
Projection Growth Two-Wheeled Vehicles at PT. Eternal Desire of Representatives Your fame With Use Equality Differential Growth Model Population Continuous (Exponential Model and Logistic Model)

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Abstract

This research explains how to determine the growth model for two-wheeled vehicles entered and sold at PT. Hasjrat Abadi, representative of Kefamenanu. The author uses data obtained from PT. Hasjrat Abadi representing Kefamenanu from 2019 – 2022. This research aims to apply the Differential Equation model Continuous Exponential Model and Logistic Model which are used to predict the growth rate of two-wheelers entered and sold at PT. Eternal Passion of the Ministry of Famennanu Representative . The results of this research show that the exponential III model is the most accurate for predicting the number of vehicles in 2025 in the form of a $P(t) = 217 e^{0,214516746t} = 786$ vehicle equation with a relative growth rate of 21% for incoming vehicles while $P(t) = 193 e^{0,211487893t} = 687$ vehicles with a relative growth rate of 21% per year. In the logistic model, the logistic model I is the most accurate for predicting the number of vehicles coming in and sold in 2025 which will be as many 487 vehicles coming in as the number of vehicles being sold while the number of vehicles being sold 440. Based on the calculation results of the two models, which has the smallest *error* (the best model) in predicting the number of two-wheeled vehicles entered and sold at PT. The Kefamenanu Representative's eternal desire in 2025 is a logistics model.

Keywords: Vehicle Estimation, Exponential Model, Logistic Model.



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1. INTRODUCTION

Growth such residents _ rapidly in the area urban push enhancement user means transportation land. This matter happen Because growth the population that caused it happen enhancement activity. Everyone will _ race (compete) for get opportunity so that needed support in the field communication and transportation like vehicle motorized (Kurniawan Kelen and Sikas, 2019) .

Need will transportation increase along with increasing growth economics, p This cause need will vehicles also increased. Request sufficient society _ tall will means transportation cause Lots its founding companies operating in the field __ provision vehicle transportation (Wardani, 2010) .

One of the Yamaha distributors in Indonesia is the official dealer PT. Hasjrat Abadi representative Famenanu . PT. Hasjrat Abadi is one of them companies in the field automotive largest in Indonesia. PT. Hasjrat Abadi holds company cars and motorbikes, namely Toyota and Yamaha. PT. Eternal Hasjrat has image quality brands and products _ so that capable competing in the automotive world , seen from facet many vehicles on the road the output highway from Toyota and Yamaha. PT. Kefamenanu's Eternal Desires is one of issuing branch _ lots of motorbikes for Yamaha users in Kefamenanu City North Central Timor Regency (TTU).

Based on data from the Central Statistics Agency (BPS) of TTU Regency , that amount vehicle two - wheelers from 39,004 vehicles in 2020 continues increase become 40,355 Vehicles in 2022. With _ exists matter This We need something method For predict growth several vehicles in TTU Regency next year _ come in form a mathematical model .

According to Murray (2011) Mathematical models can applied in life real is modeling with equality differential especially population models continuous . The mathematical model will used For projecting population is a growth model population continuous including exponential models and logistic models with objective For estimate amount vehicle two wheels entered and sold to PT. Hasjrat Abadi representative Famenanu . Equality differential hold role important in engineering , physics , science economics and various type discipline knowledge . Equality differential appear in various field science and technology , relationships deterministic involving _ changed quantity _ in a way continuous modeled by functions math and speed the change stated as derivative is known or postulated (Ibnas . R, 2017).

A number of mathematical models about estimation amount population has discussed by researchers previously . Mathematical model about growth resident East Nusa Tenggara (NTT) Province has discussed by (Diki, 2022). Mathematical model For estimate amount residents in Bandar Lampung City from 2010 – 2015 has been discussed by Nuraini (2018). Mathematical model For predict level growth car personal wheel four (black plates) Manado City has discussed by Hala *et.al* , (2016).

