SPATIAL DURBIN MODEL (SDM) FOR IDENTIFIED INFLUENCE DENGUE HEMORRHAGIC FEVER FACTORS IN KABUPATEN MALANG

Indah Resti Ayuni Suri[1)], Henny Pramoedyo[2)], Endang Wahyu Handamari[3)]

[1]Magister Students of Mathematics Department, Brawijaya University, Malang
[2,3]Lecturer of Mathematics Department, Brawijaya University, Malang
[1]email: ayuni_suri@yahoo.com

ABSTRAK

Dengue Hemorrhagic Fever or usually populer call DBD (Demam Berdarah Degue) is the cronic desease that caused by virus infection who carry by Aedes Aegypti mousquito. The observation act by DBD descriptioning and some factors territorial view that influence them, also DBD's modeling use Spatial Durbin Model (SDM). SDM is the particullary case from Spatial Autoregresive Model (SAR), it means modeling with spatial lag at dependen variable and independen variable. This observation use ratio DBD invectors amount with population amount of citizenry at Kabupaten Malang in 2009. Some variable was used, those are the precentation of existention free number embrio, ratio of civil amount between family, procentation of healthy clinic between invectors and procentase of the invectors who taking care by medical help with amount of invectors. The fourth variables are independen variable to ratio of DBD invector amount with population of citizenry amount, as dependen variable trough spatial SDM modelling. The result of SDM parameter modelling, the significant influence variable in session % is the procentation of free amount embrio existention from their own district, the procentation of healthy clinic amount with the DBD invector amount from their own district, the ratio of the population of citizenry with the family from their neighborhood district, and the procentation of healthy clinic amount with the DBD invector amount from their neighborhood district.

Kata kunci: DBD modelling , Spatial Durbin Model.

INTRODUCTION

Territory Indonesia has natural resources and biodiversity, but Indonesia is also rich in disasters often hit several regions in Indonesia. Disaster hit several regions in Indonesia in recent years, ranging from natural disasters of floods, landslides, forest fires, volcanic eruptions, droughts, earthquakes and tsunamis. The disaster caused fatalities and property no small value.

According to WHO, the definition of a disaster is any occurrence that causes damage, ecological disruption, loss of human life or worsening of health status or specific health services on a scale that requires a response from outside the affected community or region. From the above definition it can be concluded that the so-called catastrophic not only natural disasters, but the Extraordinary Incident (KLB) can also be categorized as a disaster. Extraordinary Events that have occurred in Indonesia include dengue fever, diarrhea, polio (WHO, 2003).

Given the importance of effort and awareness of the community to not provide a means or a place for the proliferation of extraordinary events, all people should have an early alert to the threat of pandemic disaster.

One is dengue fever, people should have a concern for the environmental hygiene (sanitation) so that the mosquito Aedes aegypti is not able to grow. Especially for Malang regency consists of 39 centers from 33 districts. From each district in Malang, is expected to prevent the breeding of mosquitoes that will improve public health in particular and attempt to degrade and reduce morbidity and mortality due to infectious diseases. It is really very difficult to stop the Aedes aegypti mosquito population. Actually, to this day is still considered effective activities to reduce Aedes aegypti mosquito populations is to break the chain development. Dengue hemorrhagic fever (Dengue Hemorrhagic Fever), known as dengue, an acute disease caused by a viral infection carried by the mosquito Aedes aegypti.

During this time a lot of research in the fields of health, environment, economics, and other areas not involving spatial effects as being influential in the model so often lead to conclusions that are less precise. Spatial effects exist be explained by a model that can capture these phenomena. Anselin (1988) distinguish the spatial effects into two parts, namely the spatial dependency and spatial heterogeneity. Spatial dependencies are shown with similar properties for locations that are close together, while the spatial heterogeneity shown by the difference in

nature between the various locations. Spatial dependencies occur in areas which have close proximity resulting in spatial interaction in the area.

Spatial data analysis needs to be done with attention to the linkages antarlokasi (spatial autocorrelation). Spatial linkages can be seen from a distance antarlokasi so as to analyze the spatial relationship is often used as a weighting antarlokasi distance. Weighting matrix is expressed in used to calculate the autocorrelation coefficient. matrix is a matrix whose entries are weighted value assigned to a specific interregional comparisons. Weighting was based on the spatial relationships between regions. In some cases the spatial model, weighting only be assessed on the dependent variable, while Durbin Model (SDM) is a model using spatial weighting on independent and dependent variables. The condition of a region generally associated with conditions in other areas, especially areas adjacent. Is known as spatial relationships.

The first law of geography proposed by Tobler, stating that everything is inter-related to each other, but something close to have more influence than anything away (Anselin, 1988). The law is the basis of assessment of the problem based on the effect of location or spatial methods.

There are several studies that use spatial models Spatial Durbin Model (SDM) of which is the research conducted by Kissling and Carl (2007) applied research in the fields of ecology and biogeography that models the effect of rain forest relation to the spread of the organism in Auckland, New Zealand. Stating that spatial autocorrelation can affect the independent and dependent variables so W_1 X added in the modeling. Bekti (2011) apply epidemiological research in modeling the relationship influences the availability of infrastructure, sanitation, clean water, and health facilities as independent variables on the incidence of diarrhea in Tuban, East Java as the dependent variable using the test moran's I. In the study, stated that the lag of the dependent and independent variables plays an important role in modeling the incidence of diarrhea and the factors that influence it. In the second study, the type of matrix used is the weighted contiguity matrix and is recommended for future studies using different methods in order to obtain a more precise modeling. In the study Indrayati (2012) modeled the effect of human spatial density urban, bare soil, and density industrial area, as the independent variables on the dependent variable vegetation density in the city of Surabaya.

