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The Modeling Level of Birth Weight Using a Maximum Likelihood Estimation and Generalized Method of Moment

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ABSTRACT

Infant Mortality (AKB) in Indonesia is still relatively high compared with other countries in the ASEAN region. Baby born with low weight is easier to become sick even died compared with normal birth weight babies. The study was conducted in the regional general hospital (RSUD) IBNUSINA district Gresik which is a secondary data in the medical record in January and December 2015. The purpose of this research is to examine the factors that influence birth weight (BBL) using ordinal logistic regression model with maximum likelihood estimation method (MLE) and Generalized Method of Moments (GMM). The results of the study showed that with the GMM Method produces estimates of parameters that better in the model of the level of the weight of the baby born compared with MLE method criteria R^2. Opportunities in the weight of the baby born more than or up to 2500 grams of 0.999 influenced by the age of the mother during birth, age pregnancy during birth, hemoglobin level, distance pregnancy and parity.
KEYWORDS: BBL, logistic regression, MLE, GMM

1. INTRODUCTION

Infant mortality reflects the degree of community health. Baby born with low weight is easier to become sick even died compared with normal birth weight babies. The main steps to save the baby BBLR in order to grow and develop with good is through early detection of baby BBLR at born that followed with efforts to follow up the target [1]. BBLR is a major factor in increased mortality, morbidity and disabilities neonates infants and children as well as provide long-term impact on his life in the [2].

Indonesia occupies the position to 9 th with infant mortality rate at 30 per 1000 live births [3]. infant mortality (AKB) lowest still held by Singapore and the highest in the country Myanmar. Infant Mortality (AKB) in Indonesia is still relatively high compared with other countries in the ASEAN region. The survey data demographics and Health Indonesia (SDKI) 2007 infant mortality of 34 deaths per 1000 live births and neonatal mortality of 19 deaths per 1000 birth. Demographic survey of Health Indonesia (SDKI) on 2012 obtained infant mortality 32 per 1000 live births and neonatal mortality of 19 deaths per 1000 birth. This shows that the number of death that occurred at the time of the neonatal not decline compared to the SDKI 2007 and the figure is greater than the target of the Millennium Development Goals (MDGs) namely neonatal mortality rate by 14 deaths per 1000 birth and infant mortality of 23 per 1000 birth.

The results of the report Tribulan (LB3) the health of mothers and children (KIA), Family Health section of the East Java Provincial Health Office 2012 known that BBLR is still the main cause of death of neonatal namely 38,03% [4]. This figure was the highest compared to other causes such as Trauma born (9,10%), Asfiksia (27,38%), Infection (3.70%), Tetanus Neonatorum (0.08%), congenital abnormalities (3.34%) and others (18,38%). The cause of the majority votes for BBLR is premature birth.

The various factors that is the cause of BBLR factor is the mother of the fetus factors and environmental factors. Maternal factors include the age of the mother is less than 20 years or above 35 years, parity, nutritional status mother, disease suffered by the mother, complications during pregnancy and factors such as the mother smoking habit. Fetal factors include hidramnion, pregnancy twins or dual and chromosome disorders. While environmental factors include the place of living in the highlands, radiation, socio-economic and exposure to toxic substances [5]. Based on the profile of the health of the province of East Java 2010 it is known that the number of district BBLR Gresik of 389 cases from 18.830 live births. Data from RSUD Avicenna district Gresik years 2014 known that the number of BBLR 216 cases from 2207 delivery. The data shows that the case BBLR in RSUD Avicenna district Gresik still high enough so that the problem of the baby BBLR it is important to note because it is closely related with the survival of the baby.

Some of the research related to *Maximum Likelihood estimation method* (MLE) and *generalized method of moment* (GMM), [6] get parameter estimator β from logistic regression model polikotomus on lost data. The results obtained in the research in the form of the equation is not *closed form*, so that continued with the method *Newton-Raphson.* [7] on logistics exponensial model to test the significance of the time hold living in patients with cardiac transplantion seen from *age, surgery* and *transplant.* [8] which apply double linier regression model with panel data methods *generalized method of moment* (GMM) in order to get a the best model on the occurrences of the disease malaria in North Maluku from the year 2010-2014. 9 implementing the estimation regression model double linier longitudinal data with *generalized method moment*.