2. METHOD

Study This If seen from level the explanation including to in type study descriptive with approach qualitative. The purpose of exists study descriptive is describe incident at some point incident . The purpose of study This is For describe application equality differential population models



continuous in estimation vehicle two wheels at PT. Hasjrat Abadi representative Your fame TTU Regency.

Steps _ For count results estimation vehicle two wheels entered and sold to PT. Eternal Desire of Representatives Your fame use application equality differential population models continuous among others:

- 1) Collect data related to the field to be researched, namely regarding continuous population model differential equations and data on the number of two-wheeled vehicle populations in 2019 - 2022.
- 2) From the formulation of differential equations for the logistic model and exponential model, the researchers then formed mathematical modeling from data on the number of vehicle populations.
- 3) Calculating the estimation results for two-wheeled vehicles at PT. Hasjrat Abadi, a representative of Kefamenanu, uses an exponential model differential equation with a special solution form $P(t) = P_0 e^{kt}$
- 4) Calculating the estimation results for two-wheeled vehicles at PT. Hasjrat Abadi, a representative from Kefamenanu, used a differential equation logistic model with a special solution form $P(t) = \frac{K}{e^{-kt}(\frac{K}{P_0}-1)+1}$.
- 5) The final step, the researchers compared the accuracy of the vehicle estimation results calculated using the exponential model and the logistic model by comparing the data results that were close to the smallest error with the actual data to predict the number of two-wheeled vehicles at PT. Hasjrat Abadi representative Kefamenanu in 2025 .

3. RESULTS AND DISCUSSION

3.1 Quantity Data Vehicles at PT. Eternal Desire of Representatives Your fame

Quantity data vehicle two wheels at PT. The eternal wishes of Kefamenanu Representatives can be presented in Table 1.

Table 1. Data on the number of vehicles entered and sold at PT. Hasjrat Abadi Kefamenanu Representative in 2019 – 2022.

Year	Amount Incoming Vehicles	Amount Vehicles Sold _
2019	217	193
2020	283	254
2021	345	312
2022	413	364

Source : PT. Eternal Desire of Representatives Your fame

Based on the data in the table above amount vehicle two wheels at PT. Eternal Desire of Representatives Your fame always experience enhancement amount vehicle every the year .



3.2 Count Amount Two-Wheeled Vehicles Entered by PT. Eternal Desire of Kefamenanu Representatives with an Exponential Model

Completing the exponential population model with data on the number of two-wheeled vehicles is assumed first $t = 0$ and $P(0) = 217$ then we obtain the solution of the exponential model with k different intrinsic rates (values), the general form of the solution is:

$$P(t) = P_0 e^{kt} \quad (1)$$

Substitution $P(0) = 217$ to equation (4.2) becomes $P(t) = 217 e^{kt}$.

Overall, there are three exponential models with different intrinsic rates that will be used to estimate the number of two-wheeled vehicles entering PT. Hasjrat Abadi Kefamenanu Representative from 2019 to 2022. The following are the results of the exponential model including:

- 1) Exponential Model I, form the equation : $P(t) = 217 e^{0,2655495448t}$
with rate growth relative is 26% per year .
- 2) Exponential Model II, form the equation : $P(t) = 217 e^{0,231823532t}$
with rate growth relative is 23% per year .
- 3) Exponential Model III, form the equation : $P(t) = 217 e^{0,214516746t}$
with rate growth relative is 21% per year .

After knowing the form of the equation for each exponential model from model I to model III with relative growth rates of 26%, 23% and 21%. Then a comparison was made between the number of two-wheeled vehicles entering PT. Kefamenanu Representative Hasjrat Abadi between the actual data and the results of the exponential model. The comparison is presented in Table 2.

Table 2 Calculation Results of the Number of Two-Wheeled Vehicles Entering PT. Eternal Desire of Representatives Your fame with the Exponential Model .