This research will be carried out modeling of human resources in health. The model used for spatial modeling approach using influence spatial area of the dependent and independent variables. The method used is the Spatial Durbin Model (SDM), which is one of the model using spatial weighting on the independent variables and the dependent variable. In this analysis will want to obtain a regression model of the factors that significantly influence the number of dengue fever patients in every district in Malang. By exploiting the spatial information, the model predicted results can be presented in a map to know dengue fever in Malang.

LITERATURE REVIEW

Spatial Data

Spatial data is measurement data containing location information. Spatial data collected from different spatial locations indicating dependence between measurement data by location (Cressie, 1993).

The word is derived from the spatial space, which means space is spatial and spatial means. Spatial data is measurement data containing an information site. Spatial data has a certain coordinate system as the basis of reference so as to have two essential parts that make it different from other data, location information (spatial) and descriptive information (attributes) are described as follows (GIS Consortium Aceh Nias, 2007):

1. Location information (spatial), corresponds to a coordinate both geographic coordinates (latitude and longitude) and the XYZ coordinates, including the datum and projection information.
2. Descriptive information (attributes) or non-spatial information is information relating to the location (spatial), for example: type of vegetation, population, area, zip code, and so on.

Purwaamijaya (2008) describes one of the sources for spatial data is to map analog. Analog maps are maps in printed form, such as topographic maps, soil maps, and so on. In general, analog maps made with cartographic techniques that are likely to have a spatial reference, such as coordinates, scale, wind direction, and so on. Spatial data becomes an important medium for development planning and management of natural resources in the coverage area of sustainable national, regional, and local levels. The use of spatial data increased as digital mapping technology and its use in Geographic Information Systems (GIS).

Mapping is a process of presentation of information the actual earth, good shape Earth's surface and its natural axis, based on the map scale, map projection systems, as well as symbols of the elements of the earth are presented. Advances in technology, particularly in the field of computer makes the map not only in tangible form (on paper, real folders, or hardcopy), but can also be stored in digital form that can be presented on the screen, known as virtual maps (maps virtual or softcopy). Digital mapping is a process of making maps in a digital format that can be saved and printed as desired manufacturer.

Model Spatial

The model is a functional relationship, including variables, parameters, and equations. A variable is a symbol used to represent an item that can be numeric or value whatever. The independent variable (independent variable) is a variable whose value does not depend on anything in the equation, while the dependent variable (the dependent variable) is a variable whose value depends on the independent variable. The parameter is a constant value which is usually the coefficients of the variables in an equation. The value of the parameters obtained from the data (Taylor, 1999).

According Prahasta (2004), in general, a model is a representation of reality. Therefore the aim of developing a model is to help the user to understand, describe, or make predictions about how things work in the real world

The use of GIS in spatial modeling will make the output (output) into a spatial information that is both two-dimensional and three-dimensional so that the information will become more clear and useful for businesses utilization and processing of natural resources.

As a simplification of a system, the spatial model using GIS also has four major components of a system, the hardware (hardware), software (software), data (dataware), and human resource (brainware).

Spatial method is a method to obtain observations that influenced the effects of space or location. Models often use spatial relations in the form of dependency relationship with the model autoregressive covariance structure (Wall, 2004). Lesage and Pace (2009) states that the autoregressive process is shown through correlation dependence (autocorrelation) between a set of observations or location.

Spatial Modeling

During this time a lot of research in the fields of health, environment, economics, and other areas not involving spatial effects as being influential in the model so often lead to conclusions that are less precise. Existing spatial effects should be explained by a model that can

Anselin (1988) distinguish the spatial effects into two parts, namely the spatial dependency and spatial heterogeneity. Spatial dependencies are shown with similar properties for locations that are close together, while the spatial heterogeneity shown by the difference in nature between the various locations. Spatial dependencies occur in areas which have close proximity resulting in spatial interaction in the area.

The first law of geography proposed by Tobler, stating that everything is inter-related to each other, but something close to have more influence than anything away (Anselin, 1988). The law is the basis of assessment of the problem based on the effect of location or spatial methods.

Based on the data types, spatial modeling can be divided into modeling approaches and point area.

1. This type of approach point Geographically Weighted Regression them (GWR), Geographically Weighted Poisson Regression (GWPR), Space-Time Autoregressive (STAR), and the Generalized Space-Time Autoregressive (GSTAR).
2. This type of approach among area Spatial Autoregressive Model (SAR), Spatial Error Model (SEM), Spatial Durbin Model (SDM), Conditional Autoregressive Model (CAR), and the Spatial Autoregressive Moving Average (Sarma).

Spatial Autoregressive Models are models that follow the autoregressive process, which is indicated by the dependence relationship between a set of observations or location. The relationship is shown by the lag on the dependent and independent variables. Type Spatial Autoregressive Models such as SAR, SEM, HR, and CAR (Anselin, 1988).

