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Modeling the number of cases of Lung Tuberculosis Drug Sensitive Contracting (TBSO-1) in East Java Using Geographically Weighted Poisson Regression (GWPR)

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ABSTRACT

Tuberculosis lungs attacked the most productive age group, social economy is weak and low education. One of the main risks associated with the transmission of TB in the place of the Ministry of Health is derived from patients with TB that has yet to be identified. As a result the patient has not had the opportunity to immediately treated according to the rules of the PPI TB that right. All the place of health services need to apply the effort of PPI TB to ensure the continuation of the action immediately detect the prevention and treatment of a person suspected or identified suffer TB. This research will be discussed about the factors that were supposed to affect many cases for Tuberculosis Drug Sensitive Contracting (TBSO-1) which occurred in East Java with Geographically Weighted Poisson Regression (GWPR), because overdispersion cases. From the results of the analysis and discussion, obtained the result that GWPR model more appropriate to analyze the patients TBSO-1 in East Java because it has the value of AICc smaller than Poisson Regression. Healthy house, Overheads Basic Health, Household surfing the Clean and Healthy Living Behavior (*Perilaku Hidup Bersih dan Sehat: PHBS),* health workers, the inhabitants of the schools in the area for Tuberculosis Drug Sensitive Lung as regions prone to contracting (TBSO-1) affect patients TBSO-1 on 4 groups of districts in East Java. The dominant factor in influencing TBSO-1 in all districts in East Java is the percentage of healthy house and the percentage of households *PHBS*, except in Nganjuk. The number of patients with TBSO-1 Pacitan District in addition to influenced by the percentage of healthy house and the percentage of households *PHBS* was also influenced by the ratio of overheads Basic Health. So also in Ponorogo district, Lumajang, Bangkalan Sumenep and also influenced by the percentage of the population of schools.
KEY WORDS: TBSO-1, Poisson Regression, GWPR, AICc

INTRODUCTION

Indonesia is a country with the patient TB lungs top 3 in the world after India and China. Estimated number of patients with TB of the lung in Indonesia around Ten percent of the total number of patients with TB of the lung in the world [1]. According [2], the prevalence of cases of TB of the lung in Indonesia for all age is 0.4%, and there are 9 (nine) province experienced in other words the prevalence of him than with the year 2007. Indonesia a rough estimation there are 115 new patients TB positive Lung every 100,000 inhabitants, most productive age group (15-50 years), social economy is weak and low education [3]. The status of the economy very closely also with contracting TB, because the small income make people could not live worthy to meet the conditions of health. TBSO patients with low economic level, find difficulties in the requirements of healthy house or balanced nutrition [4].

According [5], that from 378 Respondents with the TBSO throughout the year 2010 with 2014 on 7 Hospital Education in Korea, obtained 57.1% patients with TB of primary SO. Clinical managements TBSO uses drugs anti-TB line I and II line causing the problem of tolerance and side effects. [6] the 100 people who are all located living in a shantytown and densely populated with personal hygiene bad, which is the source of infection Mycobacterium *tuberculosis*.

The risk of contracting TB patients lungs can through *droplet infection. Droplet infection droplet nuclei from* which contains germs TB (*Mycobacterium tuberculosis)* can slurp by the healthy. The environment around the house contribute the survival of Mycobacterium *tuberculosis.* [7], to active case findings research done by taking *bhayangkara* around the patients with TB of the lung that is 200 meters obtained patients with TB of the Lung new 32 households from 364.

According [8], on the results of research to get the lighting, humidity and ventilation is the environmental factors that affect significant houses on the genesis of tuberculosis. [9], in his research titled multivariat analysis of tuberculosis 2012 in Surabaya City, wrote that the healthy house, Means of Clean Water and Sanitation Project is a factor that contribute to tuberculosis. The same thing was also obtained from the results of research fallow, [10] Who says that the children around the environment patients with TB of the Lung vulnerable contracting and dhosts neighborhood, density the place of shelter very contribute to the genesis of tuberculosis.