Year	Actual data	Exponential Model			Error (Percentage)		
		Model I	Model II	Model III	Model I	Model II	Model III
2019	217	217	217	217	0%	0%	0%
2020	283	283	274	269	0%	0.032%	0.049%
2021	345	369	345	333	0.070%	0%	0,032%
2022	413	481	435	413	0,16%	0,053%	0%
$\Sigma Galat/n$					0,058%	0,021%	0,020%

Based on Table 4.2 results calculation from the three exponential models that have error smallest or closest to it results census is an exponential model III of 0.20%. Therefore _ that's the best model is an exponential III model with rate intrinsic $k = 0,214516746$ or can write $P(t) = 217 e^{0,214516746t}$ so we can conclude that the population model Exponential III is one of the best models For predict amount vehicle two wheels at PT. Eternal Desire of Representatives Your fame 2025 will be come namely : $P(t) = 217 e^{0,214516746t} = 786$ vehicles. As for the quantity diagram



description vehicle between actual data results and exponential model results is displayed in form Figure 1.

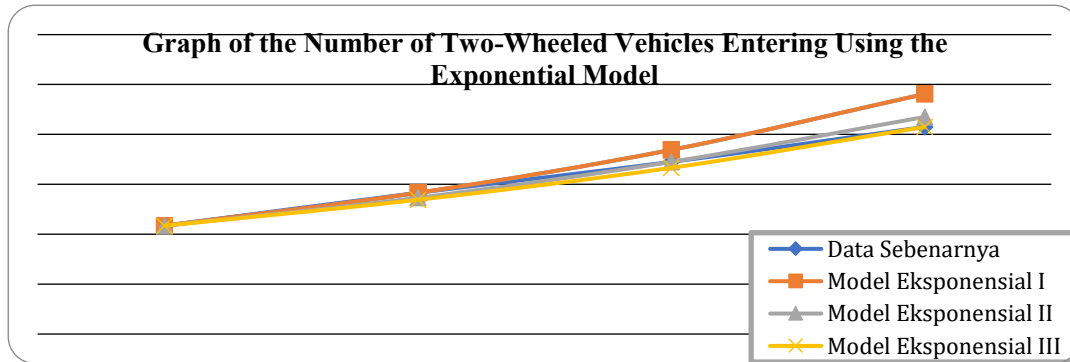


Figure 1. Graph of the Number of Incoming Two-Wheeled Vehicles Based on PT Data. Eternal Desire of Representatives Your fame with the Exponential Model .

3.3 Count Amount Two-Wheeled Vehicles Entered by PT. Eternal Desire of Kefamenanu Representatives with a Logistics Model

The initial step to complete the logistic population model from two-wheeled vehicle data at PT. Hasjrat Abadi, representative of Kefamenanu for 2019 – 2022, first determine the value K (capacity), then determine the value k (population growth rate) of each census result to form a logistic population model equation.

The value K can be searched using the formula:

$$K = \frac{P_1(P_1P_0 - 2P_0P_2 + P_1P_2)}{P_1^2 - P_0P_2} \quad (2)$$

Information :

K =Capacity (*Carrying capacity*)

P_0 =Preliminary Population Numbers in 2019

P_1 =Total Population in 2020

P_2 =Total Population in 2021



Microsoft Excel calculations, the value or capacity of two-wheeled vehicles entering PT is obtained . 504,68Hasjrat Abadi, representative of Kefamenanu, so that $P(0)$ the and values K are substituted into the solution of the logistic population model equation as follows:

$$P(t) = \frac{K}{e^{-kt\left(\frac{K}{P_0}-1\right)+1}} = \frac{504,68}{e^{-kt\left(\frac{504,68}{217}-1\right)+1}} \quad (3)$$

Overall , there are three logistics models with different intrinsic rates that will be used to estimate the number of two-wheeled vehicles entering PT. Hasjrat Abadi Kefamenanu Representative from 2019 to 2022. The following are the results of the logistic model including:

- Logistic Model I, form the equation : $P(t) = \frac{504,68}{e^{-(0,51616339)t(1,325714286)+1}}$, with a relative growth rate of around 51%.
- Logistic Model II, Equation form: $P(t) = \frac{504,68}{e^{-(0,5261620012)t(1,325714286)+1}}$, with a relative growth rate of 52%.
- Logistics Model III, equation form: $P(t) = \frac{504,68}{e^{-(0,595698246)t(1,325714286)+1}}$, with a relative growth rate of 59%.

