IJEEE: Indonesian Journal of Electrical Engineering and Electronics
| Vol. 1 | No. 2 | Pages 55 - 61
[July] [2024]

Analysis of the Effect of Indonesia's Per Capita Income on Household Electricity Consumption from 2018 to 2022 Using Correlation Coefficient and Simple Regression Methods

Verianto Nugroho

Teknik Elektro Universitas Pembangunan Nasional Veteran Jakarta

Received 3rd December 2023 **|** Revised 3rd June 2024 **|** Accepted June 2024

ABSTRACT

Nowadays, electricity has become one of the essential factors in daily life. It can be said that almost every object around us uses electricity to function. The main factor influencing electricity usage is the number of electronic devices in a person's home, which is also affected by that individual's income. This study aims to analyze the effect of Indonesia's per capita income on household electricity consumption from 2014 to 2022. Simple linear correlation and regression methods are used to identify the relationship between the variables of per capita income and household electricity consumption. Economic and electricity consumption data were obtained from official sources, and the analysis was conducted using the latest statistical software.

Keywords: *Household electricity, correlation coefficient, simple regression*

1. INTRODUCTION

Electricity has become an essential need that is inseparable from the lives of all societal layers. All activities, ranging from household tasks to industrial activities, heavily rely on the availability of electrical energy sources. Every segment of society, whether the upper class, lower class, or business owners, requires electrical energy to carry out their activities.

Electricity consumption in a region can be measured using the parameter of electricity consumption per capita (kWh/capita). This reflects the amount of electrical energy used directly or indirectly by the residents of a region within a year. Data on electricity consumption per capita serves as an important indicator in evaluating the level of energy use by society and reflects the economic development and welfare of an area.

A country's per capita income is a statistical measure that indicates the amount of income generated by the country divided by its population. Per capita income provides an overview of wealth distribution and the level of societal welfare. Countries with high per capita income tend to have better welfare levels, better access to healthcare, education, and infrastructure. In this context, we will discuss its impact on society's electricity consumption.

Electricity consumption is a key variable due to its relationship with economic activities and development. Electrical energy plays a crucial role in economic development and is a significant factor supporting the welfare of the people. Nowadays, electricity is classified as a basic need used by four groups of electricity users: households, industry, businesses, and public. In this context, the author will specifically focus on the household group.

The relationship between per capita income and electricity consumption can reflect the extent of a country's development and industrialization. Generally, countries with high per capita income tend to have higher electricity consumption levels due to more advanced industries and infrastructure. Conversely, countries with low per capita income may have lower electricity consumption due to limited access and infrastructure development.

The demand and use of electricity in Indonesia's household sector continue to increase each year. Therefore, it is important to conduct research on the factors influencing electricity consumption in this sector. This aims to enable the government and PT. PLN (Persero) as the electricity provider to plan adequate strategies and power plant infrastructure to produce and distribute electricity supplies throughout Indonesia.

2. THEORITICAL FRAMEWORK

2.1 Simple Linear Correlation

Simple correlation is a statistical technique used to measure the strength of the relationship between two variables and to determine the form of the relationship between these two variables with quantitative results. The strength of the relationship between the two variables can be STRONG, WEAK, or NO RELATION, while the form of the relationship can be either Positive Linear or Negative Linear. In statistics, the relationship between two variables, used to measure whether there is a relationship between variables, is called Correlation. The following are the types of correlation that can occur between two variables:

1. Positive Correlation: This occurs when two variables have a relationship where if the independent variable (X) increases or decreases, the dependent variable (Y) tends to increase or decrease as well.

2. Negative Correlation: This occurs when two variables have a relationship where if the independent variable (X) increases or decreases, the dependent variable (Y) tends to decrease or increase.