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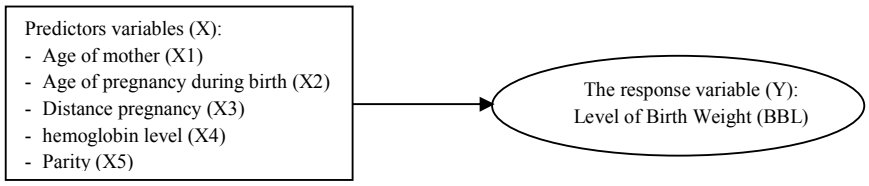
The explanation above, shows that the Genesis BBLR still high this reflects the degree of community health is still low. Because, needs to be examined the factors that influence birth weight (BBL) using ordinal logistic regression model with *Maximum Likelihood Estimation* (MLE) and *Generalized Method of Moments* (GMM) *method* [10][11].

2. METHODOLOGY

The type of research that is used is *Non Reactive research* (unobstrutive) because the use of secondary data in the form of a document in the medical record at the hospital. The data is the data collected by the health workers in accordance with the form of questions that are in the medical record and researchers are not directly involved in getting information from the subject of the research. This research will be conducted in the regional general hospital (RSUD) Avicenna district Gresik and data that will be used is a secondary data that is in the medical record in January and December 2015. Independent variables in this research is the age of the mother (X1), the age of pregnancy during birth (X2), the distance pregnancy (X3), parity (X4) and hemoglobin level (X5). The dependent variables in this research is the level of birth weight (BBL) (Y), with the framework of the following concepts [12][13][14].



Picture 1. The Conceptual Framework the level of Birth Weight

Analysis of data used is ordinal logistic regression with the estimation *parameters* of *Maximum Likelihood Estimation* (MLE) and *Generalized Method of Moments* (GMM), then test good parameters simultaneously or partial and test the suitability of the model [15][[16]

3. RESULTS AND DISCUSSION

Age relationship mother (X1), the age of pregnancy during birth (X2), the distance pregnancy (X3), parity (X4) and hemoglobin level (X5) with the level of birth weight (BBL) (Y) using statistic test Chi-Square served in the following table 1.

Table 1. The Description & Test the independency of the level of birth weight with independent variables

Frequency **% of total** **Asymptotic Significance (2-sided) [17]**		**Birth Weight**		
		<= 1500 grams	**1500 - 2500 grams**	**=> 2500 grams**
Age of the mother during birth	< 20 th or > 35 th	6 4.9	16 13	28 22.8
	20 - 35 th	4 3.3	9 7.3	60 48.8
	Pearson Chi-Square = 10.047 df=2 Asymptotic Significance (2-sided) = 0.007			
Age of pregnancy during birth	<= 37 weeks	8 6.5	17 13.8	29 23.6
	> 37 weeks	2 1.6	8 6.5	59 48
	Pearson Chi-Square = 15.468 df=2 Asymptotic Significance (2-sided) = 0.000			
Level of HB	<= 7 g/dl	3 2.4	2 1.6	1 0.8
	7 g/dl - 11 g/dl	5 4.1	15 12.2	32 26
	=> 11 g/dl	2 1.6	8 6.5	55 44.7
	Pearson Chi-Square = 24.339 df=4 Asymptotic Significance (2-sided) = 0.000			
Distance Pregnancy	< 2 years	5 4.1	14 11.4	28 22.8
	=> 2 years	5 4.1	11 8.9	60 48.8
	Pearson Chi-Square = 5.463 df=2 Asymptotic Significance (2-sided) = 0.065			
Paritas	> 4	3 2.4	13 10.6	14 11.4
	2 - 4	2 1.6	2 1.6	48 39.0
	1	5 4.1	10 8.1	26 21.1
	Pearson Chi-Square = 23.338 df=4 Asymptotic Significance (2-sided) = 0.000			

Table 1 can be shown that all the value of asymptotic Significance (2-sided) smaller than $\alpha = 0.05$ Then there is a relationship between the weight of the baby born to the age of the mother during birth, age pregnancy during birth, hemoglobin level, distance pregnancy, and parity. Table 1 also shows that the percentage of BBL more than 2500 grams of 48.8 percent occurs at the age of the mother during birth was from 20 to 35 years, USD 48.0 percent occurs at the age of pregnancy during birth was more than 37 weeks, USD 44.7 percent occurs on the level of HB more than or equal to 11 g/dl, USD 48.8 percent occurs at a distance of pregnancy more than or equal to 2 Years, and as much as 39.0 percent occur on parity 2 to 4.