Based on the three models obtained, and the number of vehicles in Table 4.1, an estimate of the number of vehicles can be calculated using logistics model I to logistics model III, then you can see the comparison of the number of incoming vehicles with the estimated number of two-wheeled vehicles at PT. Hasjrat Abadi Kefamenanu Representatives from 2019 - 2022 in Table 3.

Table 3. Calculation Results of the Number of Two-Wheeled Vehicles Entering PT. Eternal Desire of Representatives Your fame with a Logistics Model .

Year	Actual data	Logistics Model			Error (Percentage)		
		Model I	Model II	Model III	Model I	Model II	Model III
2019	217	217	217	217	0%	0%	0%
2020	283	283	282	292	0%	0,0035%	0,032%
2021	345	345	345	360	0%	0%	0,044%
2022	413	396	396	413	0,041%	0,041%	0%
$\Sigma Galat/n$					0,010%	0,011%	0,012%

From the calculation results in Table 3, it can be seen that the logistic model that has the smallest average error is in logistic model I of 0.010% with an intrinsic rate. $k = 0,51616339$ or it can be written: $P(t) = \frac{504,68}{e^{-(0,51616339)t(1,325714286)+1}}$. So it can be concluded that the logistic population model I is one of the best models, to predict the number of two-wheeled vehicles entering



PT. Hasjrat Abadi representing Kefamenanu in 2025, namely: $P(6) = \frac{504,68}{e^{-(0,52616339)(6)(1,325714286)+1}} = 487$. The results of the logistic model are displayed in Figure 2.

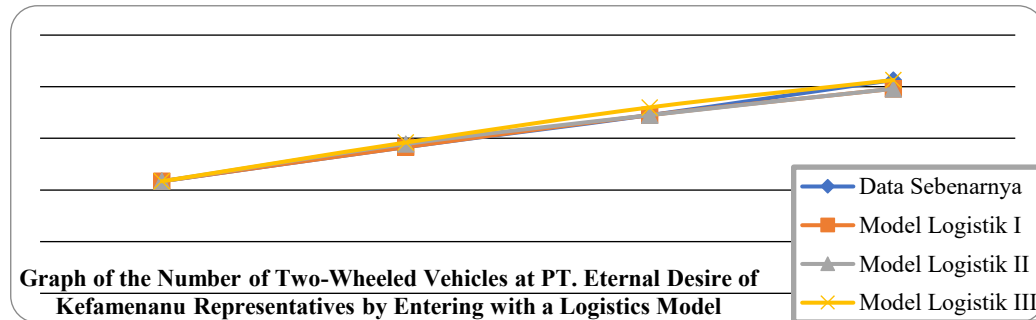


Figure 2. Graph of the number of incoming two-wheeled vehicles based on data from PT. Eternal Desire of Representatives with a Logistics Model

3.4 Count Amount Two-Wheeled Vehicles Sold to PT. Eternal Desire of Kefamenanu Representatives with an Exponential Model

Completing the population model exponential with quantity data vehicle two wheels are assumed moreover formerly $t = 0$ and $P(0) = 193$ then we get the solution of the exponential model with k different intrinsic rates (values), the general form of the solution is:

$$P(t) = P_0 e^{kt} \quad (4)$$

Substitution $P(0) = 193$ to equation (4.2) becomes

$$P(t) = 193 e^{kt}$$

By overall there is three exponential models with rate different intrinsic that will be used to do estimation amount vehicle two-wheeled vehicles that enter PT. Eternal Desire of Representatives Your fame from 2019 to 2022. Following This is results from the exponential model including :

