, Corolla Altis, Voxy, Fortuner, C-HR, Innova
3. High prices: Supra, FT86, Alphard, Vellfire, Camry, Land Cruiser

In the competitive car market, demand forecasting plays an important role. Demand forecasting is the process of forecasting future time series based on past data (Rahman & Zahura 2018). Demand forecasting is an essential aspect of supply chain management that significantly impacts planning, capacity, and inventory control decisions (Kerkkanen et al. 2009). In the inventory system, every company needs to carry out safety stock. The quantity of safety stock needs to be maintained not to cause waste (Liker 2004). An accurate forecasting method produces the appropriate safety stock and influences the company to identify competitive strengths, assess market demand patterns, and determine product development strategies (Gao 2018).

The accuracy of time series forecasting is a challenge for scientists (Taskaya-Temizel & Ahmad 2005). Methods in forecasting are generally divided into two categories, namely qualitative methods and quantitative methods. With quantitative methods, forecasting car demand is influenced by many factors such as the economic situation, state policies, family income, and others (L. Yang & Li 2016). (Bruhl et al. 2009) forecasting with a data-based model for the German car market that connects various economic indicators such as Gross Domestic Product (GDP), Consumer Price Index (CPI), interest rates, unemployment rates, and fuel prices. These factors include characteristics that are not linear and have high fluctuations. So for the case study of car sales, these variables are needed in forecasting demand.

In forecasting the demand for cars, many variables can affect the economy or others. In the uncertainty of COVID-19, the COVID-19 variable and several other variables are considered for further research in this study. With the hope that Toyota in Indonesia will be able to adapt by making accurate forecasts despite the challenges in the future. This study uses the Delphi method to survey several experts in forecasting Toyota car demand. Of the many variables that may influence the Delphi method will produce the variables that most influence the forecasting of Toyota car demand in Indonesia. Furthermore, this research uses Multiple Linear Regression.

### 1.1 Objectives

This study aims to create an effective forecasting model for medium prices Toyota car demand accurately and the effect of variables on the number of Toyota car demand in Indonesia. That way, an error rate will be generated for each method used. Finally, the estimated demand for medium prices Toyota cars in the future is generated.

## 2. Literature Review

### 2.1 Forecasting

Forecasting is the beginning of planning. Before making a plan, forecasts must be made with the conditions of what will happen over the following several periods (Arnold et al. 2008). How the forecast is made and with what accuracy is another matter. Forecasting techniques are inevitable in developing plans to meet future demands. Most companies do forecasts before planning what to produce to meet demand. Companies need to have goods that can be sold immediately to shorten delivery times (Arnold et al. 2008). Five essential steps for an organization to forecast effectively (Chopra & Meindl 2016):

1. Understand the purpose of forecasting.
2. Integrate demand planning and forecasting across the supply chain.
3. Identify the main factors influencing demand forecasts.
4. Estimate at the appropriate level of aggregation.
5. Set performance and error measures for the forecast.

Forecasting methods are classified into four types of methods (Chopra & Meindl 2016):

1. Qualitative method.

Qualitative forecasting methods are subjective because they rely on human judgment. This method is appropriate when there is little historical data available or when experts can produce precise estimates. Such a method may also be necessary to forecast demand in a new industry over the next few years.

2. Time series method.

The time series forecasting method uses historical demand to make forecasts. They are based on the assumption that past demand history is a good indicator for forecasting future demand. This method is best suited when the basic demand pattern does not vary significantly from one year to the next.

3. Causal method.

The causal forecasting method assumes that demand forecasts are highly correlated with certain environmental factors (economic conditions, interest rates, etc.). The causal forecasting method uses environmental factor estimates to determine what influences demand to forecast. Thus, the firm can use the cause-and-effect method to determine the impact of its factors on demand.

4. Simulation method.

The simulation forecasting method imitates the consumer's choice that creates a demand to arrive at the forecast. Using simulation, and a company can combine time series and causal methods to answer questions such as: What will be the impact of a price promotion? What is the impact of a competitor opening a nearby store?

