THE TRUTH OF OHM'S LAW IS SEEN FROM THE STANDPOINT OF STATISTICAL SCIENCE

Ulul Ilmi[1]
[1]Teknik Elektro, Fakultas Teknik, Universitas Islam Lamongan
Ululilmi78@yahoo.co.id

ABSTRAK
In the world of science there are several laws such as Kirchoff's Law, Lavoisier's Law and Ohm's Law. In this study discussed the truth of Ohm's Law when viewed in terms of statistics. Based on the results of the study it can be concluded that Ohm's Law can be verified in terms of statistics through the use of linear regression methods and the use of Pearson Correlation methods. After statistical data processing can be found the Pearson correlation value, which comes from the variable electric current and the potential difference is equal to one, which shows that these two variables have a very strong relationship. In addition to the use of the Pearson Correlation method, ohm's legal correctness can also be proven through the use of linear regression equations. This is evidenced by the results of significance level of the variable of electric current less than 0.05. With this result shows the variable electric current can be used to predict the value of potential difference significantly through the linear regression equation.
Kata Kunci: linear regression equation, Pearson correlation, ohm law, statistics

1. INTRODUCTION

In the world of engineering, especially electrical engineering, there are several laws. One of the laws is Ohm's Law. Ohm's Law, if viewed from engineering, the truth has been recognized by all scientists around the world. On the occasion of this research, the truth of Ohm's Law will be reviewed when viewed from the standpoint of statistical science.

a. Ohm's law

In Electronics Science, the basic Law of Electronics that must be studied and understood by every Electronic Engineer or the hobbyist of Electronics is Ohm's Law, namely the Basic Law which states the relationship between Electric Current (I), Voltage (V) and Obstacle (R). Ohm's law in English is called "Ohm's Laws". Ohm's Law was first introduced by a German physicist named Georg Simon Ohm (1789-1854) in 1825. Georg Simon Ohm published the Ohm Law in a paper entitled "The Galvanic Circuit Investigated Mathematically" in 1827.

Basically, the sound of Ohm's Law is:

"Large electric current (I) flowing through a conductor or conductor will be directly proportional to the potential / voltage difference (V) applied to it and inversely proportional to the resistance (R)".

Mathematically, Ohm's Law can be formulated into an equation like this:

$V = I \times R$

$I = V / R$

$R = V / I$

Where :

V = Voltage (Potential Difference or Voltage whose unit is Volt (V))

I = Current (Electric current whose unit is Ampere (A))

R = Resistance (resistance or unit which is Ohm (Ω))

In the application, we can use Ohm's Law Theory in the Electronic Series to reduce electric current, reduce the voltage and also get the resistance value (resistance) that we want.

Things to keep in mind in the calculation of Ohm's Law formula, the units used are Volt, Ampere and Ohm. If we use other units such as millivolts, kilovolts, miliamperes, megaohms or kiloohms, then we need to convert to Volt units, Ampere and Ohm first to make calculations easier and also to get the correct results.

On the other hand, the circuit is the trajectory of electricity passed from the resource and back again. All parts of a simple circuit must conduct electricity and connect to each other. There are two types of series ,: series and parallel. Flashlight is an example of a series of series; all components are connected to each other. Parallel circuits have batteries or other components connected crossing each other. In the electrical circuit, voltage, resistance, or current passing can be calculated by Ohm's law formula.

The components in the electrical circuit are each represented by special symbols and are different from each other. This is so that the components and connections can be clearly described. In the simple component diagram below, you can see various symbols used in electrical components. Circuit diagram drawings are made to facilitate and simplify the actual electrical components.

The greater the resistance or resistance in the circuit, the smaller the current flowing. Vice

 ISBN: 978-602-62815-4-9

versa, if the resources provided are too large, then the burden must also be able to receive large power. If the load receives power above its ability, it can cause component damage to the device (overload). If the current flowing in the circuit is too large to be accepted by the load, then an electrical component called a resistor is used. Resistors are one of the electrical components that causes the voltage to drop.

b. Linear Regression Analysis

Regression analysis studies the relationship between one or more variables / independent variables (X) with one independent variable (Y). In the study of independent variables (X), the variables determined by the researcher are usually free, such as drug dosage, storage time, levels of preservatives, age of livestock and so on.

Besides that, independent variables can also be independent variables, for example in measuring body length and weight of cows, because body length is easier to measure, the body length is entered into independent variables (X), while body weight is included in independent variables (Y).

