Journal of Intelligent Decision Support System (IDSS) 8 (1) (2025), pp. 34-43

Published by: Institute of Computer Science (IOCS)

Journal of Intelligent Decision Support System (IDSS)

Journal homepage: www.idss.iocspublisher.org

Mapping ownership of luxury goods and household assets in cities in Jawa Tengah using logistic regression

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Article Info

Article history:

Received Mar 03, 2025
Revised Mar 25, 2025
Accepted Mar 28, 2025

Keywords:

Asset Ownership;
Economic Inequality;
Luxury Goods;
Logistic Regression;

ABSTRACT

Ownership of luxury goods and household assets is a crucial issue in the Indonesian economy, particularly in Jawa Tengah, as it reflects complex socio-economic dynamics. This study aims to map the distribution of luxury goods and household assets across regencies and cities in Jawa Tengah and analyze the factors influencing their ownership using logistic regression. Socio-economic disparities in asset ownership are driven by factors such as education, income, and access to information, which contribute to broader social inequality and regional economic development.Using data from the Jawa Tengah Statistics Agency, this study examines variations in asset ownership, including motorcycles, refrigerators, and land, across different regions. Findings indicate that regions with higher motor vehicle ownership tend to exhibit stronger economic welfare compared to those with lower asset ownership. Beyond economic factors, psychological and social aspects, including social status and religious influences, also shape decisions regarding luxury goods acquisition.This research contributes to the literature by addressing the underexplored local context of asset ownership in Indonesia. The findings provide insights for policymakers in designing more inclusive and responsive socio-economic policies, aiming to reduce disparities and promote equitable regional development.

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Introduction

The ownership of luxury goods and household assets is becoming an increasingly relevant topic in the context of the Indonesian economy, particularly in Jawa Tengah. This phenomenon reflects complex social and economic dynamics, where luxury goods often serve as symbols of social prestige(Mas' udah, 2020; Permanasari et al., 2024). Understanding the distribution of luxury goods and household asset ownership at the district/city level is crucial, especially in supporting public policy decision-making and local economic development (Sari et al., 2022; Setijadi, 2023; Wulaningrum et al., 2022). A deeper analysis of these patterns can contribute to efforts in promoting economic equality and addressing the widening social disparities observed in recent years.

Despite various economic development programs, inequality in luxury goods and household asset ownership remains a persistent issue across districts and cities in Jawa Tengah. This inequality is largely driven by disparities in education, income, and access to information. The uneven distribution of assets not only exacerbates social conflicts but also hinders regional economic growth(Huang et al., 2024;

Kuznets, 2019; Lessmann & Steinkraus, 2019). Addressing this issue is essential to achieving economic equality and social welfare(Hariram et al., 2023; Johnson et al., 2020; Leal Filho et al., 2023).

Based on data from the Jawa Tengah Provincial Statistics Agency reveals significant variation in household asset ownership, including motorcycles, refrigerators, and land, across different regions. In areas with a high percentage of motor vehicle ownership, economic welfare tends to be better, whereas regions with lower asset ownership often face limited access to essential facilities. These disparities highlight the need for a data-driven approach to understanding household asset ownership patterns and their implications for socio-economic policies.

In consumer behavior research, there are a number of studies that review the motivations for purchasing luxury goods, pointing out the psychological and social factors that influence purchase decisions. For example, research conducted by Kim et al. shows how social status can influence consumer preferences for sustainable luxury brands Kim et al. (2022). On the other hand, Zakiyyah et al. (2023) found that religious factors are also influential although not always the main consideration in asset ownership Zakiyyah et al. (2023). This research will extend this study by analyzing the local context in Indonesia, particularly in Jawa Tengah, and how these factors interact in determining the ownership of luxury goods and household assets.