### 2.2 Forecasting Error

1. Mean Absolute Percentage Error (MAPE)

Mean absolute percentage error (MAPE) is calculated using the absolute error in each period divided by the actual observed value for that period. Then, average the absolute percentage error. This approach works when the size or magnitude of the forecast variable is essential in evaluating the accuracy of the forecast. MAPE indicates how big the forecast error is compared to the actual value. Here is the MAPE formula.

$$\text{MAPE} = \sum \frac{\frac{|\text{Actual} - \text{Forecast}|}{\text{Actual}} \times 100\%}{\text{n}} \quad (1)$$

Where: Actual is actual data, Forecast is predicted value, and n is forecasting period

2. Mean Squared Error (MSE)

One measure of forecasting error is the mean squared error (MSE) with the following equation.

$$\text{MSE}_\text{n} = \frac{1}{\text{n}} \sum_{\text{t}=1}^{\text{n}} \text{E}_\text{t}^2 \quad (2)$$

Where: $\text{E}_\text{t}$ is absolute deviation

MSE can be related to the variance of forecasting errors. Therefore, we can estimate that the random demand component has a mean of 0 and an MSE variance. The use of MSE as a measure of error is particularly appropriate when the estimated error has an asymmetric distribution of about zero.

3. Root Mean Square Error (RMSE)

Root mean square error is an alternative method for evaluating forecasting techniques used to measure the accuracy of the forecast results of a model. RMSE is the average value of the number of squared errors, and it can also state the size of the error generated by a forecast model. The following is the RMSE calculation formula.

$$\mathrm{RMSE} = \sqrt{\frac{1}{n}\sum_{i=1}^{n} e_i^2} \quad (3)$$

Where: $e_i$ is absolute deviation

4. Mean Absolute Deviation (MAD)

The following equation defines mean absolute deviation (MAD) as the mean absolute deviation of all periods.

$$\mathrm{MAD}_n = \frac{1}{n}\sum_{i=1}^{n} A_t \quad (4)$$

Where: $A_t$ is absolute deviation

MAD can be used to estimate the random components' standard deviation, assuming that the random components are normally distributed.

### 2.3 Delphi Method

The Delphi method is a systematic method of collecting opinions from experts through a series of questionnaires. The Delphi method was developed by Derlkey and his associates at the Rand Corporation, California, in the 1960s. The Delphi method is a method that harmonizes the communication process of a group so that an effective process is achieved in obtaining solutions to complex problems. The classic Delphi method is used when several consultations collect data through experts separately. The data will be applied in a Delphi cycle, and the consensus level reaches 60% (Eadie, R et al. 2008).

### 2.3 Multiple Linear Regression

According to (Chatterjee & Simonoff, 2013) simple linear regression exists a causal relationship between one independent variable and the dependent variable. Whereas it consists of several independent variables, it is called multiple linear regression. Data consist of n set observation $\{x_1, x_2, x_3, ...., x_k, y\}$, that represent random samples from a larger population. It is assumed that this observation fulfills a linear relationship.

$$y = \beta_0 + \beta_1 x_1 + \beta_2 x_2 + \cdots + \beta_k X_k + \varepsilon \quad (5)$$

Where: Y is predicted subject or dependent variable, $\beta_0$ is intercept, $\beta_1, \beta_2, ...$, are Slope, and $x_1, x_2, ...$, are independent variable value

## 3. Methods

The first step in forecasting car demand is to determine the variables that affect the demand for Toyota cars in Indonesia. Determining these variables refers to previous research journals related to car demand, then the Delphi Method process to conclude from several experts. Below are 23 variables that have been used previously in 21 previous studies. From the 23 variables, several variables will be selected with a minimum of 3 journals that used these variables previously. The literature study results of previous research journals related to the variables used in forecasting car demand are described in Table 1.

Table 1. Car Demand Forecasting Variables in Previous Studies

| No | Variable | Journal | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | Total |
| 1 | **National Car Sales** | | | | | | | ✓ | | | | ✓ | | ✓ | | ✓ | | ✓ | ✓ | | **6** |
| 2 | **Car Sales** | ✓ | | ✓ | ✓ | ✓ | ✓ | | ✓ | ✓ | | ✓ | ✓ | | | ✓ | ✓ | | | | **11** |
| 3 | **GDP** | | | | | | | | | | ✓ | | ✓ | | ✓ | ✓ | | | ✓ | ✓ | **6** |
| 4 | Economic Sentiment | | | | | | | | | | | | | ✓ | | | | | | | 1 |
| 5 | Stock Value | | | | | | | | | | | | | | | | | ✓ | | | 1 |
| 6 | **Inflation Rate** | | ✓ | | ✓ | | | | | | | | ✓ | ✓ | | | | | ✓ | | **5** |
| 7 | **Income per Capita** | | ✓ | | | | | | | | | | | ✓ | | ✓ | | | | | **3** |

| | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 8 | Total Road Length | | | | | | | | | | | | | | | | | | ✓ | 1 |
| 9 | **Interest Rate** | | ✓ | | | | | | | | | ✓ | | | | | | ✓ | | **3** |
| 10 | Import Tariff | | ✓ | | | | | | | | | | | | | | | | | 1 |
| 11 | Revenue | | | | | ✓ | | | | | | | | | | | | | | 1 |
| 12 | Total Export | | | | | | | ✓ | | | | | | | | | | | | 1 |
| 13 | Car Price | | | | | | | | | | | ✓ | | ✓ | | | | | | 2 |
| 14 | **Consumer Price Index** | | | | | | | | | ✓ | ✓ | | | | | | | | ✓ | **3** |
| 15 | Unemployment rate | | | | | | | | | | | | ✓ | ✓ | | | | | | 2 |
| 16 | Employment Rate | | | | | | | | | | ✓ | | | | | ✓ | | | | 2 |
| 17 | **Total Population** | | | | | | | ✓ | | | ✓ | | | | ✓ | | | | | **3** |
| 18 | Total Cars Nationwide | | | | | | | | | | ✓ | | | | ✓ | | | | | 2 |
| 19 | Total Car Production | | | | | | | ✓ | | | | | | | | | | | ✓ | 2 |
| 20 | **Dollar Exchange Rate** | | ✓ | | | | | | | | | | | | | | | ✓ | ✓ | **3** |
| 21 | **Consumer Confidence Index** | | | | | | | | | | | ✓ | | ✓ | | | | | ✓ | **3** |
| 22 | Fuel Oil Price | | | | ✓ | | | | | | | | | | | | | | | 1 |
| 23 | Total New Cars | | | | | | | | | | | | | | | | ✓ | | ✓ | 2 |
| 24 | Reel Sector Confidence Index | | | | | | | | | | | | | | | | | | ✓ | 1 |

Journal Description: 1: (Arsy 2021), 2: (Vahabi et al. 2016), 3: (Farahani et al. 2016), 4: (Sharma 2012), 5: (Tran 2018), 6 : (Fahrudin et al., 2021), 7: (Subramanian et al. 2020), 8: (Wisudawati et al. 2021), 9: (Sa-Ngasoongsong et al. 2012), 10: (Abu- Eisheh & Mannering, 2002), 11: (Wang et al. 2011), 12: (F. Muhammad et al. 2012), 13: (Kaya et al. 2019), 14: (Lu et al. 2017), 15: (Zhu et al. 2014), 16: (Fleurke 2017), 17: (Pai & Liu, 2018), 18: (Johan, 2020), 19: (Arslankaya & z 2018).

The literature studies' results found ten variables with at least three journals using these variables plus the COVID-19 variable. After the variables that affect demand based on literature studies are known, the next step is to determine the variables used as independent in this study. In determining the variables used in this study is the Delphi method of the 11 variables.

Based on the problems and issues in this research, the researcher selects and determines people who have experienced knowledge and pay attention to the problem areas and issues of this research. According to Delbecq et al. in Okoli et al. (2004), panel members can come from academics, practitioners, government, and non-governmental organizations. Next, the researcher approached and explained the aims and objectives to 8 panelists with different backgrounds.

From all the panelists above, the researcher sent a questionnaire to be filled out by the panelists. Separately, each panelist filled out their questionnaire without any influence from anyone. Of the ten variables found based on previous studies and the COVID-19 variable, the panelists were asked to provide their views whether they agree or disagree with each variable. Based on the questionnaires, the answers from the panelists are as follows in table 2.

Table 2. Delphi Method Questionnaire Results

| No | Variable | Panelist | | | | | | | | Total |
|---|---|---|---|---|---|---|---|---|---|---|
| | | P1 | P2 | P3 | P4 | P5 | P6 | P7 | P8 | |
| 1 | **National Car Sales** | ✓ | ✓ | ✓ | - | ✓ | ✓ | ✓ | ✓ | **7** |
| 2 | **Car Sales** | ✓ | ✓ | ✓ | - | ✓ | ✓ | ✓ | ✓ | **7** |
| 3 | GDP | - | - | ✓ | ✓ | ✓ | ✓ | ✓ | - | 5 |
| 4 | **Inflation Rate** | ✓ | - | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | **7** |
| 5 | Income per Capita | ✓ | - | ✓ | ✓ | ✓ | ✓ | ✓ | - | 6 |
| 6 | **Interest Rate** | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | **8** |
| 7 | **Consumer Price Index** | ✓ | - | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | **7** |
| 8 | Total Population | - | ✓ | ✓ | ✓ | - | - | - | - | 3 |
| 9 | Dollar Exchange Rate | ✓ | - | ✓ | ✓ | - | - | ✓ | - | 4 |
| 10 | **Consumer Confidence Index** | ✓ | ✓ | - | ✓ | ✓ | ✓ | ✓ | ✓ | **7** |
| 11 | **COVID-19** | ✓ | - | ✓ | ✓ | ✓ | ✓ | ✓ | ✓ | **7** |

From the results of the literature study on previous studies and the Delphi method process, it was found that six variables would be used as independent variables in this study. In determining the factors used in this study are the variables selected by seven panelists in the Delphi method. The seven selected variables are National Car Sales, Car Sales, Inflation Rate, Interest Rate, Consumer Price Index, Consumer Confidence Index, and COVID-19.