Then the parameter estimate ordinal logistic regression model with *Maximum Likelihood Estimation method* (MLE) and *Generalized Method of Moments* (GMM) presented in Table 2.

Table 2. The estimation of Model Parameters the level of Birth Weight Using MLE and GMM Method

No	Variables	MLE				GMM			
		Estimate	**Standard *Error***	**Wald**	**Sig.**	**Estimate**	**Standard *Error***	***T-value***	**Sig.**
1	Age of the mother during birth (X1)	-1.317	.521	6.398	0.011	0.201	0.095	2.108	0.037
2	Age of pregnancy during birth (X2)	-1.488	.516	8.334	0.004	0.301	0.108	2.787	0.006
3	Level of HB (X3)	-3.702	1.045	12.548	0.000	0.288	0.075	3.803	0.000
4	Distance of pregnancy (X4)	-1.602	.970	2.729	0.099	0.411	0.092	4.452	0.000
5	Paritas (X5)	-2.173	1,003	4.692	0.030	0.224	0.083	2.671	0.009
The determination coefficient (R-Square)		0.314				0.324			

Table 2 shows with MLE method that distance of pregnancy variables (X4) is not significant because the value of Sig = 0.099 greater than $\alpha = 0.05$, while for with GMM method all significant variables. The Model with the criteria R-Square, GMM method is better than the MLE method.

Ordinal logistic regression model with *Maximum Likelihood Estimation method* (MLE) can be obtained from each categoric opportunities value on the variable level of birth weight is as follows.

$$\pi_1(x) = \frac{\exp(g_1(x))}{1+\exp(g_1(x))} = \frac{\exp(-15.517)}{1+\exp(-15.517)} = 0.0000002$$

$$\pi_1(x) = \frac{\exp(g_1(x))}{1+\exp(g_1(x))} = \frac{\exp(-13.103)}{1+\exp(-13.103)} = 0.000002$$

$$\pi_2(x) = \frac{\exp(g_2(x))}{1+\exp((g_2(x))} - \frac{\exp(g_1(x))}{1+(g_1(x))} = 0.000020577 - 0.0000022 = 0.0000184$$

$$\pi_3(x) = 1 - \frac{\exp(g_2(x))}{1+\exp(g_2(x))} = 1 - 0.0000184 = 0.999982$$

Heavy opportunities baby born less or the same with 1500 grams of 0.0000022, probability of birth weight between 1500 until 2500 grams of 0.0000184 and opportunity of birth weight more than or up to 2500 grams of 0.999982. This is obtained if the age of the mother during birth (X1)(1) = < 20 th or > 35 th; Age pregnancy during birth (X2)(1) <= 37 weeks; hemoglobin level (X3)(1) <= 7 g/dl or hemoglobin level (X3)(2) = 8 g/dl - 10g/dl; distance of pregnancy (X4)(1)= < 2 years and Parity X5(1) = > 4.

4. CONCLUSION

GMM method produces estimates of parameters that better in the modeling the level of birth weight compared to MLE method based on the criteria R-Square. The age of the mother, the age of pregnancy during birth, and hemoglobin level affect the level of birth weight. BBL more than 2500 grams of 48.8 percent occurs at the age of the mother during birth was from 20 to 35 years, USD 48.0 percent occurs at the age of pregnancy during birth was more than 37 weeks, USD 44.7 percent occurs on the level of HB more than or equal to 11 g/dl, USD 48.8 percent occurs at a distance of pregnancy more than or equal to 2 years and as much as 39.0 percent occur on parity 2 to 4. Peluang heavy level baby born more than or up to 2500 grams of 0.999982 influenced by if the age of the mother during birth (X1)(1) = < 20 th or > 35 th; age pregnancy during birth (X2)(1) = <= 37 weeks; hemoglobin level (X3)(1) = <= 7 g/dl or hemoglobin level (X3)(2) = 8 g/dl - 10g/dl; distance of pregnancy (X4)(1) = < 2 years and Parity X5(1) = > 4.

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