Spatial Durbin Model (SDM)

According to Anselin (1988) general model of spatial autoregressive between the independent variable (X) with the dependent variable (y) is expressed in the form

(2.1)

(2.2)

(2.3) Which is:

: vector variable depends

: matrix variable independent

: the vector parameter regression coefficients

: layer spatial variable coefficient depends

: parameter coefficients team the spatial error

: vector error

: error vector, which is normally distributed with mean zero and variance

: weighting matrix

: identity matrix,

capture these phenomena.

: number of observations or location
: number of variable independent.

When ρ = 0 and λ = 0 it will be a simple linear regression model parameter estimation can be done via ordinary least squares (OLS) as the following equation:

(2.4)

with . In this model there is no effect or no spatial autocorrelation. Matrix and

In equation (2.1) and (2.2) is a weighting that shows relationship antarlokasi contiguity or distance function. Diagonal is zero or w_ij = 0 for i = j and w_ij ≠ 0 for i ≠ j, where i = 1,2, ..., n and j = 1,2,...,n is an observation or location.

Spatial Durbin Model (SDM) is a model with the effect of spatial autoregressive lag on the dependent and independent variables. SDM model form is as follows:

where k = i = a lot of variables and a lot of scrutiny.

Equation (2.5) can be expressed in matrix form as shown in equation (2.6) where the coefficient of the spatial lag parameter vector of independent variables declared in

(2.6)

atau

This is

dan

SDM model was developed on the grounds that in some cases the spatial dependency relationship does not only occur on the dependent variable, but also on the independent variables. Therefore, it should be added spatial lag model (Lesage and Pace, 2009).

The basic principle of Spatial Durbin Model is almost the same as the weighted regression development in a region other than the independent variable affected is also affected by other variables, the spatial relationships. Representation of the Spatial Durbin location factor model in the form of the so-called adjacency matrix weighting matrix (Lesage, 1999).

Spatial data analysis needs to be done with attention to the linkages between locations (spatial autocorrelation). Spatial linkages can be seen from the distance between locations so as to analyze the spatial relationship is often used as a weighting distances between locations. Weighting matrix is expressed in W is used to calculate the autocorrelation coefficient. The matrix W is a matrix whose entries are given weighted values for comparisons between specific areas. Weighting is based on the spatial relationships between regions. In some cases the spatial model, weighting only be assessed on the dependent variable, whereas HR is one of the model using spatial weighting on independent and dependent variables.

Assumptions Spatial Durbin Model (SDM)

(weighted regression), with a variable weighting factor is location. Proximity and linkages antarlokasi this phenomenon led to the emergence of spatial autocorrelation. Spatial Durbin model is the development of a simple regression model that has to accommodate spatial autocorrelation phenomena, both in the dependent variable and the independent variable. For example, to determine the level of

Spatial Autocorrelation

According to Lembo (2006) Spatial autocorrelation is the correlation between a variable with itself by space. Spatial autocorrelation can also mean a measure of the similarity of objects in space (distance, time, and region). If there are systematic patterns in the spread of a variable, then there is spatial autocorrelation. The existence of spatial autocorrelation indicates that the value of an attribute in a specific area related to the value of these attributes in other areas adjacent (neighboring). Another definition is the correlation between a variable with itself by the space, in the spatial domain means that the correlation between the value in location-i with the value in location-j (Anselin, 1988).

Spatial autocorrelation can measure the occurrence of an event in the area of the adjacent unit. The existence of spatial autocorrelation indicates that the value of a variable in a particular area is affected by the value of the variable in other adjacent areas. The important issue in spatial autocorrelation is: a) the value of a variable in the region r is determined by variables measured in several areas around and b) variable region r affect the value of the variable in the surrounding area (Ngudiantoro, 2004). If from a variable found in the form of a systematic spatial autocorrelation, then the variable is said to be spatially berautokorelasi. If the areas adjacent or similar areas, the spatial region berautokorelasi positive. Conversely, if the area or adjacent areas are not similar or opposite the spatial berautokorelasi negative territory, and decrypted form indicates there is no spatial autocorrelation. One common statistic used in spatial autocorrelation is Moran Index and Geary Index.

Test Methods Geary

Spatial patterns can be described into three parts, namely clustered (gangs), dispersed (like a chess board), and random (random). Spatial autocorrelation is positive if in an area adjacent to each other have similar values. If described will form cluster Spatial autocorrelation will be negative if in an area adjacent to each other have different values or do not like. If described will form a pattern like a chessboard. Meanwhile, if

there is a form that randomly showed no spatial autocorrelation.

Sawada (2009) describes the measurement

of spatial autocorrelation can be given by a statistic (normalized) cross-product that shows the degree of relationship between the relationship of the entries of the two matrices, one matrix determines the spatial relationships among n locations (weight matrix) and others to explain the definition of matrix similarity between a collection of values on a variable at the location n.

All measurements of spatial autocorrelation have a common source, namely cross-product matrix. Cross-product matrix is also called a general statistical cross-product, which is expressed by the equation:

$ \$ \quad \$ $

$ 6 \quad ∎ \; ∎ \; 7_{,\%} 8_{,\%} $ /09

$,\&\cdot \; \%\&\cdot $

with 6 is a general cross-product statistic, $-_{,\%}$ are elements of the matrix of spatial proximity

measurement point i to j places commonly called the spatial weighting matrix, and $8_{,\%}$ is a measure of the relationship between i and j in some other dimension (brittle, 2010). One test of spatial

autocorrelation that include general cross-product in measuring spatial autocorrelation is Geary test.