## 4. Data Collection

Dependent data in this study is data on medium prices sales of Toyota car models in Indonesia. The following table 3 is Toyota's medium prices sales data in Indonesia.

Table 3. Medium Prices Sales of Toyota Car Models in Indonesia

| Month | Total | Month | Total | Month | Total | Month | Total |
|---|---|---|---|---|---|---|---|
| Jan-18 | 6,293 | Oct-18 | 9,424 | Jul-19 | 5,120 | Apr-20 | 2,781 |
| Feb-18 | 7,337 | Nov-18 | 8,240 | Aug-19 | 6,287 | May-20 | 2,226 |
| Mar-18 | 7,955 | Dec-18 | 6,801 | Sep-19 | 6,501 | Jun-20 | 3,923 |
| Apr-18 | 6,334 | Jan-19 | 6,856 | Oct-19 | 6,884 | Jul-20 | 3,462 |
| May-18 | 7,002 | Feb-19 | 6,038 | Nov-19 | 6,796 | Aug-20 | 3,034 |
| Jun-18 | 3,699 | Mar-19 | 7,020 | Dec-19 | 6,323 | Sep-20 | 1,113 |
| Jul-18 | 8,731 | Apr-19 | 6,791 | Jan-20 | 5,185 | Oct-20 | 4,848 |
| Aug-18 | 8,101 | May-19 | 6,455 | Feb-20 | 7,047 | Nov-20 | 5,671 |
| Sep-18 | 7,939 | Jun-19 | 4,667 | Mar-20 | 6,356 | Dec-20 | 3,338 |

The independent variables have been defined: national car sales, Toyota sales, inflation rate, interest rates, consumer confidence index, and COVID-19 variables—furthermore, the process of collecting and processing data on independent variables. The data collected is monthly data from January 2018 to December 2020. The following are the results of data collection for each variable (Table 4 to 11).

1. Variable National Car Sales

Table 4. National Car Sales

| Month | Total | Month | Total | Month | Total | Month | Total |
|---|---|---|---|---|---|---|---|
| Jan-18 | 94,120 | Oct-18 | 93,632 | Jul-19 | 87,611 | Apr-20 | 24,275 |
| Feb-18 | 90,852 | Nov-18 | 98,002 | Aug-19 | 89,258 | May-20 | 17,083 |
| Mar-18 | 106,050 | Dec-18 | 109,480 | Sep-19 | 82,853 | Jun-20 | 29,858 |
| Apr-18 | 94,727 | Jan-19 | 87,555 | Oct-19 | 88,914 | Jul-20 | 35,799 |
| May-18 | 104,153 | Feb-19 | 81,293 | Nov-19 | 93,318 | Aug-20 | 37,654 |
| Jun-18 | 71,778 | Mar-19 | 91,115 | Dec-19 | 100,847 | Sep-20 | 43,357 |
| Jul-18 | 98,182 | Apr-19 | 80,622 | Jan-20 | 81,059 | Oct-20 | 46,131 |
| Aug-18 | 99,310 | May-19 | 93,881 | Feb-20 | 77,865 | Nov-20 | 56,102 |
| Sep-18 | 92,355 | Jun-19 | 65,750 | Mar-20 | 60,440 | Dec-20 | 69,139 |

2. Variable Toyota Sales

Table 5. Toyota Sales

| Month | Total | Month | Total | Month | Total | Month | Total |
|---|---|---|---|---|---|---|---|
| Jan-18 | 28,495 | Oct-18 | 28,622 | Jul-19 | 28,179 | Apr-20 | 8,443 |
| Feb-18 | 27,774 | Nov-18 | 30,533 | Aug-19 | 28,022 | May-20 | 6,727 |
| Mar-18 | 30,293 | Dec-18 | 35,107 | Sep-19 | 26,529 | Jun-20 | 11,196 |
| Apr-18 | 30,076 | Jan-19 | 25,248 | Oct-19 | 28,495 | Jul-20 | 11,531 |
| May-18 | 32,979 | Feb-19 | 23,226 | Nov-19 | 29,672 | Aug-20 | 11,057 |
| Jun-18 | 22,002 | Mar-19 | 27,608 | Dec-19 | 33,420 | Sep-20 | 12,523 |
| Jul-18 | 31,605 | Apr-19 | 26,611 | Jan-20 | 24,928 | Oct-20 | 13,466 |
| Aug-18 | 30,273 | May-19 | 31,871 | Feb-20 | 23,884 | Nov-20 | 17,908 |
| Sep-18 | 28,304 | Jun-19 | 22,123 | Mar-20 | 17,787 | Dec-20 | 23,215 |