- Exponential Model I, form the equation : $P(t) = 193e^{0,27464408t}$ with rate growth relative is 27% per year .
- Exponential Model II, form the equation : $P(t) = 193 e^{0,240156499t}$ with rate growth relative is 24% per year .
- Exponential Model III, form the equation : $P(t) = 193e^{0,211487893t}$ with rate growth relative is 21% per year

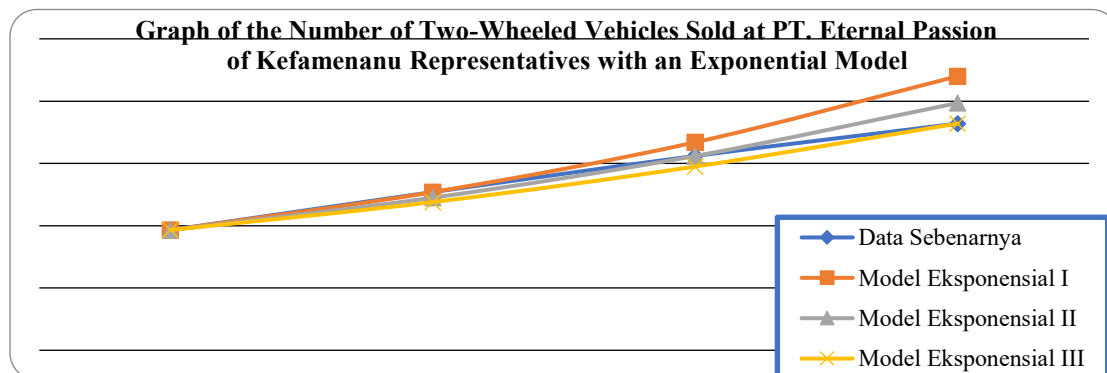
After is known form equality For any exponential model from model I to model III with rate body the relative values are 27%, 24% and 21%. Then done comparison between amount vehicle two-wheeled wheels sold to PT. Passionate Eternal Representative Your fame with actual data with exponential model results . As for the comparison served in form Table 4.



Table 4. Calculation Results Amount Two-Wheeled Vehicles Sold to PT. Eternal Desire of Representatives Your fame with the Exponential Model .

Year	Actual Data _	Exponential Model			Error (Percentage)		
		Model I	Model II	Model III	Model I	Model II	Model III
2019	193	193	193	193	0%	0%	0%
2020	254	254	245	238	0%	0,035%	0,063%
2021	312	334	312	295	0,071%	0%	0,055%
2022	364	440	397	364	0,21%	0,091%	0%
$\sum Galat/n$					0,070%	0,032%	0,030%

Based on Table 4 results calculation from the three exponential models that have error smallest or closest to it actual data results is an exponential model III of 0.030%. Therefore _ that's the best model is an exponential III model with rate intrinsic $k = 0,211487893$ or can be written: $P(t) = 193 e^{0,211487893t}$ so we can conclude that the exponential population model III is one of the best models for predicting the number of vehicles sold at PT. Abadi's future desires for 2025 are: $P(t) = 193 e^{0,211487893(6)} = 687$ vehicles. So results calculation amount vehicle two wheels sold to PT. Hasjrat Abadi representative Your fame 2025 using a population model Exponential III is estimated reach 687 vehicle. The diagrammatic depiction of the number of vehicles between the actual data results and the exponential model results is shown in Figure 3.

**Figure 3.** Chart Amount Two-Wheeled Vehicles Sold Based on PT data. Eternal Desire of Representatives Your fame with the Exponential Model .

3.5 Count Amount Two-Wheeled Vehicles Sold to PT. Eternal Desire of Kefamenanu Representatives with a Logistics Model

The initial step to complete the logistic population model from two-wheeled vehicle data at PT. Hasjrat Abadi, representative of Kefamenanu for 2019 – 2022, first determines the value K (capacity capacity), then determines the value k (population growth rate) of each census result to form a logistic population model equation.