The main objective of this study is to map the ownership of luxury goods and household assets in Jawa Tengah using logistic regression to analyze the factors that contribute to such ownership. This study seeks to fill a gap in the existing literature by focusing on the Indonesian context which has not been widely studied before (Tora et al., 2021; Zein et al., 2020). This study extends prior research by analyzing these factors within the Indonesian context, particularly in Jawa Tengah, to better understand how economic, psychological, and social aspects interact in determining household asset ownership.

Ultimately, this research aims to provide valuable insights for stakeholders in designing policies that better address the needs of the population and enhance social inclusion. Given the growing socio-economic disparities observed in urban areas, including disparities in luxury asset ownership, these findings will be critical for fostering equitable economic development(Chamberlain et al., 2020; Nijman & Wei, 2020).

Method

This research consists of several components, including research data, research tools,and analysis techniques. The technical analysis in this research uses Logistic Regression.

Research Data

The data used in this study includes information on household asset ownership, including:

No	City	LPG 5,5 Kgs or More	Refri	AC	Water Heater	Gold	Moto Bike	Boat	Motor Boat	Car	Flat Monitor TV	Land
1	Provinsi Jawa Tengah	5,73	65,02	4,12	2,32	16,5	86,46	0,7	0,59	11,55	15,9	84.53
2	Kabupaten Cilacap	4,97	66,22	3,8	1,92	12,99	84,15	2,71	0,8	8,4	13,79	83,91
3	Kabupaten Banyumas	5,13	66,04	2,96	2,34	16,42	81,94	0,25	0,11	9,59	16,08	86,8
4	Kabupaten Purbalingga	3,24	58,21	1,27	1,04	12,34	84,45	0,39	0,81	8,68	13,87	89,97
5	Kabupaten Banjarnegara	4,94	52,3	0,39	6,78	15,59	81,57	0,75	0,24	9,94	11,87	89,61
⋮	⋯	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮	⋮
36	Kota Tegal	12,29	75,49	10,49	2,02	18,74	87,07	0,38	0	7,19	23,52	64,59

Research Tools

The analysis in this study uses Google Collabolatory by using the Python 3 Google Compute Engine Backend runtime on CPU mode and 2GB of RAM.

Logistic Regression

Logistic Regression is a statistical analysis technique used to predict the probability of an event based on one or more independent variables (Lapatta & Husin, 2024; Senaviratna & Cooray, 2019). This technique is particularly useful in cases where the dependent variable to be predicted is binary, such as yes/no, success/failure, or present/absent(Dahal et al., 2022). Logistic Regression operates by estimating the probability that the dependent variable is in a particular category, utilizing the logit function as the link function(Alevizakos et al., 2019). The formula of Logistic Regression is as in Equation 1.

$$P(Y = 1) = \frac{1}{1 + e^{-(\beta_0 + \beta_1 \chi_1 + \beta_2 \chi_2 + \cdots + \beta_p \chi_p)}} \quad (1)$$

Description:
(Y=1) is the probability that the dependent variable (Y) is equal to 1, given the values of the independent variables (X). $\beta_{0,1},\beta_2,...,\beta p$ are regression coefficients to be estimated. $X_{1,2},...,X_p$ are the independent variables. The function e is an exponential function, which is Euler's constant (about 2.71828).

Logistic Regression is often used in various fields such as medicine to predict the probability of disease (Nourelahi et al., 2019), in finance for credit risk assessment (Khemais et al., 2016), and in marketing to predict consumer buying behavior (Dani & Ginting, 2023).

One of the main advantages of Logistic Regression is that it is able to handle both numerical and categoricalpredictor variables, and is suitable for situations where the relationship between the independent variable and the probability of occurrence is not linear (Kuhn & Johnson, 2019; Theobald et al., 2019).

Research Instruments

The main dataset used in this study is sourced from BPS (Badan Pusat Statistik), containing percentages of households owning various assets across districts/cities in Jawa Tengah. The variables analyzed include indicators of household wealth such as electronic appliances, transportation assets, and land ownership.