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[6], in South Africa difficulties reach basic health facilities is one of the factors that make a person slowly detected as for tuberculosis. [7], write with sanitation house that low in the neighborhood in Maharashtra India, make children vulnerable contracting Mycobacterium tuberculosis. According [8], on the results of research to get the lighting (OR = 3,286), Humidity (OR = 3,202), ventilation (OR = 4,144). Sanitation house contribute the survival of Mycobacterium tuberculosis. [11], wrote that the most dominant risk factor is education. To support the global *tuberculosis control* and recognition program as early as possible TB lungs on the elementary school and the utilization of media information need to be increased in order to decrease the cases and deaths due to TB lungs especially on productive age.

The problem of treatment TB become an important public health problem and need to be solved soon. Therefore this research examines the relationship between the number of cases of patients with TBSO-1 in East Java with the variables predictors which allegedly influence with how to get the best relationship model using Geographically Weighted Poisson Regression (GWPR).

METHODOLOGY

This research using secondary data obtained from the profile data the health of the province of East Java 2015 and Reporting Data P2TB East Java Provincial Health Office 2015. The variable data is examined in the form of the address and the date the enactment of respondents as patients TBSO-1 in East Java Province [12]. The variables used in this research consists of one response variable (Y) , the number of patients with TBSO-1 and 4 variables predictors (Z), the percentage of healthy house (Z1), the ratio of the Basic Health Overheads (Z2), the percentage of households PHBS (Z3) and the percentage of the population of schools (Z4) and the layout of the latitude south (UI) and East longitude layout (vi).

The steps done in the analysis of the data to achieve the goal of research [13][14][15]

1. Do multikolinieritas detection against the variables predictors
2. Get Poisson regression model on the number of patients with TBSO-1 in East Java
3. Get GWPR model on the number of patients with TBSO-1 in East Java with some analysis phase which includes:
   a. Determine the optimum bandwidth for each of the research object
   b. Calculate the distance to get pembobot Euclidean matrix on each pembobot function
   c. Do assessments GWPR model parameters
   d. Test the suitability of the GWPR model with Poisson regression model
   e. Test the significance of model parameters GWPR simultaneously and continued partially
   f. Get the best model

RESULTS AND DISCUSSION

Characteristics of patients with TBSO-1 East Java Province 2015 in Regency/City in East Java Province consists of the percentage of healthy house (Z1), the ratio of the Basic Health Overheads (Z2), the percentage of households clean and healthy life behavior (*PHBS)* (Z3) and the percentage of the population of schools (Z4). The description of each research variable is as follows.

Table 1. A description of the research Variables

The variables	Mean	Variance	Minimum	Maximum
TBSO-1 (Y)	865.00	663.00	136.00	2900.00
Percentage of healthy house (Z1)	66.41	21.30	4.87	99.61
Ratio of the Basic Health Overheads (Z2)	69.18	16.85	34.18	96.44
Percentage of households *PHBS* (Z3)	48.63	15.59	20.10	82.10
Percentage of school population (Z4)	84.52	15.13	54.63	122.09

Based on Table 1 it is known that the average number of patients with TBSO-1 in East Java as much as 865 cases with variance of 663 cases. The average persentase healthy house (Z1) of 66.41% with variance of 21.3%, an average of the ratio of the basic health overheads (Z2) of 69.18% with variance of 16.85%, the average percentage of households ber PHBS (Z3) of 48.63% with variance 15.59 percent and the average percentage of the population of schools (Z4) of 84.53% with variance 15.13%. This shows the existence of overdispersi on TBSO-1.

Next, multicolinearity examination on the variables predictors based on based on the correlation between and the value of VIF each of which is shown in Table 2 and Table 3.

Table 2 matrix of the correlation between the variables Predictors

Correlation coefficient (P-value)	Percentage of healthy house (Z1)	Ratio of the Basic Health Overheads (Z2)	Percentage of households *PHBS* (Z3)
Ratio of the Basic Health Overheads (Z2)	0.362	*	*
	0.025	*	*
Percentage of households *PHBS* (Z3)	0.626	0.292	*
	0.000	0.075	*
Percentage of school population (Z4)	0.205	0.254	0.260
	0.218	0.123	0.116

The table 4.2 stating the value of the correlation between the variables predictors. The value of the great correlation there is between a variable percentage of healthy house (Z1) with the ratio of the Basic Health Overheads (Z2) of 0.362 (p-value = 0.025), a variable percentage of healthy house (Z1) and the percentage of households PHBS (Z3) of 0.626 (p-value = 0.626). This indicates the multicolinearity between a variable percentage of healthy house (Z1), the ratio of the Basic Health Overheads (Z2), the percentage of households *PHBS* (Z3).

