ANALYSIS OF THE RELATIONSHIP BETWEEN THE COVID-19 PANDEMIC AND ELECTRICITY CONSUMPTION IN SOUTH SUMATRA USING A LINEAR REGRESSION APPROACH

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ABSTRACT

Electrical energy is one of the major needs of society and an important economic resource required for various activities. With population growth and development, power demand will increase in the future, the development of industry and technology, and the development of the educational world. This study focuses on estimating the total amount of energy sold based on the population of South Sumatra from 2014 to 2021. The methods used are simple linear regression and correlation methods. Regression analysis is used to investigate and measure statistical relationships that occur between two or more variables. Judging from the population calculation data for 2020-2021 and data from BPS South Sumatra, the calculated population is much greater than the population in the BPS data. This also applies to the total amount of energy data (with KWh units), for the total amount of energy in 2020 of 5,308.450000 KWh in the expected range of values, this is in the range of $5,215,695,859 < y < 5,626,645,251$, while for the total energy 2021 according to PLN data 5,593,930,000 KWh which is in the predicted range value, which is in the range of $5,290,517,098 < y < 6,284,994,826$. This is because population growth affects the increase in total energy consumption.

Keywords: Electricity Energy, Regression Method, BPS Sumatera, PLN

1. INTRODUCTION

The use of statistics in processing research data can affect the level of analysis of research results. Research in the field of science that uses statistical calculations will produce accurate data if it follows the correct data analysis procedures. Regression can be used to calculate and predict how one variable (independent) affects another variable (dependent). Regression analysis is an examination of the relationship between a variable explained by one or more explanatory variables. It is said to be simple regression if there is only one independent variable. If there are more than one independent variables, then the analysis is called multiple linear regression because the dependent variable is influenced by many independent variables.

As we know, Indonesia ranks fourth in the world with the largest population after China, India, and the United States. Until mid-2022, the Central Statistics Agency (BPS) recorded an increase in Indonesia's population by 1.13% compared to 2021. That number rose from 272.68 million people to 275.77 million people. With this population growth, Perusahaan Listrik Negara (PLN) must record electricity/energy consumption sold per customer group (KWh), as electricity availability in Indonesia is still limited. This study aims to identify the effect of population growth on electricity consumption in South Sumatra. This study focuses on data published by the Central Statistics Agency (BPS) from 2014-2019. By using simple linear regression and correlation analysis, we can determine whether there is a relationship between population size (variable x) and total energy sold (variable y). Then we can also determine how strong the relationship between these two variables is.
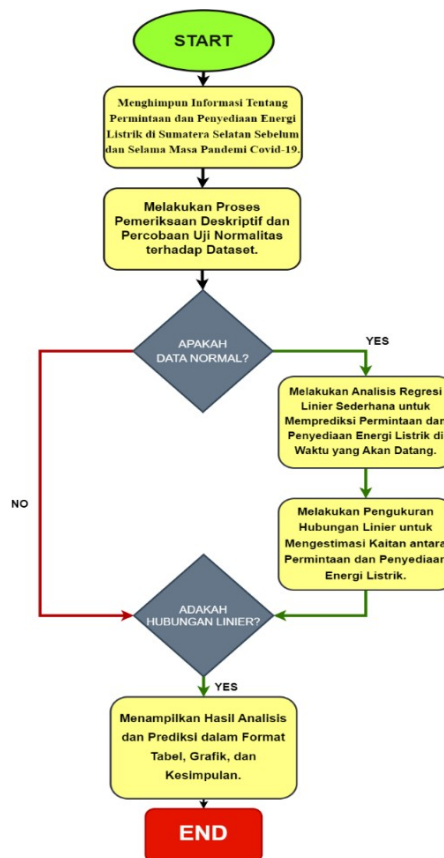
2. METHODOLOGY

Figure 1 : System Work Flowchart

The method used is Simple Linear Regression and Correlation Analysis. In Regression Analysis, to determine the pattern of the relationship or function between two or more variables, Simple Linear Regression Equation is used. In the Regression Equation, there are two variables, namely the dependent variable and the independent variable. The dependent variable or response variable is a variable that will be sought for its value and is usually displayed on the vertical axis (y-axis). Meanwhile, the independent variable or explanatory variable is a variable that affects the variation of the dependent variable. The dependent variable can be predicted with the help of regression if the value of the independent variable is known. Meanwhile, Correlation Analysis aims to estimate "how strong" or "degree of closeness" of the relationship between variables.

Regression analysis and correlation are often performed sequentially to find a relationship model in the form of a regression equation along with the strength of the relationship in correlation coefficients.