Sawada (2009) explains that Geary autocorrelation coefficient is denoted by C, which measures the difference between the values of a variable at a nearby location. Geary

n : Number of data

$+_{,}$: value of the variable at location i

$+_{\%}$: value of the variable at location j

Lee and Wong (2001) stated that Geary autocorrelation coefficient ranges from 0, which indicates a positive spatial autocorrelation, up to 2 which indicates negative spatial autocorrelation. The absence of spatial autocorrelation indicated by the expected value of C (E(C)) by 1. Geary underlying hypothesis test can be written as follows:

G) H I (spatial autocorrelation),

G· H I J (no spatial autocorrelation)

Varians Geary autocorrelation coefficient I is given by the equation:

KLM I N P /F· F RS
2 2 QF $O·; : A

(2.9)

F) ,& $ <%& - ,%
<$

F· <B >C <B ?C T>?OT?> A
D D

F <$ - ,U - U,
,&

If G) true, significance testing Geary autocorrelation coefficient C using the test statistic Z as follows:

V I W4Y W

(2.10) Z[N]
W

Value of Z(C) compared with the critical points of the distribution N (0,1) to test G) stating there is no spatial autocorrelation. Criteria for decision reject G) if the value of V I ^ V_` where V_` is a critical point Z test with level α error. It

can be concluded that there is autocorrelation spatial. Criteria for decision making can also be done by comparing the p-value and α. p-value can be obtained from the following calculation:

a 2 bLcde fPV I g V g
2V I R

/ h f V i V I
(2.11)

If the p-value < j then rejected, so there is G)

spatial autocorrelation.

Spatial Weighting Matrix

autocorrelation coefficient C is given by the following equation:

B A B

Weighting matrix can be used to determine the proximity of spatial data or spatial relationships. Weighting matrix is used to calculate the autocorrelation coefficient. Weighting matrix is a matrix whose entries are

C $4' : ; + ≤>CD ≤?CD ≡>? @>4@? <B >C @>4@ A D <$ (2.8)

With value F) ,& %& 7, <$: %

Which is:

C : Geary Index

7,% : Index/size analysis of the spatial proximity of the location states i and j

given weighted values for comparisons between specific areas. Weighting is based on the spatial relationships between regions (Ngudiantoro, 2004).

Lee and Wong (2001) states that if there are n units in the observation area, it can be used spatial weighting matrix of size n × n for determining the closeness of the relationship between the unit area. Each unit area described as rows and columns. Each value in the matrix describes the spatial relationship between geographic characteristics with rows and columns. A value of 1 and 0 are used as a matrix to describe the closeness between regions.

Paradis (2009) stated that the study of spatial patterns and spatial processes, is expected to close observations are more likely to be similar than observations that are far apart. It is usually related to the weights for each pair (+, +%).

In its simplest form, the weight is given a value of 1 for the neighbor who is near and given a value of 0 for any other. Lee and Wong (2001) called the binary matrix denoted by W. The matrix W has some interesting characteristics. First, all -,, diagonal elements are 0, because it is assumed that a unit area is not adjacent to itself. Second, the matrix W is symmetric where
-,% -%,. Symmetry owned by W matrix
essentially describes the interrelationship of spatial relationships. The three, rows in the matrix W shows how a spatial region associated with other regions. In general, there are two concepts to determine the elements of the matrix of weights, respectively found in the proximity principle (contiguty matrix) and the principle of distance (distance matrix). Therefore the number of values in a row i is the number of neighbors owned by the i-th region. Notation is the sum of

the line:

$ -, ▀ -,% /0 / %&·

Which is:

-,0 : the total value of the i-th row
-,% : the value of the i-th row j-th column

One way to determine the weighting matrix is to use distance bands. Anselin and Rey (2008) explains that building a simple weighting matrix is based on the measurement of distance. i and j are considered neighbors if j falls within a specified critical distance (distance bands) of i. Distance bands are denoted by k the elements of the matrix -,% defined as:

mnop q,% g P r J s

-,% /0 z

tuvpnww xp

Distance Euclid

In geostatistical models, structural correlation between adjacent response depends only on the distance between locations not on the locations of the value of the response. The

} € { ― ━ ▀ a· 2 □· , a} 2 □} /0 Q ,&·

Maximum Likelihood Estimation

Maximum Likelihood Estimation (MLE) is a classical estimation method of the most popular used in the parameter estimation process. (Mendenhall, Scheaffer and Wackerly, 1981) states that this method is used to determine the estimator for ƒ, where the expected value is the value that makes the data most likely observation (the most Likely) occurs. Based on this principle, if the data observed are more likely (more Likely) has a value of ƒ ƒ· than ƒ ƒ have value, it will be selected as the alleged ƒ·. Likelihood function is the joint density function of n random variables ,,· ,, ▌ ,,$ evaluated at x_1, x_2, ..., x_n: f +· + ▌ +$ . . . ┼ +· + ▌ +$ ƒ or values +· + ▌ +$ certain likelihood function is a function of θ and is denoted by ╪ ƒ . If ,,· ,, ▌ ,,$ is a random sample of independent, identical, and certain distributed (IID) of the population is distributed ┼ + ƒ· ▌ ƒ* has a likelihood function:

╪ ƒ + ╪ ƒ· ▌ ƒ* +· ▌ +$ (2.15)

$ ― ;& ┼ +, ƒ· ▌ ƒ*

The properties of parameter estimators can be seen from Unbiased, consistent, and efficient.