Other criteria that can see multikolinearitas case is the value of the Variance Inflation Factor (VIF). VIF values in each of the variables predictors can be seen in the table 4.3

Table 3. The value of the *Variance Inflation Factor*

The variables	VIF
Percentage of healthy house (Z1)	1.747
Ratio of the Basic Health Overheads (Z2)	1.202
Percentage of households *PHBS* (Z3)	1.702
Percentage of school population (Z4)	1.114

Table 3 indicates that there is no predictors variables which VIF value more than 10, so that there will be no cases multicolinearity. Then can be used poisson regression model TBSO-1 by involving the percentage of healthy house (Z1), the ratio of the Basic Health Overheads (Z2), the percentage of households *PHBS* (Z3) and the percentage of the population of schools (Z4).

The results of the parameter estimation value reached convergence after iteration 5. Next, test is done simultaneously parameters to know is whether or not the influence of the independent variables against the dependent variables with the hypothesis as follows:

H0 : $\gamma_1 = \gamma_2 = \gamma_3 = \gamma_4 = 0$

H1 : most no one $\gamma_j \neq 0$, *J = 1, 2, 3, 4*

The value of the *deviance* on this analysis of 12984 and $\chi^2_{(33;0,05)} = 47.3999$, Then reject H0 because $D(\hat{\beta})_{\text{hitung}} > \chi^2_{(v;\alpha)}$ So it can be concluded that there are at least one independent variables that affect the significant impact on the dependent variables. Then the test is done partially parameters to know the influence of each independent variables.

H0 : $\gamma_j = 0$ (Variables to-*I* do not affect significant)

H1 : $\gamma_j \neq 0$, (The variables to-*i* give significant influence) *J = 1, 2, 3, 4*

Using the MLE method obtained the estimation of parameters as follows:

Table 4. Partial test Poisson Regression parameters on the TBSO-1

Parameters	estimator	*Standard Error*	Z	*P-value*
γ_0	7.70654	0.0358436	215.004	0.000
γ_1	-0.00924	0.0003481	-26.545	0.000
γ_2	-0.00012	0.0003593	-0.322	0.748
γ_3	0.02228	0.0004980	44.733	0.000
γ_4	-0.01728	0.0003823	-45.200	0.018

Table 4. Show that $|Z_{hitung}| > Z_{(\alpha/2)}$, where $Z_{(0,025)} = 1.96$, so that on a significant 5 percent decline H0 which means a variable percentage of healthy house (Z1), the ratio of the Basic Health Overheads (Z2), the percentage of households *PHBS* (Z3) and the percentage of the population of schools (Z4) influential significant on the number of patients with TBSO-1 2015. While for the variable ratio of Basic Health Overheads (Z2) is not significant in affecting the number of patients with TBSO-1 2015, because the value of Z smaller than 1.96 or p-value = 0.748 greater than 0.05. So poisson regression model obtained is as follows:

$$\hat{\mu} = \exp\left(7.707 - 0{,}009Z_1 - 0{,}0001Z_2 + 0{,}022Z_3 - 0.017Z_4\right)$$

Increase or decrease the number of patients with TBSO-1 each district in East Java 2015 depending of the value of the coefficient of each variable that influence. Furthermore done overdispersi case examination on poisson regression model that is presented in table 5.

Table 5. *Overdispersi Examination*

Criterion	Value	Db	value of/db
Deviance	1660.7	32	51.8969

Table 5 shows that the value of the *deviance*/db of 51.8969 greater than 1 so that it can be concluded on poisson regression model number of patients with TBSO-1 each district in East Java 2015 happened *overdispersi*.

The analysis using the GWPR method aims to know the variables that affect the prevalence of Genesis disease TBSO-1 on each observation location which is in the District of the province of East Java. Following the modeling the number of patients with TB using GWPR method.