The general regression equation for simple linear regression is:

$$\hat{y} = a + bx$$

To obtain the constant values a and b, the following formulas can be used:

$$b = \frac{n(\Sigma xy) - (\Sigma x)\,(\Sigma y)}{n(\Sigma x^2) - (\Sigma x)^2}$$

$$a = \bar{y} - b\bar{x}$$

To determine the correlation relationship, we can use the following formula:

$$r = \frac{n\Sigma xy - (\Sigma x)\,(\Sigma y)}{\sqrt{\{n\Sigma x^2 - (\Sigma x)^2\}\,\{n\Sigma y2 - (\Sigma y)2\}}}$$

Where r is mark coefficient correlation and ratio correlation.

3. RESULTS AND DISCUSSION

Intervals r value	Connections Correlation
0.00	Nothing _ correlation
0.00 < r < 0.25	Weak
0.25 < r < 0.50	Enough
0.50 < r < 0.75	Strong
0.75 < r < 1	Very strong
1	Perfect

Table 1 Calculation of energy consumption in South Sumatra Province

To predict energy consumption before Covid-19, energy consumption data before the pandemic is needed. Since the Covid-19 pandemic started in 20 20 , we need pre-pandemic data, namely data for 2018-2019. Regression analysis requires an independent variable (x) and a dependent variable (y). Where population is the x variable and electricity consumption is the y variable. Using the population of South Sumatra as an independent variable, we will examine whether there is a relationship between the population of South Sumatra and the dependent variable energy consumption. Data on the population of South Sumatra for 2014-2019 was taken from the PLN Statistical Data Report Book, and data for 2020-2021 was taken from BPS data for South Sumatra.

Following is the Amount Table Population and Electricity Consumption in South Sumatra Province from 2014-2019 :

Table 2 Total Population and Total Number Energy Sold (KWh) in South Sumatra Province in 2014-2019

Year	Amount Population (x)	Total Amount Energy Sold (y)
Year 2014	7,941,500	4,431,950,000
2015	8,052,300	4,737,480,000
2016	8,160,900	4,938,550,000
2017	8,267,000	5,195,520,000
2018	8,444,200	5,450,690.00 0
2019	8,548,840	5,254,050,000

Perform a simple regression analysis to find out know relationship between the dependent variable (y) and the independent variable (x) at the 95% confidence level or significance level of 0.05 (α = 0.05). Data calculations in Ms. Excel provide information in the table below.

Table 3 Calculation Results Simple Linear Regression

b	1489.1
a	- 7262211849
Sy, x	163070379.16
R^2	0, 848317582
R	0.9 21041575

Based on results calculations the table above , can be seen Equality Simple Linear Regression US following:

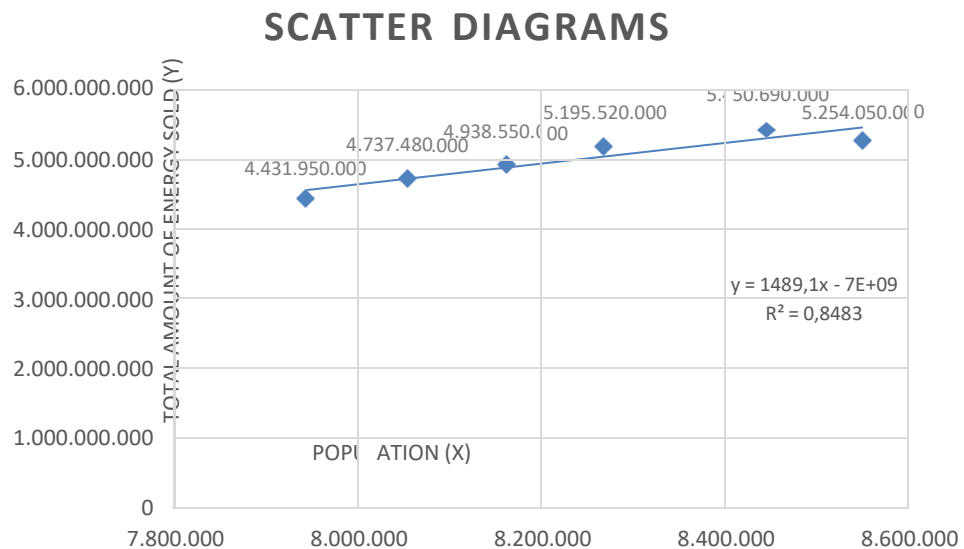y = 1489.1x − 7262211849

Figure 2 SCATTER DIAGRAM

Test the relationship And intervals predictions done For test is There is connections real between growth resident And levels consumption energy. Use t-test For determine slope line regression And estimates intervals B-grade on levels trust two side And 95% :

1) Hypothesis
H0 : B = 0
H1: B ≠ 0
2) Level of Importance
α   0.05
3) Limit both ends rejection/critical interval

α/2   0.025
df=v   4
4) The t value (0.025, 4) is generated from the t distribution table.
tcr = 2.7764
5) A decision rule
Reject H0 and accept H1 if the standard difference between the sample slope (b) and the predicted population slope (BH0) is less than 2.7764 or greater than 2.7764.
6) Test Ratio:
Ruth: 4.72978727
7) Decision making:

Because - 2.7764 < RUt < + 2.7764 then H0 : B = 0 is accepted. This means that there is no significant difference in the total amount of energy sold (KWh) among the population of South Sumatra.
is a relationship between population (x) and the total amount of energy sold (y). This statement can also be strengthened use analysis simple linear correlation . For this test , the coefficient determination (R^2) ad 0.848317582 and the correlation coefficient (R) is 0.9 21041575 because the correlation coefficient (R) value is close to 1, it is known that the relationship between variable x and variable y is very close.