Estimation of Parameters of SDM

Anselin (1988) has written estimate model parameters using Maximum Likelihood HR Estimation (MLE) and also wrote some subset of the statistics hypothesis testing and MLE-based tests such as the following: 1

2 2 1

2 2 1

(2.16)

Differential equation (2.16) with respect to will form Jacobian functions as follows:

‰ Š<ŒŠ 2

< ╪ Ž

N· e+a ’2 · $‘ “ ” S

A A ╪ (

$‘

distance between the location can be determined using Euclidean distance. Euclidean distance (Euclidean distance) is defined as the shortest straight line between two points. This distance is

the sum of the square of the distance of the two vector values. Suppose there are two vectors P and Q, where { a. a | a} and

— ▭. ▭ | ▭} , where m is the number of coordinates, the Euclidean distance between vectors P and Q are determined by the equation:

N S „‰ e+a ’2

$‘ A ” 2

A

‡ (— 5

/—

e+a l2— —P 2 P 2

2 1 R

/

2 1 R˜™

Operation natural logarithm likelihood in equation (2.17)

ẄW ‡ $c N·S c 2 7
2 ——P A2 ·
5 A
2 P 2
1 R 2 1 R˜
2 $W /— 2 $W c
2 2
·2 1A R —P 2 P 2 12R5S

(2.17)

Obtained parameters (and
.

Best Model Selection

Criteria for selecting the best model for this study using the information coefficient of determination R^2 and Akaike's Information Criterion (AIC).

Coefficient of Determination R^2

According to Gujarati (2003), the coefficient of determination stating the size of the accuracy or suitability of a regression line is applied to a group of data and research results are used to determine the proportion of the total diversity of dependent variables diterang by several independent variables simultaneously. Determination coefficient ranges from 0 to 1. The greater the deviation R^2 indicates smaller, it indicates that the model approaches the actual data and the model is said to more accurately. The coefficient of determination in these equations are susceptible to the addition of the independent variables. The more independent variables are involved, then the value will be higher. To compare two or more R^2 should be taken into account that there are many independent variebel in the model. Criteria for selecting the best model to use the criteria of R^2 by the following formula:

> = 1 – ::Y
œ4œ ' œ4œ

Where ž is the average of y. Alternative criteria for selecting the best model.

AIC (Akaike's Information Criterion)

Akaike develop methods for selecting the best model. AIC is defined as follows:

AIC = 2/ Y$ 1 ¢ / 1
$ $

autocorrelation coefficient

Where n is the number of observations. According to Winarno (2009) as a measure of the accuracy of the model, selected models with the lowest AIC value. Additionally Akaike develop methods for selecting the best model, and formulate it as follows:

AIC = -2£¤ /¥

Where:
£¤ = maximum log-likelihood
m = number of parameters in the model

the mosquito Aedes aegypti. Early symptoms of VIMS transmission, ie fever or history of acute fever lasts 2-7 days and the bleeding tendency. DHF patients will also decrease levels of thrombosit. In DHF patients will experience acute seizures and can lead to death.

METHOD

Types and Sources of Data

The data used in this study is secondary data obtained from the District Health Office in Malang. The data is Malang District Health Publications in 2009 covering 33 districts This data includes the data of dengue hemorrhagic fever (DHF) and factors affecting dengue hemorrhagic fever (DHF) in 2009. District location coordinates in Appendix 1 and Appendix 2 there are research data used.

Research Methods

In this research, spatial autocorrelation test using test Geary. Significant spatial data are performed modeling using spatial autocorrelation Spatial Durbin Model (SDM). In this study required two processing stages, namely preparation stage and the stage of data analysis. Here's a full explanation of the methods of research:

1. Preparation

At this stage, prepared maps that have been digitized and made input attribute data into the map. Variables used consists of a dependent variable (Y) and four independent variable (X).

data analysis

Step-by-step analysis of the data is as follows:

a. Determine the nearest neighbor distance of each point as seen from the distance matrix has been formed, each point has one nearest neighbor.
b. Determine the distance the band is the greatest value of the nearest neighbor distance.

c. Determining Geary

Scarlet Fever

Dengue disease is an infectious disease caused by the dengue virus and transmitted by by equation (2.8) and the manifold based on equations (2.9) and then tested for significance by equation (2.10).

d. Calculate the spatial weighting matrix based on equation (2.13).
e. Determine the spatial proximity point using distance matrices, corresponding to equation (2.14). The size of the distance matrix based on the number of points.

RESULTS AND DISCUSSION

Test of Spatial Autocorrelation

The test results by the method of Geary's spatial autocorrelation data on the number of dengue patients in Malang regency briefly shown in Table 1 as follows:

Table 1. Spatial Autocorrelation Test Results With Geary Method.