The dependent variable is luxury goods ownership, categorized as follows: 1: Households that own luxury goods. 0: Households that do not own luxury goods

Research Objectives

This study aims to map the distribution of luxury goods ownership and household assets across different regions in Jawa Tengah and analyze the influencing factors using logistic regression. The findings will provide insights into economic disparities and asset distribution patterns in the region.

Results and Discussions

There are several processes in this research that will be discussed, including data preprocessing.

Data Processing

Before entering the modeling stage, the following data preparation is carried out. In Table 1 and Table 2 we can see the dataset description and data distribution from the list of 36 cities.

Table 1 Description and Distribution of Asset Ownership Data

	LPG 5,5 Kgs or More	Refrigerator	Air Conditioner	Water Heater	Gold/Jewelery (Min10 Grams)
Count	36.000000	36.000000	36.000000	36.000000	36.000000
Mean	6.741389	65.813889	4.253333	2.866944	16.956111
Std	5.604429	9.872033	4.264921	3.171886	4.609332
Min	1.460000	48.790000	0.390000	0.400000	8.420000
25%	3.222500	58.135000	1.730000	1.117500	13.852500

	LPG 5,5 Kgs or More	Refrigerator	Air Conditioner	Water Heater	Gold/Jewelery (Min10 Grams)
50%	5.410000	65.550000	2.985000	1.970000	16.740000
75%	7.717500	72.872500	4.822500	2.602500	18.717500
Max	25.350000	84.820000	21.550000	16.210000	32.450000

Table 2 Description and Distribution of Asset Ownership Data

	Motorbike	Boat	Motor Boat	Car	Flat Monitor TV	Land
Count	36.000000	36.000000	36.000000	36.000000	36.000000	36.000000
Mean	86.621944	0.641944	0.586944	12.204167	16.695278	83.470000
Std	2.729058	0.616385	0.489150	5.714760	7.634871	9.532184
Min	81.470000	0.000000	0.000000	4.670000	7.660000	58.280000
25%	84.872500	0.255000	0.280000	7.850000	12.110000	81.387500
50%	86.615000	0.485000	0.435000	11.295000	15.285000	86.345000
75%	88.575000	0.840000	0.747500	14.687500	18.185000	89.400000
Max	91.750000	2.710000	2.050000	29.290000	41.300000	96.430000

Based on the results of data preprocessing, it can be seen that in the Motor Boat column there is a maximum value of 2.71, while the minimum value is 0.00. This shows that there are households that do not own a motor boat at all, while others own more than 2 units. In addition, the Gold/Jewelry column (Min 10 Grams) found a maximum value of 16.21, which is much higher than the third quartile (2.60). This indicates the possibility of outliers that may affect the data distribution. To ensure the quality of the data, it is necessary to further analyze the outliers and the possibility of data transformation to make the prediction model more stable. All attributes in this dataset have a total of 36 observations without any null values, so the data can be directly used for further analysis without the need for imputation of missing values.

Table 3 Normalization Result

	LPG 5,5 Kgs or More	Refrigerator	Air Conditioner	Water Heater	Gold/Jewelery (Min10 Grams)
count	36.000000	36.000000	36.000000	36.000000	36.000000
Mean	0.221071	0.472492	0.182577	0.156037	0.355227
Std	0.234593	0.273995	0.201556	0.200625	0.191816
Min	0.000000	0.000000	0.000000	0.000000	0.000000
25%	0.073776	0.259367	0.063327	0.045383	0.226072
50%	0.165341	0.465168	0.122637	0.099304	0.346234
75%	0.261930	0.668401	0.209475	0.139311	0.428527
max	1.000000	1.000000	1.000000	1.000000	1.000000