Table 4 Predictions Amount Population and Range of Average ElectricityConsumption Values in South Sumatra Province in 2020-2021

Prediction Amount Population (x) and Range average consumption value electricity (y)		
T year	Population (x)	Total Amount of Energy Sold (y)
2020	8.65 5 . 701	5 ,215,695,859 < y < 5,626,645,251
2021	8.7 63,897	5 ,290,517,098 < y < 6 ,284,994,826

To predict the range of average energy consumption values for variable y, we need to predict the population of North Sumatra for variable x, because variable y is the dependent variable of the independent variable x. According to BPS Indonesia, Indonesia's population growth rate remains at 1.25%. Therefore, to predict the amount resident
Post Sumatra pandemic can use the following formula:

Population in year n = (1.25% x population in year n-1) + population in year n-1

If the value of x, namely the amount population is known. y value, namely total electricity consumption average countable. The table below contains predictions population (x) and range average consumption electricity (y) after pandemic .

From BPS data, South Sumatra , total population and BPS PLN data, total electricity consumption post-pandemic, forecast results are shown in the table. D can compare them with real data.

The following is a table with current data :

Table 5 Total Data Resident recorded based on BPS data and Total Amount Energy Sold in 2020-2021

Quantity Data Resident recorded based on BPS data (x) and Total Amount Electrical Energy Sold (y)		
T year	Population (x)	Total Amount of Energy Sold (y)
2020	8. 467,432.00	5,308,450,000
2021	8. 550,849.00	5 ,593,930,000

Retrieval of population data from BPS South Sumatra:

Viewed from calculated data and original data from PLN, total amount Energy sold in 2020 was 5,308.450,000 KWh is in value range predictions , that is is in the range $5,215,695,859 < y < 5,626,645. 251$, while for the total amount energy sold in 2021 according to PLN data is 5,593,930,000 KWh which is at a value range predictions , that is is in the range $5,290,517,098 < y < 6,284,994,826$.

This is due to growth amount resident influence increase total consumption amount energy .

4. CONCLUSIONS

From the research that has been carried out, it was found that there is a difference between the predictions and the original BPS data for population growth between 2020 and 2021. The calculated population is greater than the population recorded in the BPS data. Apart from that, there are also differences in the data on the total amount of energy sold (in KWh units). With an importance level of 0.05 ($\alpha = 0.05$), the correlation value between X and Y is 0.921041575, where this value is close to 1, which indicates the correlation coefficient value is very strong. This proves that Covid-19 is affecting the rate of population growth and electricity supply in South Sumatra Province .

REFERENCES

Dr. Ir. Harinaldi, M. (2005). Statistical Principles for Engineering and Science . Jakarta : Erlangga

(Persero), PP (2015). PLN Statistics 2014. Jakarta: PT PLN (Persero) Corporate Secretariat.

(Persero), PP (2016). PLN Statistics 2015. Jakarta: Corporate Secretary PT PLN (Persero).

(Persero), PP (2017). PLN Statistics 2016. Jakarta: PT PLN (Persero) Corporate Secretariat.
(Persero), PP (2018). PLN STATISTICS 2017. Jakarta: Corporate Secretary of PT PLN (Persero).

(Persero), PP (2019). PLN STATISTICS 2018. Jakarta: PT PLN (Persero) Corporate Secretariat.

JF Hair, CB William, JB Barry, EA Rolph and LT Ronald, Multivariate Data Analysis, 6th ed., New Jersey: Pearson Prentice Hall, 2006.

Annur, C. M. (2022, 7 7). databox . Retrieved from https://databoks.katadata.co.id/: https://databoks.katadata.co.id/datapublish/2022/07/07/terus-meningkat-nomor-penbangun-ri-tembus-275-77 -million-by-mid-2022.

Setiaji, N., MM, IS, & Agus Sugiharto, SM (2022). ANALYSIS OF POWER CONSUMPTION AND ELECTRICITY DISTRIBUTION. 1-1.

Wahid, A., Ir. Junaidi, M., & Dr. Ir. HM Iqbal Arsyad, M. (2014). ANALYSIS OF CAPACITY AND ELECTRIC POWER REQUIREMENTS TO SAVE ELECTRIC ENERGY USE AT THE FACULTY OF ENGINEERING, TANJUNGPURA UNIVERSITY. 2.

YULIARA, IM (2016). SIMPLE LINEAR REGRESSION. Bali: Faculty of Mathematics and Natural Sciences, Udaya University na.