3. No Correlation: This occurs when both variables X and Y do not show any relationship.

4. Perfect Correlation: This is the correlation of two variables that is absolute.

2.2 Coefficient Simple Correlation

To determine the relationship between two variables, it is sufficient to look at the value of the correlation coefficient. The correlation coefficient (r) is an index or number used to measure the strength of the relationship between variables with the value between -1 and 1 (-1≤ r ≤1). The following is the formula for the correlation coefficient.

$$r = \frac{n\sum XY - \sum X \sum Y}{\sqrt{(n\sum X^2 - (\sum X)^2)(n\sum Y^2 - (\sum Y)^2)}} \quad (1)$$

where X = Independent variable

Y = Dependent variabel

n = The sample number

2.3 Correlation Strength Interval Between Variables

To determine whether the relationship between two variables is perfect, strong, weak, or non existent, the following intervals indicate the strength of the relationship between the variables.

1. r = 0, no correlation
2. 0 < r < 0.2, very weak correlation
3. 0.2 < r ≤ 0.4, weak correlation
4. 0.4 < r ≤ 0.7, fairly strong correlation
5. 0.7 < r ≤ 0.9, strong correlation
6. 0.9 < r ≤ 1, very strong correlation
7. r = 1, perfect correlation

2.4 Coefficient of Determination

The coefficient of determination is often interpreted as the extent to which all independent variables can explain the variance of the dependent variable. Simply put, the coefficient of determination is calculated by squaring the correlation coefficient (r). For example, if the value of r is 0.8, then the coefficient of determination is 0.8 x 0.8 = 0.64. This means that the independent variables explain 64% of the variance of the dependent variable. Consequently, 36% of the variance of the dependent variable is explained by other factors.

2.5 Simple Linear Regression

Linear regression is a statistical tool used to determine the effect of one or more variables on a single variable. The variables that influence the outcome are often referred to as independent variables or explanatory variables. The variable that is influenced is referred to as the dependent variable. Linear regression can only be used with interval and ratio scales. The simplest model for explaining the effect between a dependent variable and one independent variable is simple linear regression.

The equation of simple linear regression is

$$\bar{Y}_t = a + bX \quad (2)$$

where Yt = Regression equation

X = Independent variable

Y = Dependent variabel

n = The sample number

a = Constanta

$$a = \frac{\sum Y \sum X^2 - \sum X \sum XY}{n \sum X^2 - (\sum X)^2} \quad (3)$$

b = Regression coefficient

$$b = \frac{n \sum XY - \sum X \sum Y}{n \sum X^2 - (\sum X)^2} \quad (4)$$

Sy,x = Kesalahan baku

$$S_{Y,X} = \sqrt{\frac{\sum (Y - \bar{Y}_t)^2}{n-2}} \quad (5)$$

3. METHODS

This paper follow the steps of research according to the flowchart in Figure 1. It begins with per capita income and electricity consumption, processes data with correlation and simple linear regression, then analyzes the data, after that it will be the end.

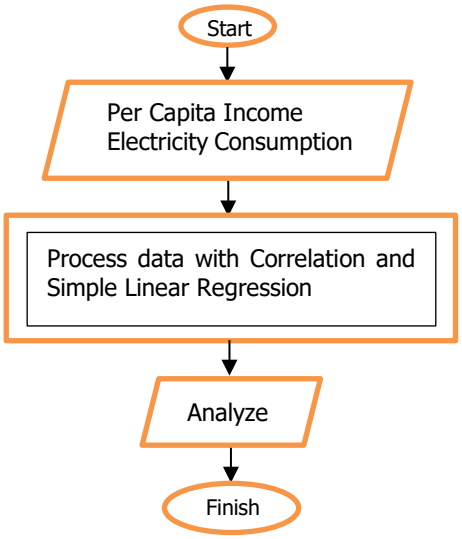

Figure 1. Flowchart of research

Table 1. Per Capita Income

Year	Per Capita Income (million Rp)	Total Household Electricity Customer
2018	107.853.456,00	66.071.133,00
2019	114.009.150,67	69.619.877,00
2020	111.249.935,56	72.711.040,00
2021	118.139.629,65	75.701.789,00
2022	131.002.679,73	78.327.897,00
	898.983.036,61	594.133.427,00