3. Variable Inflation Rate

Table 6. Inflation Rate

| Month | Inflation | Month | Inflation | Month | Inflation | Month | Inflation |
|---|---|---|---|---|---|---|---|
| Jan-18 | 0.62 | Oct-18 | 0.28 | Jul-19 | 0.31 | Apr-20 | 0.08 |
| Feb-18 | 0.17 | Nov-18 | 0.27 | Aug-19 | 0.12 | May-20 | 0.07 |
| Mar-18 | 0.20 | Dec-18 | 0.62 | Sep-19 | -0.27 | Jun-20 | 0.18 |
| Apr-18 | 0.10 | Jan-19 | 0.32 | Oct-19 | 0.02 | Jul-20 | -0.10 |
| May-18 | 0.21 | Feb-19 | -0.08 | Nov-19 | 0.14 | Aug-20 | -0.05 |
| Jun-18 | 0.59 | Mar-19 | 0.11 | Dec-19 | 0.34 | Sep-20 | -0.05 |
| Jul-18 | 0.28 | Apr-19 | 0.44 | Jan-20 | 0.39 | Oct-20 | 0.07 |
| Aug-18 | -0.05 | May-19 | 0.68 | Feb-20 | 0.28 | Nov-20 | 0.28 |
| Sep-18 | -0.18 | Jun-19 | 0.55 | Mar-20 | 0.10 | Dec-20 | 0.45 |

4. Variable Interest Rates

Table 7. Interest Rates

| Month | Interest | Month | Interest | Month | Interest | Month | Interest |
|---|---|---|---|---|---|---|---|
| Jan-18 | 4.25 | Oct-18 | 5.75 | Jul-19 | 5.75 | Apr-20 | 4.5 |
| Feb-18 | 4.25 | Nov-18 | 6 | Aug-19 | 5.55 | May-20 | 4.5 |
| Mar-18 | 4.25 | Dec-18 | 6 | Sep-19 | 5.25 | Jun-20 | 4.25 |
| Apr-18 | 4.25 | Jan-19 | 6 | Oct-19 | 5 | Jul-20 | 4 |
| May-18 | 4.5 | Feb-19 | 6 | Nov-19 | 5 | Aug-20 | 4 |
| Jun-18 | 5.25 | Mar-19 | 6 | Dec-19 | 5 | Sep-20 | 4 |
| Jul-18 | 5.25 | Apr-19 | 6 | Jan-20 | 5 | Oct-20 | 4 |
| Aug-18 | 5.5 | May-19 | 6 | Feb-20 | 4.75 | Nov-20 | 3.75 |
| Sep-18 | 5.75 | Jun-19 | 6 | Mar-20 | 4.5 | Dec-20 | 3.75 |

5. Variable Consumer Confidence Index

Table 8. Consumer Confidence Index

| Month | CCI | Month | CCI | Month | CCI | Month | CCI |
|---|---|---|---|---|---|---|---|
| Jan-18 | 126.1 | Oct-18 | 119.2 | Jul-19 | 124.8 | Apr-20 | 84.8 |
| Feb-18 | 122.5 | Nov-18 | 122.7 | Aug-19 | 123.1 | May-20 | 77.8 |
| Mar-18 | 121.6 | Dec-18 | 127.0 | Sep-19 | 121.8 | Jun-20 | 83.8 |
| Apr-18 | 122.2 | Jan-19 | 125.5 | Oct-19 | 118.4 | Jul-20 | 86.2 |
| May-18 | 125.1 | Feb-19 | 125.1 | Nov-19 | 124.2 | Aug-20 | 86.9 |
| Jun-18 | 128.1 | Mar-19 | 124.5 | Dec-19 | 126.4 | Sep-20 | 83.4 |
| Jul-18 | 124.8 | Apr-19 | 128.1 | Jan-20 | 121.7 | Oct-20 | 79.0 |
| Aug-18 | 121.6 | May-19 | 128.2 | Feb-20 | 117.7 | Nov-20 | 92.0 |
| Sep-18 | 122.4 | Jun-19 | 126.4 | Mar-20 | 113.8 | Dec-20 | 96.5 |