Table 4 Normalization Result

	Motorbike	Boat	Motor Boat	Car	Flat Monitor TV	Land
Count	36.000000	36.000000	36.000000	36.000000	36.000000	36.000000
Mean	0.501162	0.236880	0.286314	0.306018	0.268587	0.660288
Std	0.265473	0.227448	0.238610	0.232119	0.226958	0.249861
Min	0.000000	0.000000	0.000000	0.000000	0.000000	0.000000
25%	0.330982	0.094096	0.136585	0.129163	0.132283	0.605701
50%	0.500486	0.178967	0.212195	0.269090	0.226665	0.735649
75%	0.691148	0.309963	0.364634	0.406885	0.312872	0.815727
Max	1.000000	1.000000	1.000000	1.000000	1.000000	1.000000

Exploratory Data Analysis

Figure 1 displays the distribution of ownership of various household goods and assets in cities in Jawa Tengah. Each histogram depicts ownership patterns for a particular category, such as LPG 5.5 kg or more, refrigerators, air conditioners, motor vehicles, gold jewelry, to land and other luxury goods. In general, the distribution shows that most households have low ownership tendencies for certain goods, such as air conditioners and boats, indicating that these goods fall into the category of limited ownership or luxury goods. Meanwhile, items such as motorcycles show a more even distribution, reflecting higher ownership levels across different household groups.