No	Variable	Geary test		
		Geary coefficient value (¦	Statistic test V ▮	Test conclusion result (§
1	Ratio of Number of Patients with Dengue Population (Y)	0,66395	-1,9747	There Spatial Autocorrelation
2	Percentage of Non-Existence Figures Flick (,,·	0,64338	-2,0955	There Spatial Autocorrelation
3	Ratio of Total Population by Household (,,	0,59818	-2,5379	There Spatial Autocorrelation
4	Percentage of health centers with Number of Patients (,,a	0,29459	-4,1450	There Spatial Autocorrelation
5	Percentage of Patients Treated Patients with Medical Assistance (,,«	0,63819	-2,1260	There Spatial Autocorrelation

Based on Table 1, Geary spatial autocorrelation test results showed all variables are significant spatial autocorrelation in the Ratio of Number of Patients with Hemorrhagic Fever with a population (Y), where the number Persentese free larvae (,,· , the ratio of number of residents with household (,, , Percentage of health centers the number of patients (,,a , the percentage of patients who handled medical assistance ,,« 0 It can be seen from the absolute value of the test statistic Geary on that variable is greater than the critical value, V›0›¬ (1,96). The absolute value of the test statistic for all variables Geary row is -1.9748, -2.0955, 2.5379, -4.1450 and -2.1260.

Spatial autocorrelation found on all variables are positive spatial autocorrelation is seen from 0.66395, 0.64338, 0.59818, 0.29459, and 0.63819. Geary coefficient is a value in the range of 0 to 1. This shows, with a significant rate of 5%, then the variables are positive spatial autocorrelation or mengerombol data patterns, i.e the closer the area the more it will have similar characteristics or value of the variables will be similar (relatively similar).

Test Results Spatial Weighting Matrix

Weighting matrix can be used to determine the proximity of spatial data or spatial relationships. Weighting matrix is used to calculate the autocorrelation coefficient. determine the weighting matrix is to use distance bands. The distance between the location can be determined using Euclidean distance. Euclidean distance (Euclidean distance) is defined as the shortest straight line between two points.

Parameter Estimation

In the first model, there is a lag on the dependent variable dependencies and lag on independent variables. Parameter estimation model called the Spatial Durbin Model (SDM) are presented in Table 2 and the modeling of Spatial Autoregressive (SAR) are presented in Table 3.

Table 2. Modeling 1 or Spatial Durbin Model (SDM): lag on the dependent variable and lag on independent variables (·, J (, J J .

No	Parameter	Variable	Modelling 1 (·, J (, J J	
			Estimasi	Wald 7
1	(›	Intersep	0.326	3.928*
2	(··	Percentage of Non-Existence Figures Flick (,,·	-0.000	6.429*
3	(·	Ratio of Total Population by Household (,,	0.014	3.408
4	(· a	Percentage of health centers with Number of Patients (,,a	-0.002	11.57*
5	(· «	Percentage of Patients Treated Patients with Medical Assistance (,,«	0.0002	1.600
6	(·	Percentage of Non-Existence Figures Flick neighbor (7·,,·	-0.000	3.642

7	☾	Rasio Jumlah Ratio of Total Population by Household neighbor (7 ,,	0.012	9,0*
8	☾a	Percentage of health centers with Number of Patients neighbor (7a,,a)	-0.001	10.09*
9	☾«	Percentage of Patients Treated Patients with Medical Assistance neighbor (7«,,«	-0.000	1.953
10		Ratio of Number of Patients with Dengue Population neighbor	0.127	3.905*
		AIC = -78.9384		
		Rsqr = 0.5204		

When without any lag independent variables, there are no independent variables without weighting or Spatial Autoregressive (SAR).

Table 3. Modelling 2 or Spatial Autoregressive (SAR): Modeling Without Lag independent variables ☾·, J ☾, J

No	Parameter	Variable	Modelling 2 ☾·, J ☾, J	
			EstimasiP ƒ	Wald 7
1	☾	Intersep	0.0248	0,424
2	☾··	Percentage of Non-Existence Figures Flick (,,·	-0.0003	1,281
3	☾·	Ratio of Total Population by Household (,,	0.0118	1,697
4	☾·a	Percentage of health centers with Number of Patients (,,a	-0.0021	10.853*
5	☾·«	Percentage of Patients Treated Patients with Medical Assistance (,,«	0,0002	1.032
6	☾·	Percentage of Non-Existence Figures Flick neighbor (7·,,·	-	-
7	☾	Rasio Jumlah Ratio of Total Population by Household neighbor (7 ,,	-	-
8	☾a	Percentage of health centers with Number of Patients neighbor (7a,,a)	-	-
9	☾«	Percentage of Patients Treated Patients with Medical Assistance neighbor (7«,,«	-	-
10		Ratio of Number of Patients with Dengue Population neighbor	0.0102	0.042
		AIC = -67.047		
		Rsqr = 0.343		

In the second modeling Spatial Autoregressive (SAR), when without any lag independent variables, there are no independent variables without weighting are significant. R^2 value of 34.3% and AIC values of -67.047.

Dengue Map and Factors Affecting in Malang

From the results of modeling Spatial Durbin Model (SDM), the ratio of the number of patients with dengue fever with a population as the dependent variable and the percentage of larvae being free numbers, the ratio of the population of the household, the percentage of health centers with a number of patients, and the percentage of patients treated with the amount of medical assistance patients, as independent variables in each sub-district Malang.