Whereas the non-independent variable (Y) in the study is a response that is measured due to treatment / independent variables (X). for example the number of red blood cells due to treatment with a certain dose, the amount of microbial meat after being stored for several days, the weight of the chicken at a certain age and so on.

Linear regression is one type of forecasting or prediction analysis that is often used on quantitative scale data (intervals or ratios).

The purpose of linear regression is: Is a set or set of significant predictor variables in predicting the response variable?

Which predictor variable is significant in explaining the response variable? This is indicated by the regression estimation coefficient. This estimation coefficient will later form the regression equation.

c. Pearson correlation

Pearson Correlation is one measure of correlation that is used to measure the strength and direction of the linear relationship of two verifiables. Two variables are said to be correlated if changes in one variable are accompanied by changes in other variables, either in the same direction or the opposite direction. It must be remembered that a small (not significant) correlation coefficient does not mean that the two variables are not interconnected. It is possible that two variables have a strong relationship but the correlation coefficient is close to zero, for example in the case of non-linear relationships. Thus, the correlation coefficient only measures the strength of the linear relationship and not the non-linear relationship. It must also be remembered that the existence of a strong linear relationship between variables does not necessarily mean there is a causal, causal relationship.

Often researchers observe several parameters from sampling or the same observation unit. For example, in the study testing a certain type of fertilizer, in addition to recording rice yields, researchers might also want to record several other responses, such as number of grains, weight of 100 seeds, number of tillers, Nitrogen uptake, potassium uptake etc. If there are only two variables recorded, it is said to be bivariate, whereas if more, it is said to be multivariate. The variable recorded is random, so it is said to be a random variable. Unlike the previously determined fertilizer dose, the fertilizer variable is fixed, so it is said to be a fixed variable. It is possible, in addition to the researchers wanting to see the relationship between fertilizer dose (factor) and rice yield (response), he also wanted to see the relationship between pairs of response variables he observed. Is increased nitrogen uptake along with increased yield or just the opposite and how is the strength of the relationship? The strength and direction of the linear relationship between the two variables can be explained by statistical measures called "correlation coefficients".

The correlation coefficient measures the strength and direction of the linear relationship of the two veriables. It must be remembered that a small (not significant) correlation coefficient does not mean that the two variables are not interconnected. It is possible that two variables have a strong relationship but the correlation coefficient is close to zero, for example in the case of non-linear relationships. Thus, the correlation coefficient only measures the strength of the linear relationship and not the non-linear relationship.

It must also be remembered that the existence of a strong linear relationship between variables does not necessarily mean there is a causal, causal relationship. Both variable pairs, x and y can be high correlation coefficients as a result of the z factor. For example, temperature (x) with air pressure (y) might be a high correlation coefficient, but not necessarily both indicate a causal relationship (for example, the lower the air temperature, the lower the air pressure). The correlation of temperature and air pressure can be solely as a result of changes in height (z) of a place, the higher the place, the temperature or air pressure will decrease. (although theoretically there is a proportional relationship between temperature and pressure: PV = nRT). Thus, Correlation only explains the strength of the relationship without regard to the causality relationship, which one is affected and which one

ISBN: 978-602-62815-4-9

affects. Both variables can act as variables X or variable Y, respectively.
Correlation characteristics
• The value of r always lies between -1 and +1
• The value of r does not change if all data is either on variable x, variable y, or both are multiplied by a constant value (c) set (provided that $c \neq 0$).
• The value of r does not change if all data in either variable x, variable y, or both are added with a constant value (c) fixed.
The value of r will not be affected by determining which variable x and which variable y. Both variables can be exchanged.
• The value of r is only for measuring the strength of a linear relationship, and is not designed to measure nonlinear relationships
Assumption
Assumptions for correlation analysis:
1. Paired data samples (x, y) come from random samples and are quantitative data.
2. Data pair (x, y) must be normally distributed.
It must be remembered that correlation analysis is very sensitive to outliers!
Assumptions can be checked visually by using:
• Boxplots, histograms & univariate scatterplots for each variable
• Bivariate scatterplots
If it does not fulfill the assumption, for example the data is not normally distributed (or there is an outlier data value), we can use the Spearman correlation (Spearman rank correlation), correlation for non-parametric analysis.

2. METHOD

In this research literature method and experimental method are used. The literature study method uses several library materials to get answers to research problems. While the experimental method is used to test Ohm's legal truth in terms of Pearson correlation and linear regression.

3. DISCUSSION

To answer the problem of how to review statistics on the truth of Ohm's Law, two methods will be used. The first method is the use of linear regression to obtain linear regression equations. To use linear regression, there must be data to be processed. The data used in this study is derived from an experiment conducted by a German scientist named George Simon Ohm as written below.

