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ANALYSIS OF THE IMPACT OF CLIMATE VARIABLES ON BANJARBARU CITY RAINFALL

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ABSTRACT

Changes in weather and climate have a negative impact on agricultural production, fisheries, and development in Banjarbaru City. An important indicator of weather and climate is rain. Using multiple regression analysis modeling, the goal of this study was to determine the magnitude of climate influences (air pressure, air temperature, air humidity, and wind speed) on rainfall, as well as the relationship between free variables and bound variables. A regression and significance analysis was performed using the SPSS program, with data on daily climate variables averaging 5 years. Multiple linear regression equation modeling was obtained after analysis: $Y = 5063{,}775 - 5{,}235X_1 + 0{,}633X_2 + 2{,}930X_3 - 0{,}328X_4$*. And for significance analysis, partial test results were obtained where the significance values of air pressure and air humidity were respectively 0,041 and 0, 038 less than the values* $\alpha = 5\%$*, meaning that they significantly affect the high and low rainfall, and from the simultaneous test results, all variables simultaneously affect the rainfall because the significance value is 0,017 less than the value* $\alpha = 0{,}05$*.*

Keywords: Climate Influences, Rainfall, Regression, Significance, Banjarbaru

1. INTRODUCTION

Indonesia is a tropical country because it is located near the equator. This condition causes Indonesia to experience heat throughout the year with relatively high temperatures. Furthermore, because Indonesia is an archipelago, the country has a relatively high level of air humidity. As is known, the geographical location of Indonesia makes the territory of Indonesia influenced by the monsoon climate, which is the climate that causes Indonesia to have only two seasons, namely the rainy season and the dry season (Kristina, 2021).

Weather and climate change can have a variety of impacts on human life. Rainfall is the most influential climate variable and has an impact on agricultural production, fisheries, and development, which is so important. Rain is one of the most important indicators of the nature of the weather and climate. According to Anwar (2015),

increasing rainfall in large cities has the potential to cause floods, while it can cause drought when there is a decrease in rainfall from normal conditions.

In civil engineering, it is necessary to review the aspects that affect changes in climate conditions because they have the potential to be affected by engineering design standards in the future. In the design of flood control buildings (drainage, dams, embankments, and so on), rainfall input data is very necessary. The huge impact is not only on the environment but also on physical, mental, and human behavior patterns.

Kalimantan Island is a tropical rainforest island with high rainfall and evaporation as well as rising air temperatures in the region. In addition, the island of Kalimantan is part of the territory of Indonesia, which consists of land and sea. Monthly rainfall conditions and seasonal lengths in the Borneo region vary widely.

Using multiple regression analysis modeling, this study aims to determine the magnitude of climate influences (air pressure, air temperature, air humidity, and wind speed) on rainfall in Banjarbaru City, as well as the relationship between free variables and bound variables.

2. THEORETICAL STUDY

Rainfall

Rainfall is the amount of water that falls on the ground surface in a certain period in the sense that it does not evaporate, does not permeate, and does not flow (Perdana et al., 2015).

Climate Variables

According to Guslim (2007), "climate" is the average measure and variability of quantity of certain variables such as air pressure, temperature, humidity, wind speed, and so on. Air pressure is defined as the weight of an air column, i.e., the direct influence of changes in air pressure on life. Changes in air pressure will cause changes in wind speed and direction; these changes will also lead to changes in temperature and precipitation. Temperature is a measure of the kinetic energy of the average movement of molecules. Air humidity is the amount of moisture contained in the air or atmosphere. Then, according to Lakitan (2002), "wind current" is the horizontal transfer of air masses.

Test Classical Assumptions

The classical assumption test is used as a prerequisite in multiple regression analysis; this test must be met so that the parameter estimates and regression coefficients are not biased. Testing of these classical assumptions includes tests of normality, heteroscedasticity, and multicholinearity. Sudjana (2005) added uji normalitas, which aims to find out whether the data is normally distributed or not. The heteroscedasticity test can be used to determine how much free variables influence bound variables. Meanwhile, the multicholinearity test serves to show the existence of more than one perfect linear relationship (Helmi, 2010).

Multiple Linear Regression

Multiple linear regression, according to Helmi (2010), is used to determine the linear relationship between several free variables X_1, X_2, X_3, ... X_k and bound variables Y.

Model of multiple linear regression with k free variables:

$$Y = b_0 + b_1X_1 + b_2X_2 + \cdots + b_kX_k + \varepsilon_i \quad \text{..... (1)}$$

Significance Test

The partial test (partial test) or the simultaneous test (simultaneous test) with a degree of significance (α) 5% or α = 0.05 is used to determine whether all independent variables affect the dependent variables simultaneously or partially (Helmi, 2010).