Table 2. Further calculation

XY	X^2	Y^2
7,126E+15	1,16324E+16	4,36539E+15
7,9373E+15	1,29981E+16	4,84693E+15
8,0891E+15	1,23765E+16	5,2869E+15
8,94338E+15	1,3957E+16	5,73076E+15
1,02612E+16	1,71617E+16	6,13526E+15
4,23569E+16	6,81257E+16	2,63652E+16

4. Results

The analysis process will be conducted using Microsoft Excel, focusing on four cases:

1. Correlation (the relationship between per capita income and the number of electricity customers from 2018 to 2022)

2. Regression (the effect of the independent variable on the dependent variable)

3. Standard error of estimation

There are three cases to be addressed. Before solving these cases, we must determine which variables are X and Y. Remember that X is the independent variable and Y is the dependent variable. X is the variable that influences Y. Therefore, it can be determined that X is Per Capita Income and Y is the Number of Household Electricity Customers. Once X and Y are identified, the next step is to determine the values for XY, X^2, and Y^2 presented in Table 2.

Case 1: Correlation (relationship) between per capita income and the number of electricity customers from 2018 to 2022

To examine the relationship between X and Y, the correlation coefficient is calculated using the provided formula and the values in Table 2. For example, ∑XY is the sum of the column representing XY (found in column 4).

It should be noted that $\sum X^2$ is not the same as $(\sum X)^2$ and $\sum Y^2$ is not the same as $(\sum Y)^2$. After inputting all data, the correlation coefficient is obtained as follows:

r = 757099925685152,00/1.45579E+16 = 0,052006029

r = 0.052. This indicates a relatively weak correlation between per capita income and the number of household electricity customers.

Case 2: Regression (effect) of the independent variable on the dependent variable

To determine the effect of per capita income on the number of electricity customers from 2018 to 2022, a regression model must be created. From the data above, the following values are obtained:

b = 844110546653739000,00/1.60767E+15 = 525,0516081

a = 2.83692E+22/1,35608E+18 = 20919.97487
Yt = a+bX = 20920 + 525.05X

Case 3: Standard Error of Estimation

Next, the standard error of estimation is calculated. Before entering data into the formula, it is advisable to perform the calculations using Table 3 to simplify the computation of the standard error of estimation.

After creating the table, the data is then entered into the formula for the standard error of estimation, which is:

Syx = 61.214.829.144

The value of the standard error of estimation is 61,214,829,144. This means that the deviation of the regression value from the actual value is 61,214,829,144.

Table 3. Standard Error Estimation

Yt	Y-Yt	$(Y-Yt)^2$
56.628	-56.562.406	3.199.305.869.660.420.
59.860	- 59.790.905	3.574.952.392.621.590.
58.411	-58.339.088	3.403.449.252.235.450.
62.029	-61.953.531	3.838.240.087.343.800.
68.782	-68.704.650	4.720.328.933.578.730.
		18.736.276.535.440.000.

5. CONCLUSIONS

Based on the observations above, it can be concluded that per capita income moderately influences the number of electricity customers from 2018 to 2022. There are 525 customers per Rp. 20,920.00 of per capita income. The deviation of the regression value from the actual value is 61,214,829,144.

LIST OF REFERENCES

Miles, Mattew B. dan A. Michael Huberman. (1992). *Qualitative Data Analysis: A Sourcebook of New Method*. Terjemahan Tjetjep.

Rohendi, Rohidi. *Analisis Data Kualitatif: Buku Sumber tentang Metode-metode Baru*. Jakarta: Penerbit Universitas Indonesia(UI-PRESS)

J. Supranto, M.A. (2001). *Statistika Teori dan Aplikasi*. Jakarta : Erlangga.

R Johson and D Wichern, *Applied multivariate statistics*. Prentice Hall.

Douglas, C. Montgomery, George C.Runger. (2003). *Applied Statistic and Probability for Engineer*. Third edition. John Wiley and Son Inc.