6. Variable Consumer Price Index

Table 9. Consumer Price Index

| Month | CPI | Month | CPI | Month | CPI | Month | CPI |
|---|---|---|---|---|---|---|---|
| Jan-18 | 132.1 | Oct-18 | 134.2 | Jul-19 | 138.59 | Apr-20 | 104.8 |
| Feb-18 | 132.32 | Nov-18 | 134.56 | Aug-19 | 138.75 | May-20 | 104.87 |
| Mar-18 | 132.58 | Dec-18 | 135.39 | Sep-19 | 138.37 | Jun-20 | 105.06 |
| Apr-18 | 132.71 | Jan-19 | 135.83 | Oct-19 | 138.4 | Jul-20 | 104.95 |
| May-18 | 132.99 | Feb-19 | 135.72 | Nov-19 | 138.6 | Aug-20 | 104.9 |
| Jun-18 | 133.77 | Mar-19 | 135.87 | Dec-19 | 139.07 | Sep-20 | 104.85 |
| Jul-18 | 134.14 | Apr-19 | 136.47 | Jan-20 | 104.33 | Oct-20 | 104.92 |
| Aug-18 | 134.07 | May-19 | 137.4 | Feb-20 | 104.62 | Nov-20 | 105.21 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Sep-18 | 133.83 | Jun-19 | 138.16 | Mar-20 | 104.72 | Dec-20 | 105.68 |

6. Variable COVID-19
Each variable required data from 2018 to 2020 to know the conditions before and during the COVID-19 pandemic in Indonesia. PSBB or PPKM impacts the total number of long-distance train passengers and foreign tourists to Indonesia. Both of these data are used as surrogate data, which retains the properties of the original data (Table 10-11).

Table 10. Long-distance Train Passengers

| Month | Total | Month | Total | Month | Total | Month | Total |
|---|---|---|---|---|---|---|---|
| Jan-18 | 34,717 | Oct-18 | 36,236 | Jul-19 | 39,035 | Apr-20 | 5,898 |
| Feb-18 | 31,278 | Nov-18 | 35,298 | Aug-19 | 35,189 | May-20 | 5,484 |
| Mar-18 | 35,875 | Dec-18 | 37,965 | Sep-19 | 35,221 | Jun-20 | 9,290 |
| Apr-18 | 35,754 | Jan-19 | 35,122 | Oct-19 | 36,448 | Jul-20 | 12,238 |
| May-18 | 35,482 | Feb-19 | 31,899 | Nov-19 | 35,877 | Aug-20 | 12,774 |
| Jun-18 | 33,030 | Mar-19 | 35,751 | Dec-19 | 37,463 | Sep-20 | 11,429 |
| Jul-18 | 36,800 | Apr-19 | 35,809 | Jan-20 | 34,130 | Oct-20 | 11,937 |
| Aug-18 | 35,190 | May-19 | 35,102 | Feb-20 | 32,283 | Nov-20 | 13,722 |
| Sep-18 | 34,504 | Jun-19 | 35,090 | Mar-20 | 23,425 | Dec-20 | 13,515 |

Table 11. Foreign Tourists to Indonesia

| Month | Total | Month | Total | Month | Total | Month | Total |
|---|---|---|---|---|---|---|---|
| Jan-18 | 1,097,839 | Oct-18 | 1,291,605 | Jul-19 | 1,468,173 | Apr-20 | 158,066 |
| Feb-18 | 1,197,503 | Nov-18 | 1,157,483 | Aug-19 | 1,530,268 | May-20 | 161,842 |
| Mar-18 | 1,363,426 | Dec-18 | 1,405,554 | Sep-19 | 1,388,719 | Jun-20 | 156,561 |
| Apr-18 | 1,302,321 | Jan-19 | 1,201,735 | Oct-19 | 1,346,434 | Jul-20 | 155,742 |
| May-18 | 1,242,705 | Feb-19 | 1,243,996 | Nov-19 | 1,280,781 | Aug-20 | 161,549 |
| Jun-18 | 1,322,674 | Mar-19 | 1,311,911 | Dec-19 | 1,377,067 | Sep-20 | 148,984 |
| Jul-18 | 1,547,231 | Apr-19 | 1,274,231 | Jan-20 | 1,290,411 | Oct-20 | 152,293 |
| Aug-18 | 1,511,021 | May-19 | 1,249,536 | Feb-20 | 872,765 | Nov-20 | 144,476 |
| Sep-18 | 1,370,943 | Jun-19 | 1,434,103 | Mar-20 | 486,155 | Dec-20 | 164,079 |

## 5. Results and Discussion

This research uses IBM SPSS carried out includes 3 parts, namely classic assumption test, model feasibility test, and model interpretation test. Classical assumption tests were performed to determine the variables used for multiple linear regression models, such as multicollinearity, autocorrelation, linearity, heteroscedasticity, and residual normality. Based on multicollinearity test, the variables with VIF<10 are inflation, interest rates, and CPI. Then other than the three variables will be excluded (Figure 3).