Test *t* (Partial)

A stochastic test t is used to indicate how far or not there is an influence of one independent variable individually in describing a dependent variable (Helmi, 2010).

Test *F* (Simultaneous)

A statistical test F is used to determine whether or not free variables have an influence on their bound variables (Helmi, 2010).

SPSS

SPSS (Statistical Product and Service Solutions) is a package of computer application programs to analyze statistical data quickly and accurately (Hashim et al., 2014).

3. RESEARCH METHODS

Research Location

Banjarbaru City is located between 3°25'40" and 3°28'37"S and 114°41'22" and 114°54'25"E. The administration map can be seen in Figure 1.

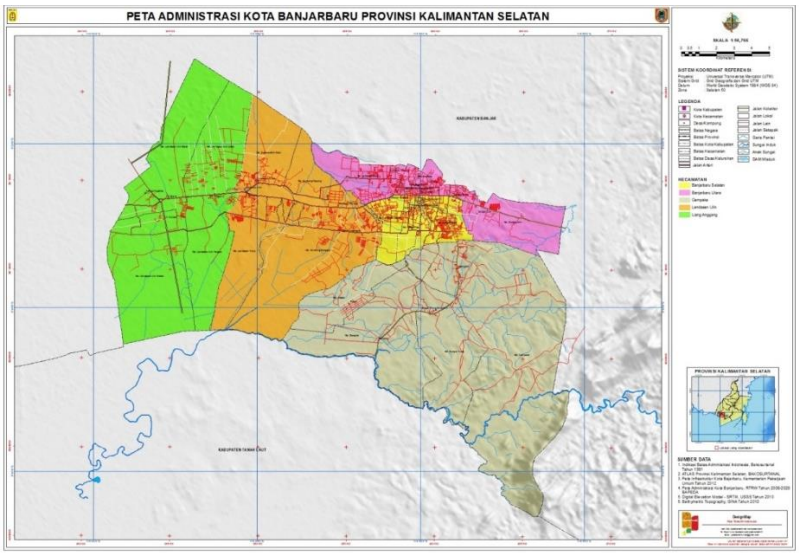

Figure 1 Research Location

(Source: Petatematikindo, 2015)

Research Procedure

Average daily climate variables from January 2017 to December 2021, obtained from the Banjarbaru Climatology Station. Then a classical assumption test is carried out for the prerequisites of multiple linear regression, followed by a regression analysis to obtain regression modeling and a significance analysis to obtain the value of each variable's influence either partially or simultaneously.

4. RESULT AND DISCUSSION

Test Classical Assumptions

It is an obligation in statistical methods to provide certainty that the regression equations obtained have accuracy in estimation and are consistent.

Normality Test

The test of data normality using the normal probability plot graph approach can be seen in Figure 2.

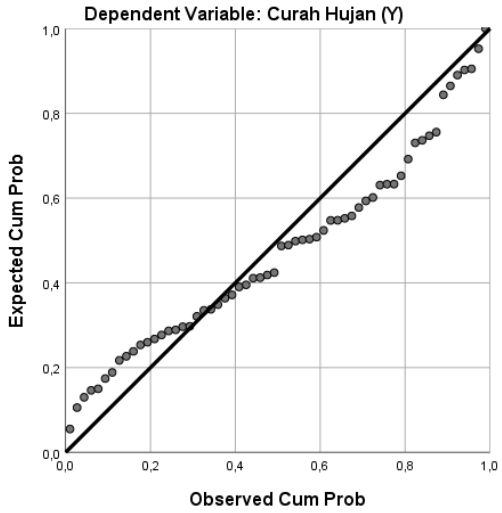

Figure 2 Normal Probability Plot Chart

In Figure 2 above, it can be seen that the points follow the data along the diagonal line of point 0 and do not widen too much; this means that the data is normally distributed.

Heteroscedasticity Test

Decision-making in testing with readings of the scatterplot chart shown in Figure 3.