The following shows some of the results of the mapping that maps the results of observations on the dependent variable and maps the results of observations on the independent variables and map the results predicted ratio of the number of patients with dengue fever resulting from the modeling results predicted using the best models are modeling Spatial Durbin Model (SDM). Some images mapping as follows:

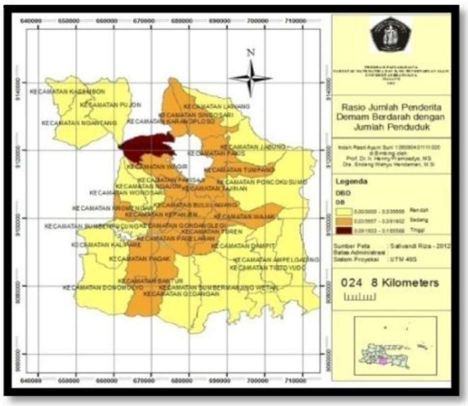

Figure 1. Map Results observations Ratio of Number of Patients with Dengue Population

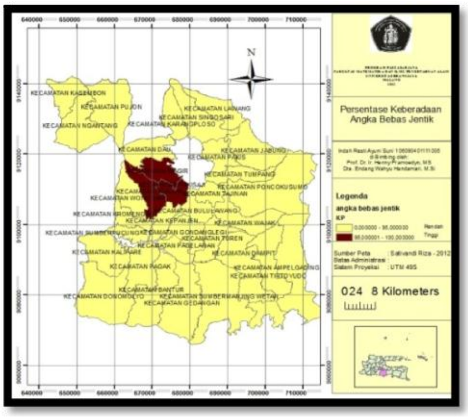

Figure 2. Percentage of Presence Map Results observations Numbers Free Flick

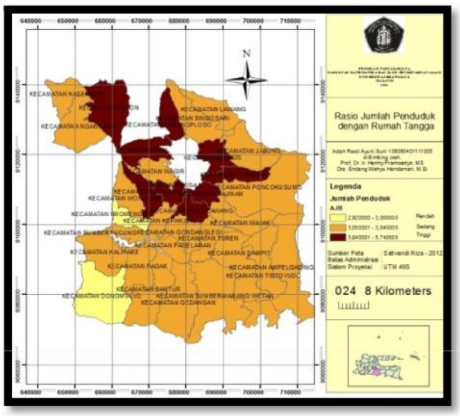

Figure 3. Map Results observations Ratio of Total Population by Household

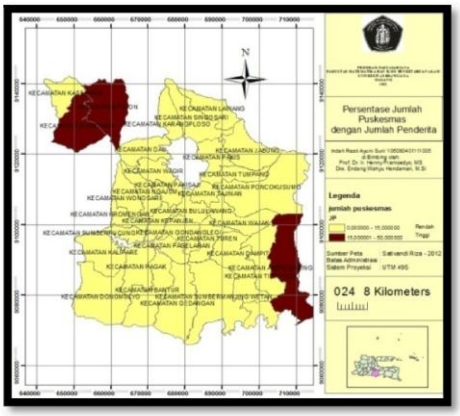

Figure 4. Map of Results with Observations Percentage of Total Health Center Total Patient

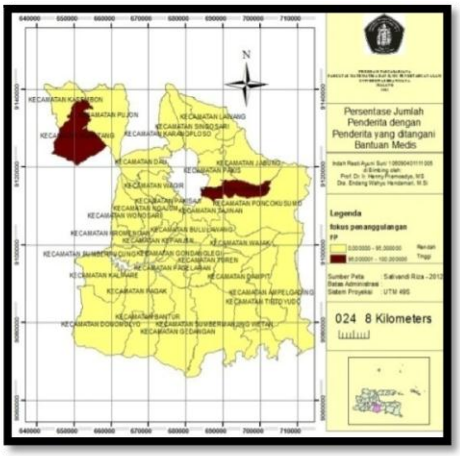

Figure 5. Map Results Percentage of Patients Treated Observations Medical Assistance by Number of Patients

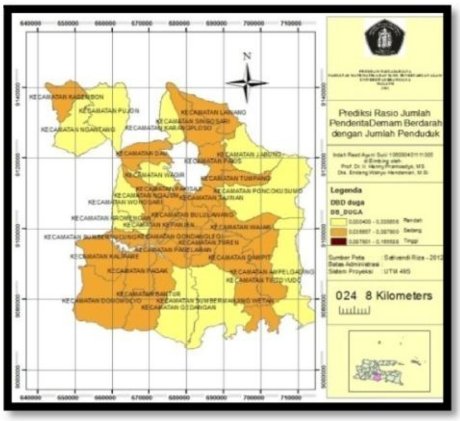

Figure 6. Map Results Predicted Ratio of Number of Patients with Dengue Fever in Malang

CONCLUSIONS AND RECOMMENDATIONS

Conclusions

1. Beberapa independent variable percentage existence free numbers larvae, the ratio of the number of resident households, the percentage of health centers with a number of people, the percentage of patients treated with a number of medical assistance patients

showed clustered patterns. The best model of the number of patients with dengue fever was first modeling, namely Spatial Durbin Model (SDM). Model of dengue fever in Malang using the Spatial Durbin Model (SDM) through the process of estimation parameters as follows:

• ¯ 0 /9Q7.•¢ 0z/®¯2
0 ¯,,.
0 Q¯,, 2 0 / ,,a
0 /,,« 2
0 z7.,,. 0 ⌈¯7.,, 2 0
Q7.,,a 2
0 7.
,,« .

2. Estimates of the parameters of the best model first modeling Spatial Durbin Model (SDM) factors that significantly influence the level 5% is the percentage of non-existence of numbers of larvae district itself, the percentage of health centers with a number of people from the district itself, the ratio of number of residents with home stairs from the neighboring districts, and the percentage of health centers with the number of patients from neighboring districts.

Suggestions

Advice can be given of the results of this research using human spatial modeling by adding a variable which contains spatial autocorrelation and the factors that affect the ratio of the number of patients with dengue fever.