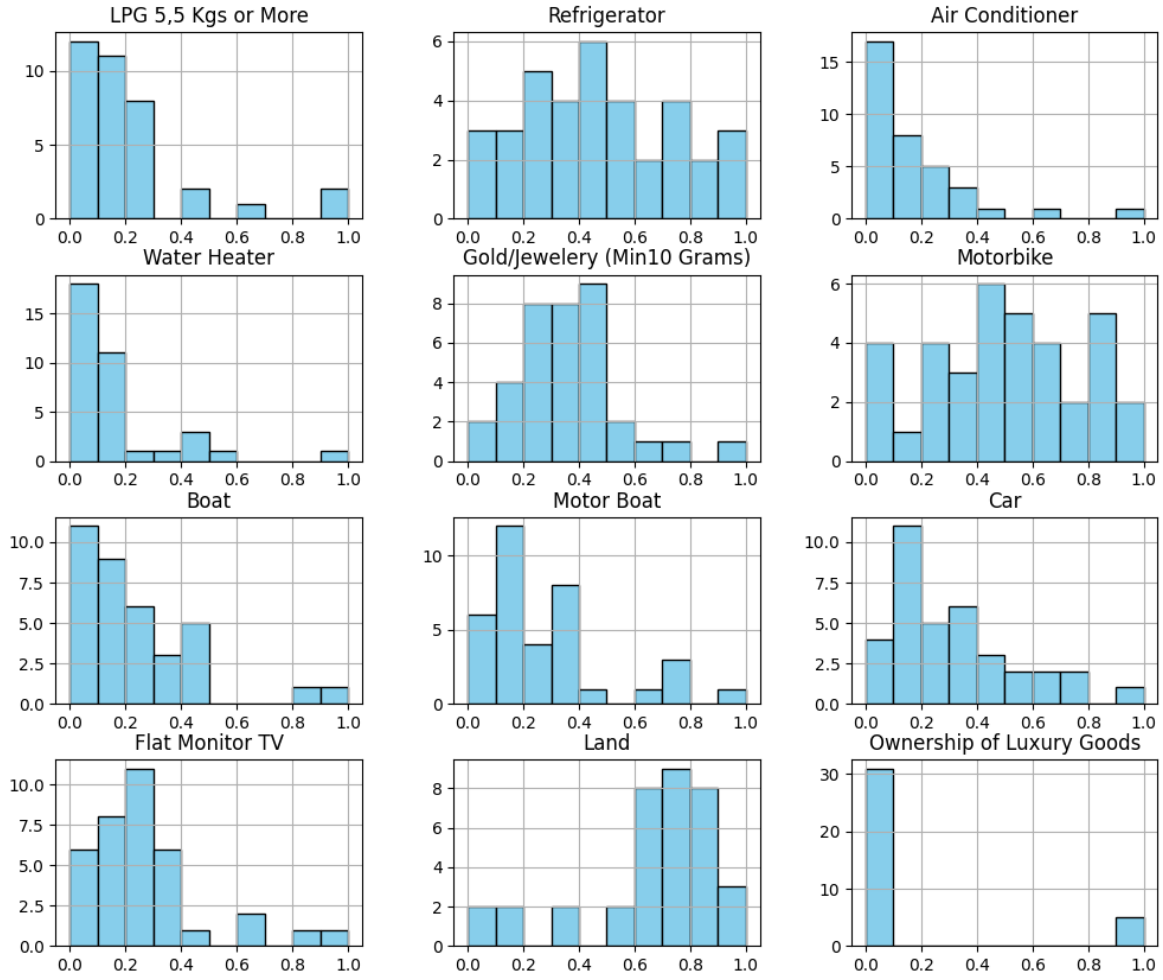

Figure 1 Variable Distribution Histogram

Figure 2 shows a heatmap of the correlation matrix that illustrates the relationship between household ownership of goods and assets in cities in Jawa Tengah. Positive correlations are seen in high-value goods, such as cars that have a strong relationship with gold jewelry (0.75), flat-screen TVs (0.75), and air conditioners (0.45), suggesting that households that own one luxury good tend to own other luxury goods. In addition, ownership of 5.5 kg or more LPG is also highly correlated with water heater (0.81), flat screen TV (0.82), and car (0.74), reflecting the welfare level of the household. In contrast, land ownership shows a negative correlation with electronic goods such as air conditioners (-0.73) and flat screen TVs (-0.54), indicating a different pattern of asset investment. Similarly, boat (-0.18) and motorboat (-0.29) ownership tends to be more common among certain groups of people, such as fishermen. The variable "Ownership of Luxury Goods" is highly correlated with cars (0.72), gold jewelry

(0.74), flat screen TVs (0.65), and LPG 5.5 kg or more (0.72), making it a key indicator in mapping the ownership of luxury goods in the region.