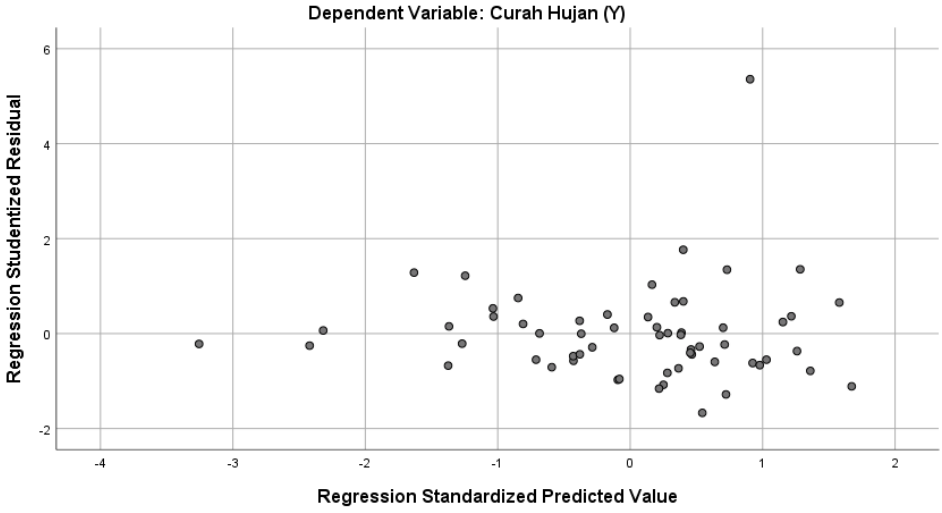

Figure 3 Scatterplot Chart

In Figure 3 above, it can be seen that the dots spread randomly, do not form a certain pattern, and are scattered both above and below the number 0 on the Y axis. Thus, it can be concluded that the residual value of the regression model obtained is free of the heteroscedasticity problem in the regression model to be used.

Multicholinearity Test

Theresearch can be seen from the magnitude of the tolerance value and the variance inflation factor (VIF) value. The results of the tests can be seen in Table 1.

Table 1 Results of the Multicholinearity Test

Coefficients[a]								
		Unstandardized Coefficients		Standardized Coefficients			Collinearity Statistics	
Type		B	Std. Error	Beta	t	Sig.	**Tolerance**	**VIF**
1	(Constant)	5063,775	2711,302		1,868	,067		
	Pressure (X1)	-5,235	2,501	-,379	-2,093	,041	**,446**	**2,244**
	Temperature (X2)	,633	9,884	,017	,064	,949	**,216**	**4,633**
	Humidity (X3)	2,930	1,375	,404	2,131	,038	**,407**	**2,458**
	Wind Speed (X4)	-,328	3,983	-,014	-,082	,935	**,537**	**1,863**

a. Dependent Variable: Rainfall (Y)

Based on Table 1 above, it can be seen that the tolerance value of each variable is greater than 0,1 (where 0,446; 0,216; 0,407; and 0,537 > 0,1). Similarly, the Variance Inflation Factor (VIF) value is less than 10 (where 2,244; 4,633; 2,458; and 1,863 are all less than 10). So it can be concluded that there is no problem of multicholinearity between free variables.

Multiple Linear Regression Analysis

The results of the multiple linear regression equation to see the influence of wind speed, air pressure, air humidity, and air temperature on rainfall are shown by the results of regression calculations based on SPSS output, such as Table 2.

Table 2 Results of Multiple Linear Regression Analysis

Coefficients[a]						
		Unstandardized Coefficients		Standardized Coefficients		
Type		**B**	Std. Error	Beta	t	**Sig.**
1	(Constant)	**5063,775**	2711,302		1,868	**,067**
	Pressure (X1)	**-5,235**	2,501	-,379	-2,093	**,041**
	Temperature (X2)	**,633**	9,884	,017	,064	**,949**
	Humidity (X3)	**2,930**	1,375	,404	2,131	**,038**
	Wind Speed (X4)	**-,328**	3,983	-,014	-,082	**,935**

a. Dependent Variable: Rainfall (Y)

Based on Equations (1), Table 2 shows a modeling of multiple linear regression equations with four free variables.

$$Y = 5063,775 - 5,235X_1 + 0,633X_2 + 2,930X_3 - 0,328X_4 \quad \text{..... (2)}$$

Multiple Linear Regression Significance Test

Significance testing in research aims to determine the influence of independent variables (free variables) on dependent variables (bound variables), both singly and together.

Test *t* (Partial Test)

Some of the influences of each variable (air pressure, air temperature, air humidity, and wind speed) individually in describing rainfall variables can be seen in Table 3.

Table 3 Test t Results

Coefficients[a]						
Type		Unstandardized Coefficients B	Unstandardized Coefficients Std. Error	Standardized Coefficients Beta	***t***	**Sig.**
1	(Constant)	5063,775	2711,302		**1,868**	**,067**
	Pressure (X1)	-5,235	2,501	-,379	**-2,093**	**,041**
	Temperature (X2)	,633	9,884	,017	**,064**	**,949**
	Humidity (X3)	2,930	1,375	,404	**2,131**	**,038**
	Wind Speed (X4)	-,328	3,983	-,014	**-,082**	**,935**

a. Dependent Variable: Rainfall (Y)

Calculating the value of t_{table} :