**Coefficients[a]**

| Model | | Unstandardized Coefficients | | Standardized Coefficients | | | 95.0% Confidence Interval for B | | Correlations | | | Collinearity Statistics | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | t | Sig. | Lower Bound | Upper Bound | Zero-order | Partial | Part | Tolerance | VIF |
| 1 | (Constant) | 1654.499 | 4704.899 | | .352 | .728 | -7999.155 | 11308.153 | | | | | |
| | National_Sales | .077 | .058 | 1.001 | 1.314 | .200 | -.043 | .197 | .826 | .245 | .130 | .017 | 59.587 |
| | Toyota_Sales | -.025 | .181 | -.100 | -.137 | .892 | -.397 | .347 | .802 | -.026 | -.013 | .018 | 54.813 |
| | Inflation | -1565.649 | 1063.067 | -.191 | -1.473 | .152 | -3746.883 | 615.584 | .084 | -.273 | -.145 | .581 | 1.720 |
| | Interest_Rates | 542.269 | 399.443 | .220 | 1.358 | .186 | -277.321 | 1361.859 | .494 | .253 | .134 | .371 | 2.696 |
| | CCI | -18.106 | 52.108 | -.161 | -.347 | .731 | -125.023 | 88.810 | .728 | -.067 | -.034 | .046 | 21.949 |
| | Train | .080 | .119 | .456 | .673 | .507 | -.164 | .325 | .776 | .128 | .066 | .021 | 47.205 |
| | Tourists | -.001 | .002 | -.333 | -.682 | .501 | -.005 | .002 | .724 | -.130 | -.067 | .041 | 24.485 |
| | CPI | -19.732 | 31.505 | -.151 | -.626 | .536 | -84.374 | 44.911 | .646 | -.120 | -.062 | .167 | 5.993 |

a. Dependent Variable: Medium

Figure 2. Multiple Linear Regression Analysis

The results of the analysis carried out are shown in Figure 4.

**Coefficients[a]**

| Model | | Unstandardized Coefficients | | Standardized Coefficients | | | 95.0% Confidence Interval for B | | Correlations | | | Collinearity Statistics | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | B | Std. Error | Beta | t | Sig. | Lower Bound | Upper Bound | Zero-order | Partial | Part | Tolerance | VIF |
| 1 | (Constant) | -4802.955 | 2226.745 | | -2.157 | .039 | -9338.685 | -267.224 | | | | | |
| | Inflation | -431.972 | 1134.745 | -.053 | -.381 | .706 | -2743.373 | 1879.428 | .084 | -.067 | -.051 | .945 | 1.058 |
| | Interest_Rates | 203.244 | 472.563 | .082 | .430 | .670 | -759.334 | 1165.823 | .494 | .076 | .058 | .491 | 2.037 |
| | CPI | 78.051 | 24.827 | .598 | 3.144 | .004 | 27.479 | 128.623 | .646 | .486 | .422 | .498 | 2.008 |

a. Dependent Variable: Medium

Figure 4. Results

The model is feasible to use with the following equation.

$$y = -4{,}802.955 - 431.972(x_1) + 203.244(x_2) + 78.051(x_3) \quad (6)$$

Where: $\mathbf{x_1}$= inflation, $\mathbf{x_2}$= interest rates, $\mathbf{x_3}$= customer price index

### 5.1 Numerical Results

The following table 12 are the results of forecasting with multiple linear regression equation models with error calculations.