REFERENCES

Anselin, L. 1988. Spatial Econometrics: Methods and Models. Kluwer Academic Publishers. Netherlands.

Anselin, L and S. J. Rey. 2008. Spatial Econometrics: Foundations. http://toae.org/serge/pub/wvu08/foundations.pdf. diakses tanggal 1 November 2011.

Anselin, L. 1999. Spatial Autocorrelation. University of Illinois. Urbana.

Arlinghaus, S. L. 1996. Practical handbook of Spatial Statistics. United States. CRC. Press. Inc.

Bekti, R. D. 2011. Spatial Durbin Model untuk Mengidentifikasi Faktor-Faktor yang Berpengaruh terhadap Kejadian Diare di Kabupaten Tuban. ITS. Surabaya.

Cressie, N.A.C. 1993. Statistics for Spatial Data. John Willey and Sons, inc. New York.

D'agustino, M. and V. Dardanoni. 2007. What's So Special About Euclid Distance? A Characterization with Application to Mobility and Spatial Voting. http://www-3.unipv.it/websiep/wp/597.pdf. Diakses tanggal 6 November 2011.

Dinas Kesehatan. 2011. Laporan Tahunan Seksi P2B2. Malang

Dinas Kesehatan dan Keluarga Berencana. 2006. Pencapaian Program Pembangunan Kesehatan. Kabupaten Bintan.

Getis, A. 2010. Perspective on Spatial Data Analysis. Springer Heidelberg Dordrecht London. NewYork.
GIS Konsorsium Aceh Nias. 2007. Modul Pelatihan ArcGis Tingkat Dasar. http://mhs.stiki.ac.id/07114058/GIS/Modul-ArcGIS%20Tingkat%20Dasara.pdf. Diakses tanggal 6 November 2011.
Gujarati, D. 2003. Ekonometrika Dasar. Alih Bahasa: Sumarno Zain. Erlangga, Jakarta.
Hidayati, R., Boer, R., Koesmaryono, Y., Kesumawati, U., dan Manuwoto, S. 2009. Penyusunan Metode Penentuan Indeks Kerawanan Wilayah dan Pemetaan Rentan Penyakit Demam Berdarah di Indonesia. IPB. Bogor.
Hosmer, D. and S. Lemeshow. 1989. Applied Logistic Regression. John Wiley and Sons, Inc. New York.
Indrayati, Nur. 2012. Pemodelan Data Yang Mengandung Autokorelasi Spasial Dengan Menggunakan Spatial Durbin Model (SDM). Universitas Brawijaya. Malang.
Kissling, W. D dan Carl, G. 2007. Spatial Autocorrelation and the Selection of Simultaneous Autoregressive Models. http://www.higrade.ufz.de/data/kissling_carl_geb3346435.pdf. Diakses tanggal 6 November 2011.
Lee, J. and D. W. S. Wong. 2001, Statistical Analysis with Arcview GIS. John Wiley and Sons, Inc. New York.
Lembo, A. J. 2006. Spatial Autocorrelation. http://faculty.salisbury.edu/~ajlembo/419/lecture15.pdf. Diakses tanggal 21 Oktober 2011.
LeSage, J.P. 1999, The Theory and Practice of Spatial Econometrics. http://www.econ.utoledo.edu. Diakses tanggal 21 Oktober 2011.
LeSage, J.P. and Pace, R.K. 2009. Introduction to Spatial Econometrics. R Press. Boca Ration.
Mendenhall, W., R. L. Scheaffer, and D. D. Wackerly. 1981. Mathematical Statistics with Applications. Duxbury Press. Boston, Massachusetts.
Ngudiantoro. 2004. Konfigurasi dan Pola spasial Pembangunan Berkelanjutan di Indonesia. www.rudyct.com/PPS702-ipb/09145/ngudiantoro.pdf. Diakses tanggal 20 Oktober 2011.
Paradis, E. 2009. Moran's Autocorrelation Coefficient in Comparative Methods. http://cran.r-project.org/web/packages/ape/vignettes/MoranI.pdf. Diakses Tanggal 20 Oktober 2011.
Prahasta, Eddy. 2004. Sistem Informasi Geografi, tool dan Plug-Ins. Informatika, Bandung.

Purwaamijaya, I. M. 2008. Teknik Survei dan Pemetaan. http://bse.ictcenter-llg.net/files/pemetaan-iskandar.pdf.pdf. Diakses Tanggal 3 November 2011.

Sawada, M. 2009. Global Spatial Autocorrelation Indices-Moran's I, Geary's C and the General Cross-Product Statistic. http://www.lpc.uottawa.ca/publications/moransi/moran.htm. Diakses Tanggal 20 Oktober 2011.

Taylor, BW. (1999). Introduction to Management Science. Sixth Edition.

Wall, M. M. 2004. A Close Look at the Spatial Structure Implied by the CAR and SAR Models. http://www.stat.ufl.edu/~mdaniels/spatial/wall.car.sar.pdf. Diakses Tanggal 20 Oktober 2011.

WHO. (2003). Dangue and Dangue Haemorrhagic Fever. Who Report on Global Surveillance of Epidemic-prone Infectious Diseases.Chapter 6.

Winarno, Deddy. (2009). Ekonometrika: Teori Aplikasi. Penerbit Ekonisia, Fakultas Ekonomi u2: Yogyakarta.