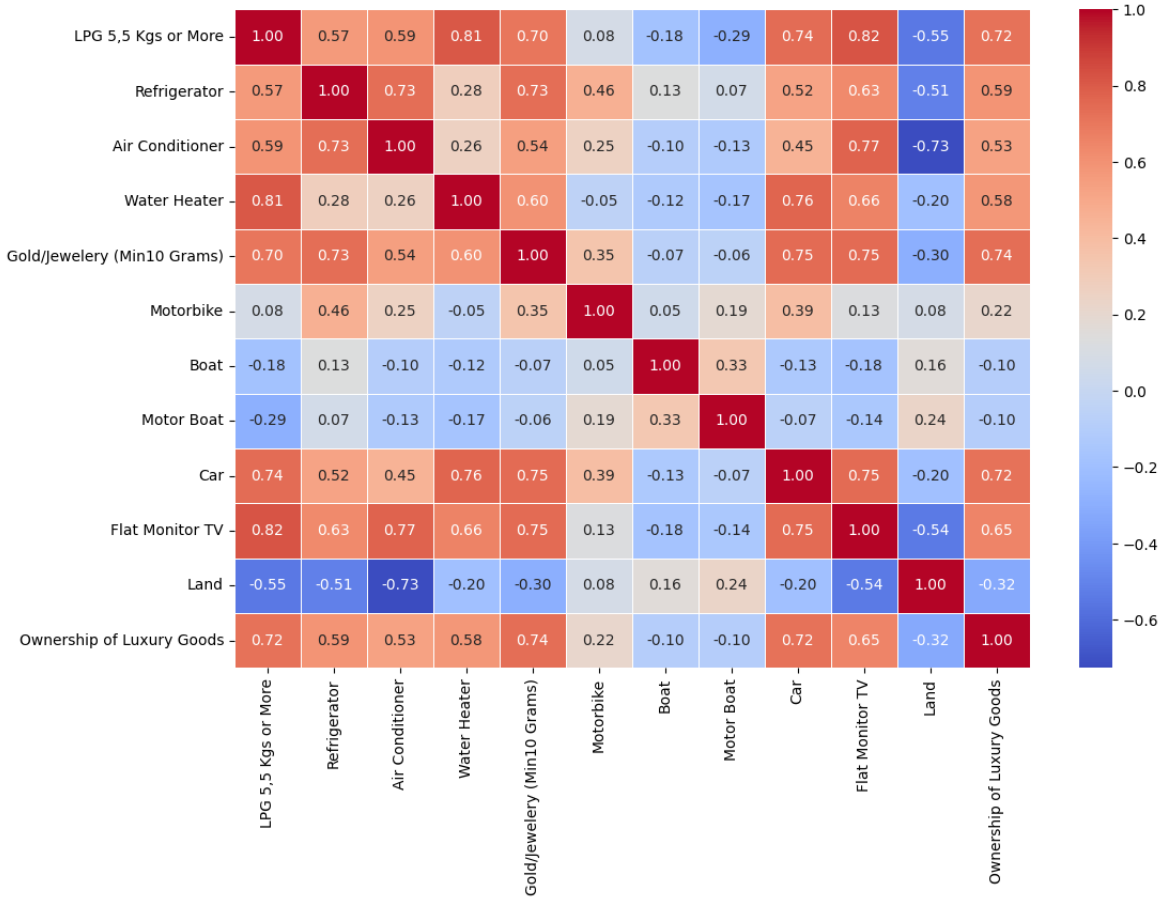

Figure 2 Correlation Between Variables

Figure 3 shows the distribution of luxury ownership across cities in Jawa Tengah. It can be seen that the number of cities where the majority of households do not own luxury goods (No Luxury) is much larger than the number of cities that have a significant level of luxury goods ownership (Luxury). The red bars represent the “No Luxury (0)” category with more than 30 cities, while the blue bars indicate the “Luxury (1)” category with a much smaller number of cities, around 5. This graph indicates that luxury ownership is still limited to a small number of cities, while most areas tend to have low levels of luxury ownership. This could reflect the differences in welfare levels between cities in Jawa Tengah.

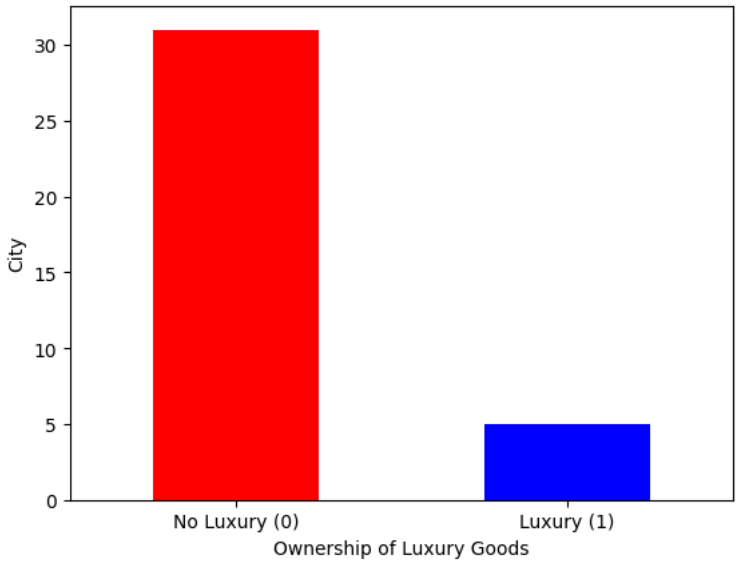

Figure 3 Distribution of Luxury Goods Ownership

Modeling and Evaluation

The model training process uses the Logistic Regression algorithm. The solver parameter `lbfgs` refers to Limited-memory Broyden-Fletcher-Goldfarb-Shanno which is an optimization algorithm that works by estimating the gradient of the objective function using a number of previous points. This solver parameter is very suitable for datasets containing ordinal data, so this study uses the solver.