Table 12. Results of Forecasting

| Month | Actual | Forecasting | MAPE | MSE | RMSE | MAE |
|---|---|---|---|---|---|---|
| **Jan-21** | 3,910 | 5,019 | 28.36% | 1,229,739.87 | 1,108.94 | 1,108.94 |
| **Feb-21** | 4,688 | 5,135 | 9.53% | 199,391.38 | 446.53 | 446.53 |
| **Mar-21** | 4,251 | 5,115 | 20.32% | 745,809.62 | 863.60 | 863.60 |
| **Apr-21** | 7,265 | 5,069 | 30.23% | 4,823,494.47 | 2,196.25 | 2,196.25 |
| **May-21** | 5,467 | 5,013 | 8.30% | 206,102.14 | 453.98 | 453.98 |
| **Jun-21** | 5,944 | 5,976 | 0.54% | 1,024.53 | 32.01 | 32.01 |
| **Jul-21** | 5,445 | 5,091 | 6.49% | 124,964.43 | 353.50 | 353.50 |
| **Aug-21** | 7,748 | 5,125 | 33.86% | 6,881,655.83 | 2,623.29 | 2,623.29 |
| **Sep-21** | 6,018 | 5,143 | 14.54% | 766,101.07 | 875.27 | 875.27 |
| **Oct-21** | 8,272 | 5,998 | 27.49% | 5,171,333.56 | 2,274.06 | 2,274.06 |
| **Nov-21** | 6,676 | 5,927 | 11.22% | 560,984.30 | 748.99 | 748.99 |
| **Dec-21** | 9,783 | 5,824 | 40.47% | 15,672,743.68 | 3,958.88 | 3,958.88 |
| **Average Error** | | | **19.28%** | **3,031,945.41** | **1,327.94** | **1,327.94** |

### 5.2 Graphical Results

The following are the graphical results of forecasting with multiple linear regression equation models (figure 5).

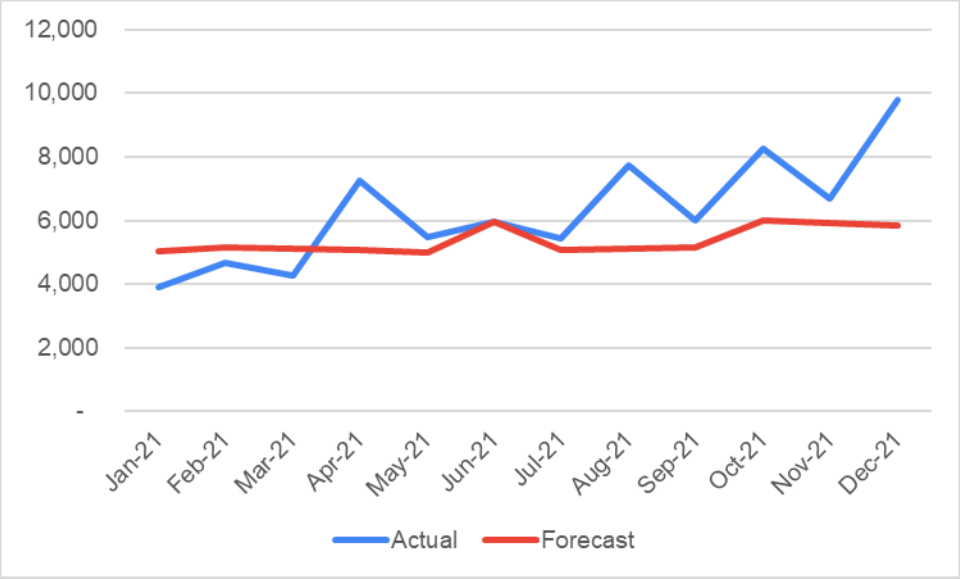


Figure 5. Graphical Results

## 6. Conclusion

Based on the analysis above there are several conclusions from this study:

1. Seven variable have been found influenced the demand for Toyota in Indonesia, i.e. the National Car Sales, Toyota Sales, Inflation Rate, Interest Rates, Consumer Confidence Index, Consumer Price Index and COVID-19 (Figure 6).

**Model Summary[b]**

| Model | R | R Square | Adjusted R Square | Std. Error of the Estimate | Change Statistics | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | R Square Change | F Change | df1 | df2 | Sig. F Change | Durbin-Watson |
| 1 | .650[a] | .423 | .369 | 1532.631 | .423 | 7.818 | 3 | 32 | .000 | 1.347 |

a. Predictors: (Constant), IHK, Inflasi, Suku_Bunga

b. Dependent Variable: Medium

Figure 6. Model Summary

2. Regarding adjusted r square = 36.9%, it can be said that the independent variable can explain the variability of the model by 36.9%, and other variables outside the model explain the rest.
3. After classical assumption tests such as multicollinearity, autocorrelation, linearity, heteroscedasticity, and residual normality. It obtained four independent variables that passed the test with the best model, such as national sales, Toyota sales, inflation rate, and interest rates with resulted model

$$y = -4{,}802.955 - 431.972(x_1) + 203.244(x_2) + 78.051(x_3)$$

4. Forecasting error of multiple linear regression is 19.28%.

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