The value K can be found using the formula in equation (2). So, using *Microsoft Excel* calculations, the value 462,99 or capacity of two-wheeled vehicles sold to PT is obtained. Hasjrat Abadi,



representative of Kefamenanu, so that $P(0)$ and values K are substituted into the solution of the logistic population model equation as follows:

$$P(t) = \frac{K}{e^{-kt\left(\frac{K}{P_0}-1\right)+1}} = \frac{462,99}{e^{-kt\left(\frac{462,99}{193}-1\right)+1}} \quad (5)$$

Overall, there are three logistics models with different intrinsic rates that will be used to estimate the number of two-wheeled vehicles sold at PT. Hasjrat Abadi Kefamenanu Representative from 2019 to 2022. The following are the results of the logistic model including:

- 1) Logistic Model I, form the equation : $P(t) = \frac{462,99}{e^{-(0,530742595)t}(1,398911917)+1}$, with rate growth relative around 53%.
- 2) Logistic Model II, Equation form: $P(t) = \frac{462,99}{e^{-(0,53742155)t}(1,398911917)+1}$, with a relative growth rate of 54%.
- 3) Logistics Model III, the form of the equation: $P(t) = \frac{462,99}{e^{-(0,545943255)t}(1,398911917)+1}$, with a relative growth rate of 55%.

Based on the three models obtained, and the number of vehicles in Table 4.1.1, an estimate of the number of vehicles can be calculated using logistics model I to logistics model III, then you can see the comparison of the number of incoming vehicles with the estimated number of two-wheeled vehicles at PT. Hasjrat Abadi Kefamenanu Representative from 2019 - 2022 in Table 5.

Table 5. Calculation Results of the Number of Two-Wheeled Vehicles Sold at PT. Eternal Desire of Representatives Your fame with a Logistics Model .

Year	Actual Data	Logistics Model			Error (Percentage)		
		Model I	Model II	Model III	Model I	Model II	Model III
2019	193	193	193	193	0%	0%	0%
2020	254	254	223	256	0%	0.12%	0.0079%
2021	312	312	312	315	0%	0%	0,0096%
2022	364	360	360	364	0,011%	0,011%	0%
$\sum Galat/n$					0,003%	0,031%	0,004%

calculation results in Table 5 can be obtained is known that the logistic model has an average error smallest is in the logistic model I of 0.003% with rate intrinsic $k = 0,530742595$ or it can be written: $P(t) = \frac{462,99}{e^{-(0,530742595)t}(1,398911917)+1}$, So can We conclude that population model Logistics I is one of the best models, for predict amount vehicle two wheels sold to PT. Hasjrat



Abadi representative Famenanu in the coming year come , namely $\therefore P(6) = \frac{462,99}{e^{-(0,530742595)(6)(1,398911917)+1}} = 440$ _

Thus, the results of calculating the number of two-wheeled vehicles sold at PT. Hasjrat Abadi, representative of Kefamenanu , in 2025 using the logistic population model I is estimated to reach 440 vehicles. The results of the logistic model are shown in Figure 4.