Table 1. Different potential and electric current on the first lamp

No	Number of battery	Different Potential (V)	Electric current (I)	Ohm = V/I
1	1	1.5	0.05	30
2	2	3	0.1	30
3	3	4.5	0.15	30
4	4	6	0.2	30
5	5	7.5	0.25	30

Based on the data in table one, using SPSS software, the following results are obtained:

Table 2. Variables Entered/Removed[a]

Model	Variables Entered	Variables Removed	Method
1	electric current[b]	.	Enter

a. Dependent Variable: different potential
b. All requested variables entered.

The table above shows the variables inputted or variables that are discarded. In this case the input variable is the electric current variable. Variable electric current is also located as an independent variable.

Table 3. Model Summary

Model	R	R Square	Adjusted R Square	Std. Error of the Estimate
1	1,000[a]	1,000	1,000	,00000

a. Predictors: (Constant), electric current

In the table above shows the magnitude of the correlation / relationship R that is equal to 1,000 and explained the percentage of the effect of the independent variable on the dependent variable, which is called the coefficient of determination, which is the result of squaring correlation values. Based on the table can be seen, the value of the coefficient of determination (R square) is equal to 1, which implies that the influence of the independent variable (electric current) on the dependent variable (potential difference) is 100% or 1.

Table 4. ANOVA[a]

Model		Sum of Squares	df	Mean Square	F	Sig.
1	Regression	22,500	1	22,500	.	.[b]
	Residual	,000	3	,000		
	Total	22,500	4			

a. Dependent Variable: different potential
b. Predictors: (Constant), electric current

In this section explains whether there is a real (significant) influence, variable electric current (X) on the potential difference variable (Y). Based on the table above shows the calculated F value (F) = 0, with a significance level or probability of 0.000

 ISBN: 978-602-62815-4-9

less than 0.05. With this result it can be concluded that the regression model can be used to predict the value of the variable potential difference.

Table 5. Coefficients[a]

Model		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	t	Sig.
1	(Constant)	2,190E-016	,000		.	.
	electric current	30,000	,000	1,000	.	.

a. Dependent Variable: different potential

Based on the table above, we can determine the linear regression equation Y = a + Bx, where the values a = 2.19 E-016 and the value of b = 30. Mathematically, the model of linear equations can be written as Y = 2.19 E-016 + 30X. This model of linear equations implies:
(1) A constant of 2.19 E-016 shows, if there is no input value from the variable electric current (X), the value of the potential difference variable is equal to a constant value of 2.19 E-016.
(2) The regression coefficient X is 30, indicating that every addition of 1 electric current value, the potential difference increases by 30.
(3) With the results of this model of linear equations, Ohm's Law can be proven statistically by linear regression method.
In addition to using the liner regression method, to prove the truth of Ohm's law, the Pearson correlation method is also used. To use the Pearson correlation method, it is also necessary to do statistical processing. By using data from table one, after processing the data statistically the following results are obtained.

Table 6. Correlations

		electric current	different voltage
electric current	Pearson Correlation	1	1,000**
	Sig. (2-tailed)		,000
	N	5	5
different voltage	Pearson Correlation	1,000**	1
	Sig. (2-tailed)	,000	
	N	5	5

**. Correlation is significant at the 0.01 level (2-tailed).

Based on the table above it can be concluded that the Pearson correlation value between the independent variable (electric current) and the dependent variable (voltage difference) is equal to one. And this also applies to the opposite. Based on the results of the Pearson correlation value, it can be concluded that the truth of Ohm's Law can be statistically proven through the use of Pearson's corelation method.

4. CONCLUSION

Based on the results of this study, it can be concluded that the truth of Ohm's Law can be statistically proven by using the method of linear regression equation and Pearson correlation.

REFERENCE

Alonso,M.1979.*Dasar-Dasar fisika Universitas*.Jakarta:Erlangga.
Giancoli,DC.2001.*Fisika edisi Kelima*.Jakarta:Erlangga.
Lesmono,D.2012.*Petunjuk Praktikum Fisika Dasar.Jember*:Universitas Jember.
Priyambodo,T.2008.*Fisika Dasar*.Yogyakarta:ANDI Yogyakarta.
Rusdianto,E.1999.*Penerapan Konsep Dasar Listrik dan Elektronika*.Yogyakarta: Kanisius.
Sutrisno.1983.*Fisika Dasar Listrik Magnet dan Termofisika*.Bandung:ITB

ISBN: 978-602-62815-4-9