The first step is done to get GWPR model is to determine the coordinates of the point latitude and longitude on each location to count the distance *euclidean*, and determine the optimum bandwidth values based on the criteria *AICc*. The next step is to determine the matrix weighted with kernel function.

The matrix pembobot obtained for each location and then used to form a model, so that obtained the model vary in each location of observation. The estimation of model parameters GWPR served in table 6 below.

Table 6. The estimation of Model Parameters GWPR

The Parameters	Adaptive *Bi-Square*		Adaptive *Gaussian*	
	Minimum	Maximum	Minimum	Maximum
γ_1	-55.7311	21.8290	5.08789	7.29571
γ_2	-30.6835	38.1654	-0.98725	0.43181
γ_3	-24.9581	46.1182	-3.31641	0.22355
γ_5	-39.6050	78.0935	-0.44966	0.89858

The number of patients with TBSO modeling-1 in Regency/City of the province of East Java using Geographically Weighted Poisson Regression approach (GWPR) to while is a model that better if compared with the poisson regression model.

Testing the hypothesis GWPR model consists of two peengujian, namely suitability test GWPR model and test the significance of the parameters GWPR model. The following is the results of the hypothesis testing GWPR model:

H0 : $\gamma_k(u_i, v_i) = \gamma_k$ (There is no significant difference between the poisson regression model (global) and GWPR model)

H1 : There is at least one $\gamma(u_i, v_i) \neq \gamma_k$; k= 1,2,….,4 (There is a significant difference between the poisson regression model (global) and GWPR model)

Table 7. Test the suitability of the Deviance with Pembobot GWPR Model

Source	Adaptive *Bi-Square*			Adaptive *Gaussian*		
	Deviance	DOF	Deviance/DOF	Deviance	DOF	Deviance/DOF
The model Global	12984.346	33	393.465	12984.346	33,000	393.465
Model GWR	0.000	0	*	3139.716	8.842	355.082
Difference	12984.346	33	393.465	9844.630	24.158	407.514
AICc	12996.221			3311.965		

Table 7. shows with weighted adaptive bi-square value difference *deviance*/d0f of 393.465 and $\chi^2_{(33;0,05)} = 47.3999$, Then Reject H0 because $D(\hat{\beta})_{\text{hitung}} > \chi^2_{(v;\alpha)}$ So it can be concluded the model number of the patients TBSO-1 is GWPR. To pembobot adaptive Gaussian value of *deviance*/d0f difference of 407.514 and $\chi^2_{(25;0,05)} = 37.6525$, Then Reject H0 because $D(\hat{\beta})_{\text{hitung}} > \chi^2_{(v;\alpha)}$ It can be concluded that the model of the number of patients with TBSO-1 each district in East Java 2015 is GWPR. The value of the smallest AICc on weighted Adaptive Gaussian amounting 3311.965, so pembobot GWPR model using adaptive Gaussian.

The next step is testing the significance of model parameters GWPR partially to know the parameters that affect the number of patients with TBSO-1 in each location of observation. The hypothesis that is used is as follows:

H0 : $\gamma_k(u_i, v_i) = 0$

H1 : $\gamma_k(u_i, v_i) \neq 0$; $I = 1, 2, ..., 38$; $k = 1.2,\ldots,4$

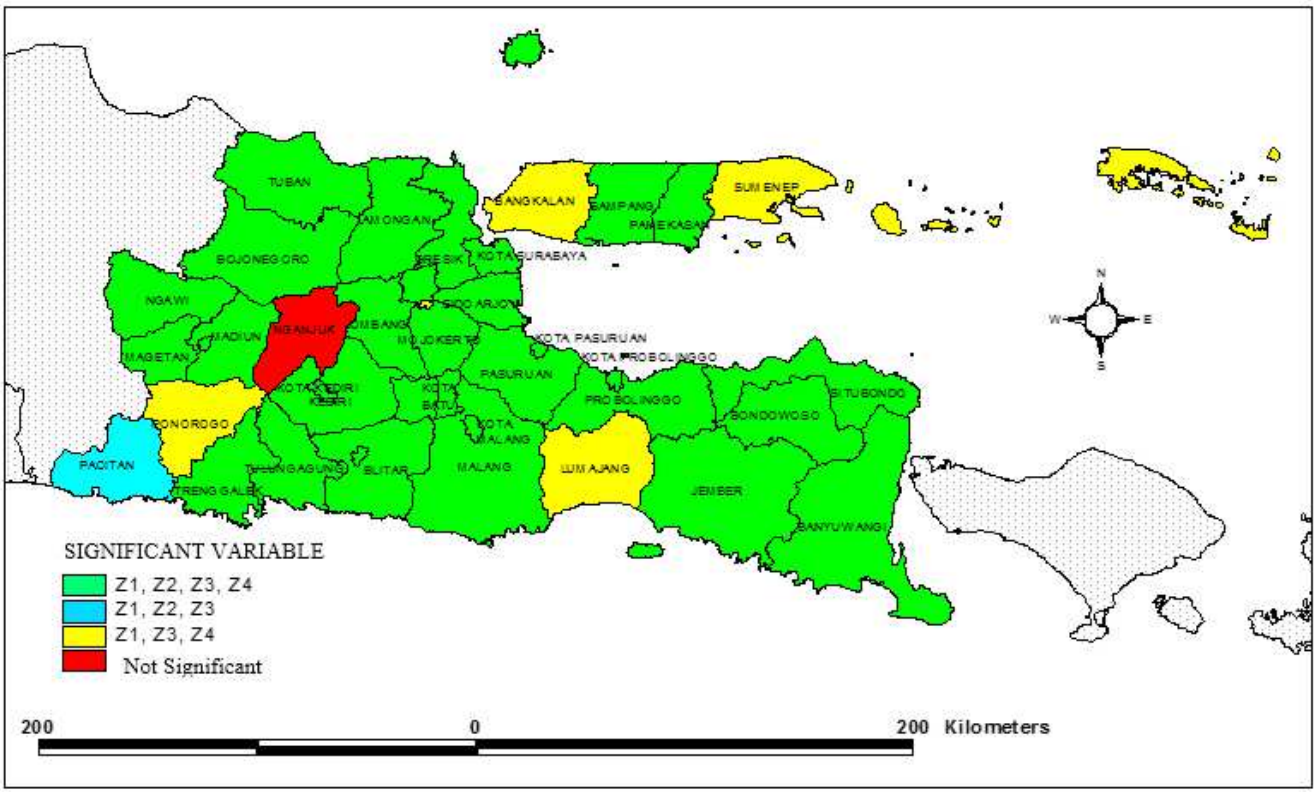
With equal significance (α) of 5%, value $t_{(0,025;32)} = 2,037$. The following variables predictors which affect significantly on each location of observation presented in Table 8.

Table 8. The value of T-count on Variable Parameter Coefficient predictors in each District in East Java Using Adaptive Gaussian

Regency/City	The value of T Statistic			
	Z1	Z2	Z3	Z4
1"Pati. Pacitan"	-17.6749	-13.1308	29.1270	0.3130
2"Pati. Ponorogo"	-17.8251	0.9157	3.9366	-7.4314
3"Pati. Trenggalek"	-32.9554	-3.0606	12.0606	-28.0668
4"Pati. Tulungagung"	-29.1178	4.6025	5.1163	-17.9405
5"Pati. Blitar"	-13.6978	-11.2685	-11.7628	-11.0431
6"Pati. Kediri"	-18.0439	27.5521	18.5738	-61.6831
7"Pati. Malang"	-13.2263	-1.2752	-7.6659	-12.3827
8"Pati. Lumajang"	-20.2069	-0.1752	7.5189	-9.0467
9"Pati. Jember"	-16.1862	25.9447	32.8131	-56.8452
10"Pati. Banyuwangi"	-1.8803	-4.0202	25.5065	-30.1316
11"Pati. Bondowoso"	-19.5163	-2.3580	8.9998	-7.3635
12"Pati. Situbondo"	-16.3749	7.3338	-1.8628	-14.5984
13"Pati. Pasuruan"	-12.1846	-7.3871	31.7160	-18.1821
14"Pati. Probolinggo"	-12.6073	-11.8419	-12.0254	-11.0572
15"Pati. Sidoarjo"	3.5379	-15.0066	9.8143	-13.7281
16"Pati. Mojokerto"	-15.8735	-16.4851	-10.9418	-12.3741
17"Pati. Jombang"	7.0903	-28.3215	11.7207	-10.4422
18"Pati. Nganjuk"	*	*	*	*
19"Pati. Madiun"	5.5849	-9.6114	3.9125	-14.1229
20"Pati. Magetan"	-15.1837	-12.2298	7.2374	-3.4257
21"Pati. Ngawi"	-24.4952	-11.0711	30.4029	-30.4488
22"Pati. Bojonegoro"	-31.6923	-16.6695	9.2138	-15.8304
23"Pati. Tuban"	20.1529	-40.6998	-9.5566	5.0663
24"Pati. Lamongan"	-24.3158	2.5487	35.2732	-56.4454
25"Pati. Gresik"	3.6662	4.9048	15.7463	-36.0269
26"Pati. Bangkalan"	-12.7963	0.2826	-6.1204	-12.6065
27"Pati. Sampang"	5.3909	-8.8327	1.8732	-6.7078