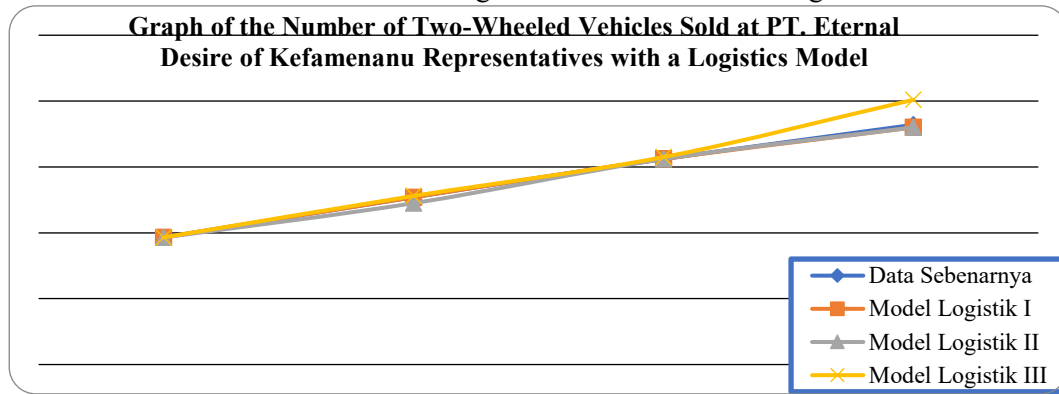


Figure 4. Graph of Number of Two-Wheeled Vehicles Sold Based on Data from PT. Eternal Desire of Representatives with a Logistics Model

3.6 Comparison Amount Two-Wheeled Vehicles Included Among the Actual Data Results With Exponential Models and Logistic Models

Below are displayed the results of calculations for vehicles entering PT. Hasjrat Abadi Kefamenanu Representative uses the exponential model and logistic model as in Table 6.

Table 6. Comparison of data from estimates of the number of vehicles entering PT. Eternal Hasjrat Kefamenanu Representatives with Exponential Models and Logistic Models.

Year	Actual Data	Exponential Model III	Logistic Model I	Error (Percentage)	
				Exponential Model III	Logistic Model I
2019	217	217	217	0%	0%
2020	283	269	283	0.049%	0%
2021	345	333	345	0.032%	0%
2022	413	413	396	0%	0,041%
$\Sigma Galat/n$				0,020%	0,010%

Based on Table 6 comparison *Mean Absolute Percentage Error* (MAPE) is the average value obtained exponential model error III is 0.020% , meanwhile mark Logistic model I error is 0.010%. Following This graphic that presents comparison amount Vehicle incoming two -wheeler between actual data results with The results of exponential model III and logistic model I are as in Figure 5.



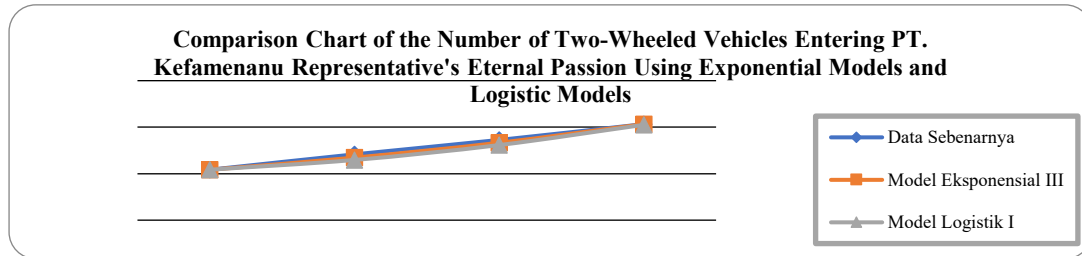


Figure 5. Comparison graph of the number of incoming two-wheeled vehicles based on data from PT. Eternal Hasjrat Kefamenanu Representatives with Exponential Models and Logistic Models.

3.7 Comparison Amount Two-Wheeled Vehicles Sold Between Actual Data Results With Exponential Models and Logistic Models

Following is displayed results comparison amount vehicle wheel two ones sold to PT. Hasjrat Abadi Kefamenanu Representative uses the exponential model and logistic model as in Table 7.

Table 7. Comparison of Estimation Data Amount Vehicles sold to PT . Eternal Hasjrat Kefamenanu Representatives with Exponential Models and Logistic Models.

Year	Actual Data	Exponential Model III	Logistic Model I	Error (Percentage)	
				Exponential Model III	Logistic Model I
2019	193	193	193	0%	0%
2020	254	238	254	0.063%	0%
2021	312	295	312	0,055%	0%
2022	364	364	360	0%	0,011%
$\Sigma Galat/n$				0,030%	0,003%

Based on Table 7 comparison *Mean Absolute Percentage Error* (MAPE) is the average value obtained exponential model III error is 0.030% , meanwhile mark Logistic model I error is 0.003%. Following This graphic that presents comparison amount vehicle two- wheelers sold between actual data results with The results of exponential model III and logistic model I are as in Figure 6.