Figure 4 is a confusion matrix table that displays the model prediction results with the following explanation :

True Positive (TP) = 16, there are 16 cities that are predicted to have a high luxury ownership rate (e.g. gold ownership above a certain value) and the prediction is correct. This means that these 16 cities do have high levels of luxury goods ownership.

True Negative (TN) = 4, there are 4 cities that are predicted to have a low luxury ownership rate and the prediction is correct. This means that these 4 cities do have a low luxury ownership rate.

False Positive (FP) = 16, there are 16 cities that are predicted to have a high luxury ownership rate, but the prediction is false. This means that these 16 cities actually have a low luxury ownership rate, but the model incorrectly predicted them as high.

False Negative (FN) = 0, there are 0 cities that are predicted to have a low luxury ownership rate, but the prediction is false. That is, there are no cities that actually have a high luxury ownership rate but are predicted as low by the model.

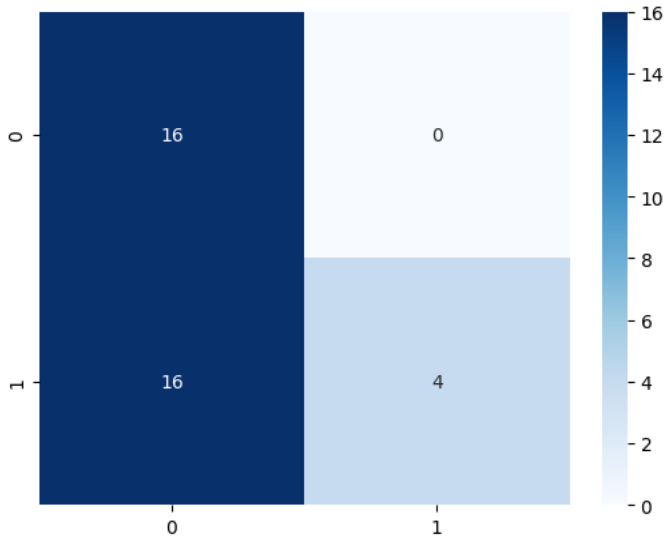

Figure 4 Confusion Matrix

Table 5 presents the results of measuring the performance of the Logistic Regression model. The model achieved an accuracy of 75%, which means that the model was able to correctly predict 75% of the total test data. In more detail, for class '0' (does not own luxury goods), the model has a precision, recall, and F1-score of 83%. Meanwhile, for class '1' (owns luxury goods), the model has a precision, recall, and F1-score of 50%. Although the overall accuracy is quite good, the performance of the model \to predict class '1' still needs to be improved.

Table 5 Model Performance Measurement Results

	Precission	Recall	F1-score	Support
0	0.83	0.83	0.83	6
1	0.50	0.50	0.50	2
Accuracy			0.75	8
Macro avg	0.67	0.67	0.67	8
Weighted avg	0.75	0.75	0.75	8

Conclusions

This study successfully developed a predictive model for luxury goods and household asset ownership in regencies and cities across Jawa Tengah using a logistic regression algorithm. The findings indicate that household income, education level, employment type, and home ownership status significantly influence the probability of owning luxury goods and household assets. The model demonstrates a high level of accuracy, offering valuable insights for policymakers and stakeholders in designing more targeted economic policies, particularly in subsidy distribution and regional economic planning. Beyond its practical implications, this study also contributes to the academic field by demonstrating the effectiveness of logistic regression in socio-economic analysis. The application of this method provides a systematic approach to understanding asset ownership patterns and their underlying determinants. For future research, it is recommended to incorporate feature selection techniques to identify the most influential variables while maintaining model accuracy. Additionally, addressing data imbalance issues through advanced handling techniques could further enhance the model's reliability, particularly in classifying households with different levels of asset ownership. Expanding the study to include a broader range of socio-economic and behavioral factors may also provide deeper insights into the dynamics of luxury goods and household asset ownership in Indonesia.

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