28"Pati. Pamekasan"	-11.0467	-15.3865	28.0880	-8.1257
29"Pati. Sumenep"	-21.7194	-0.2631	29.4300	-5.4905
30"Kediri City"	13.5314	-49.8751	-8.7530	-1.4511
31"City of Blitar"	-21.7180	-13.7498	-3.0941	-16.1372
32"Malang city"	-1.6011	-12.7815	21.4911	-14.8124
33"Probolinggo town"	-18.4198	20.2722	17.4585	-51.5702
34"Pasuruan"	7.8702	-16.9734	-5.5136	2.9481
35"City Mojokerto"	-22.2440	0.1191	9.8328	-10.1911
36"Madiun"	-18.0865	1.6857	3.8886	-10.6461
37"Surabaya City"	9.7423	-13.6207	-3.6997	-4.1342
38"Batu"	-15.8890	-11.6251	7.3548	-4.3164

Based on the table 8, with Bandwidth size = 4 can be known that all the location of the observation identified the variables significantly influenced in all Districts in East Java Province clustering become 4 group on the following image.



Picture 3. The mapping of the number of patients with TBSO-1 District in East Java based significant Variable

The percentage of healthy house (Z1), the ratio of the Basic Health Overheads (Z2), the percentage of households ber PHBS (Z3) and the percentage of the population of schools (Z4) affect the number of patients with TBSO-1 in Trenggalek, Tulungagung, Blitar, Kediri, Malang, Jember, Banyuwangi, Bondowoso, Situbondo, Pasuruan, Probolinggo, Sidoarjo, Mojokerto Jombang, Madiun, Magetan, Ngawi, Bojonegoro, Tuban Lamongan, Gresik, Sampang, Pamekasan district, and Kediri City, Blitar City, Malang city, Probolinggo, Pasuruan, City Mojokerto, Kota Madiun city of Surabaya, Batu. The percentage of healthy house (Z1), the ratio of the Basic Health Overheads (Z2), the percentage of households ber PHBS (Z3) affect the number of patients with TBSO-1 in Pacitan district. The percentage of healthy house (Z1), the percentage of households ber PHBS (Z3) and the percentage of the population of schools (Z4) affect the number of patients with TBSO-1 in Ponorogo, Lumajang, Bangkalan and Sumenep district.

CONCLUSION

Based on the results of the analysis and the discussion can be taken us aconclusion that GWPR model with adaptive Gaussian pembobot function more appropriate to analyze the number of patients with TBSO-1 in East Java because it has the value of AICc smaller. The classification of the number of patients with TBSO-1 in East Java based on the variables predictors significantly there are 4 groups. The dominant factor in influencing TBSO-1 in all districts in East Java is the percentage of healthy house (Z1) and the percentage of households *PHBS* (Z3), except in Nganjuk. The number of patients with TBSO-1 Pacitan District in addition to influenced by the percentage of healthy house (Z1) and the percentage of households ber PHBS (Z3) was also influenced by the ratio of the Basic Health Overheads (Z2). So also in Ponorogo, Lumajang, Bangkalan Sumenep district and also influenced by the percentage of the population of schools (Z4).

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