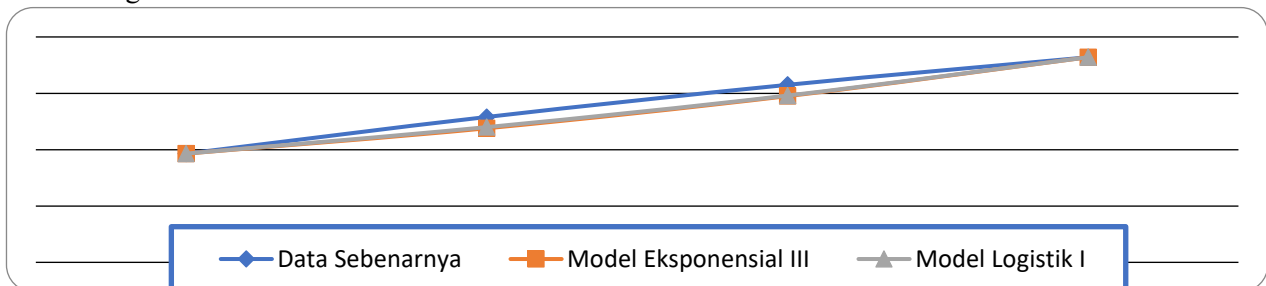


Figure 6. Comparison graph of the number of two-wheeled vehicles sold based on data from PT. Eternal Hasjrat Kefamenanu Representatives with Exponential Models and Logistic Models.



4. CONCLUSION

Based on the results and discussion obtained, it can be concluded as follows:

- 1) Estimated calculation results for two-wheeled vehicles entered and sold at PT. Hasjrat Abadi Kefamenanu Representative uses an exponential population model which has 3 types of models according to the intrinsic rate (value k) which varies every year. After obtained results calculation the estimate researcher can conclude that results calculation amount vehicle two wheels entered and sold to PT. Eternal Desire of Representatives Your fame You 're welcome own error smallest in exponential model III that can be used For predict amount vehicle two wheels entered and sold to PT. Eternal Desire of Representatives Kefamenanu in 2025 with _ form equality For vehicle enter $P(t) = 217 e^{0,214516746t}$ while vehicles are sold in the form of an equation $P(t) = 193 e^{0,211487893t}$ and the results of predictions of the number of two-wheeled vehicles entered and sold at PT. Hasjrat Abadi Kefamenanu Representative in 2025 using the exponential III model for wheeled vehicles two came in as many as 786 vehicles whereas while the exponential model III for vehicle sold as many as 687 vehicles .
- 2) Almost all calculation results estimate the number of two-wheeled vehicles entered and sold at PT. Hasjrat Abadi, the Kefamenanu representative , both have the smallest error in the logistic model I which is close to the actual data calculation results at PT. Hasjrat Abadi, Representative of Kefamenanu , and the prediction results for the number of two-wheeled vehicles entered and sold by PT. Hasjrat Abadi, the Kefamenanu Representative , in 2025 used the logistic population model I for two-wheeled vehicles that came in as many as 487 vehicles, while the logistic population model I for vehicles sold was 440 vehicles.
- 3) Both continuous population models can be used to predict the number of two-wheeled vehicles entered and sold at PT. Hasjrat Abadi Kefamenanu Representative in the following year is a logistics model I which will be used to predict the number of vehicles entered and sold at PT. Hasjrat Abadi representative Your fame on in 2025.

SUGGESTION

Advice given to study Next on the field related For development of this article that is can use method *multiple linear regression* (multiple linear regression) with add other variables such as amount vehicle two -wheeled , vehicle wheel four with various types and several PTs other than PT. The eternal desire that has been researched or Can use help *software* like Matlab , Maple and *software* other .

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