Table 4 Distribution t Value

Pr / **df**	**0,25**	**0,1**	**0,05**	**0,025**	**0,01**	**0,005**	**0,001**
	0,5	**0,2**	**0,1**	**0,05**	**0,02**	**0,01**	**0,002**
52	0,67924	1,29805	1,67469	2,00665	2,40022	2,67373	3,25451
53	0,67915	1,29773	1,67412	2,00575	2,39879	2,67182	3,25127
54	0,67906	1,29743	1,67356	2,00488	2,39741	2,66998	3,24815
55	0,67898	1,29713	1,67303	2,00404	2,39608	2,66822	3,24515
56	0,6789	1,29685	1,67252	2,00324	2,3948	2,66651	3,24226
57	0,67882	1,29658	1,67203	2,00247	2,39357	2,66487	3,23948
58	0,67874	1,29632	1,67155	2,00172	2,39238	2,66329	3,2368
59	0,67867	1,29607	1,67109	2,001	2,39123	2,66176	3,23421
60	0,6786	1,29582	1,67065	2,0003	2,39012	2,66028	3,23171

Probability level = 0,05

df denominator = $n - k - 1$ = 60 – 4 – 1 = 55;

The retrieved t_{table} is 2,004.

Based on Table 3 and the values t_{count} known, the conclusion of the test results in this study can be seen in Table 5.

Table 5 Test Comparison Results

Variable	t count	t table	Sig.	Probability	Conclusion
Pressure (X1)	-2,093	2,004	0,041	0,05	Influential
Temperature (X2)	0,064	2,004	0,949	0,05	No Effect
Humidity (X3)	2,131	2,004	0,038	0,05	Influential
Wind Speed (X4)	-0,082	2,004	0,935	0,05	No Effect

Test *F* (Simultaneous Test)

A stochastic test F is used to indicate how far an independent variable simultaneously influences the description of a dependent variable. Here are the results of statistical testing F, based on the SPSS output seen in Table 6.

Table 6 Test F Results

ANOVA[a]

Type		Sum of Squares	df	Mean Square	*F*	Sig.
1	Regression	15809,822	4	3952,455	**3,323**	**,017[b]**
	Residual	65409,908	55	1189,271		
	Total	81219,730	59			

a. Dependent Variable: Rainfall (Y)

b. Predictors: (Constant), Wind Speed (X4), Humidity (X3), Pressure (X1), Temperature (X2)

Calculating the value of F_{table} :

Table 7 Distribution Value F with Probability = 0,05

***df* for numerator (N1)**	***df* for denominator (N2)**										
	1	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**
52	4,03	3,18	2,78	2,55	2,39	2,28	2,19	2,12	2,07	2,02	1,98
53	4,02	3,17	2,78	2,55	2,39	2,28	2,19	2,12	2,06	2,01	1,97
54	4,02	3,17	2,78	2,54	2,39	2,27	2,18	2,12	2,06	2,01	1,97
55	4,02	3,16	2,77	2,54	2,38	2,27	2,18	2,11	2,06	2,01	1,97
56	4,01	3,16	2,77	2,54	2,38	2,27	2,18	2,11	2,05	2,00	1,96
57	4,01	3,16	2,77	2,53	2,38	2,26	2,18	2,11	2,05	2,00	1,96
58	4,01	3,16	2,76	2,53	2,37	2,26	2,17	2,10	2,05	2,00	1,96
59	4,00	3,15	2,76	2,53	2,37	2,26	2,17	2,10	2,04	2,00	1,96
60	4,00	3,15	2,76	2,53	2,37	2,25	2,17	2,10	2,04	1,99	1,95

Significance level = 0,05

df numerator = 4; df denominator = 60 - 4 - 1 = 55;

The retrieved value F_{table} is 2,54.

Decision-making:

obtained value F_{count} of 3,323 > F_{table} of 2,54, and calculated significance value F by 0,017 less than 0,05. It can be concluded that simultaneously there is a significant influence between air pressure, air temperature, air humidity, and wind speed on precipitation. Where these variables change, it also has an impact on the high and low rainfall in Banjarbaru City.

5. CONCLUSION

An analysis of the influence of climate variables on rainfall was used to identify regression modeling and the sensitivity of climatological data and their effect on rainfall in Banjarbaru City, which used data on average daily climate variables for a 5-year period from January 2017 to December 2021. In this analysis, climate variables include air pressure, air temperature, air humidity, and wind speed against bulk: modeling of multiple linear regression equations $Y = 5063{,}775 - 5{,}235X_1 + 0{,}633X_2 + 2{,}930X_3 - 0{,}328X_4$. And for significance analysis, partial test results were obtained where the significance values of air pressure and air humidity were respectively 0,041 and 0,038 less than the values α = 5%, meaning that they significantly affect the high and low rainfall, and from the simultaneous test results, all variables simultaneously affect the rainfall because the significance value is 0,017 less than the value α = 0,05.

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